Western Area Power Administration
Comments on the review draft of the

Environmental Assessment for Cooperating Agencies
Development and Implementation of a Protocol for High-Flow Experimental Releases
from Glen Canyon Dam, Arizona, 2011 through 2020
November 19, 2010

Thank you for the opportunity to comment on this EA. Reclamation has done a considerable amount of quality work for this EA in a very short time. Please contact us if you have questions about our comments. We understand that the time frame for preparing a public draft is short, so we offer our assistance in incorporating our comments or preparing the EA for public distribution.

In what follows, we present our comments on the general issues and describe our major concerns regarding the EA. Subsequently, we include a table of comments that hope will strengthen or clarify the EA.

General Comment #1: The EA's Description of "The Experiment"

Outside of the 2nd paragraph of page 24, Chapter 2 and the rest of the EA does not carry on the thinking of page 24 and continues to describe an "experiment" related to the testing of two science paradigms related to sediment conservation and/or the building of beaches and sandbars. The science question might be something like this: Which of the science paradigms -- Store and Transport or Rapid Response -- best meets the purpose and need of the proposed federal action while meeting legal requirements and other resource goals? Instead, the EA seems, most often, to describe a 10-year GCD flow recommendation; the Store and Transport method of sediment redistribution. The competing science paradigm; Rapid Response proposed by Western is dismissed on page 44 under the heading *Alternative Eliminated from Further Consideration.* Reclamation's Rapid Response option as presented in Chapter 2 is substantially limited, briefly described and relegated to a future adaptive management process.

Rapid Response, in its altered state, is called an "alternative," a "variation," a "subalternative," and an "alternative eliminated from further consideration." We suggest that the proposed action be rewritten as a test of two science paradigms within an adaptive management framework, where, as information is gathered and the two paradigms are tested in different years, the HFEs be reconsidered and revised. For your consideration, we have included suggested language below:

Page 24; after the second paragraph, we suggest adding the following:

A challenge in prescribing a controlled flood for building sandbar habitats is that the flooding mechanism that is needed to transport sediment into these fan-eddy complexes throughout Marble and Grand canyons also transports sediment further downstream and out of the system. As can be seen in Table x [Table 1 from Western's description of the rapid response alternative of November 16, 2010]*, previous high flow releases in 2004 and 2008 resulted in greater accumulations of sand in reaches further downstream of Glen Canyon Dam, especially in the western Grand Canyon.*

It may be possible to improve the overall benefits of controlled high releases by favoring sediment deposition in more upstream reaches, especially Marble Canyon (located between river-mile 30 and 61 in Table 1), increasing the effectiveness of processes that build and maintain ecologically important sandbar habitats, and promote ecological productivity downstream of Glen Canyon Dam.

As described previously, under the "store and transport" method, that HFE alternative would mobilize sand deposited in the main channel of the Colorado River from the Paria River tributary that has accumulated on the river bed and in eddies. Under this method controlled high flow releases from Glen Canyon Dam (ranging from 31,500 cfs to 45,000 cfs) would be used to mobilize stored sand and deposit that sand at higher elevations in sand bars.

An alternative HFE approach, referred to here as the rapid response or Paria River flood augmentation method, consists of controlled releases from Glen Canyon Dam of 33,200 cfs that would occur in coordination with sediment-rich floods in the Paria River. Coordinating controlled releases with flooding in the Paria River has the potential to transport suspended sediment at high concentrations to downstream reaches and deposit the sediment into ecologically significant sandbar complexes. The alternative HFE approach would increase ecological benefits of controlled flood events by introducing variability in the timing, frequency, magnitude, and duration of HFEs. Introducing this variability in flood events has the potential to build and maintain sandbar complexes through increased deposition of fine sands and cohesive sediments, as well as provide a mechanism for organic material transport into backwater habitats that is critical for productivity in the river.

The two HFE methods can be viewed as two different paradigms for sediment management. A description follows of (1) the potential benefits of the proposed approaches; (2) considerations regarding flood frequency, magnitude, duration, and timing; (3) hypotheses that should be tested when comparing the effectiveness of the Paria River flood augmentation alternative and the store and transport alternative; and

(4) a discussion of options for incorporating adaptive management during implementation of HFE experimentation.

General Comment #2: The EA's Description of the Rapid Response HFE

2 a: Safety and Planning Concerns

Page 30: Reclamation states that the Rapid Response HFE does not meet the purpose and need for the HFE protocol. This, because of scientific and operational uncertainties, because it does not fit within the release windows and because it does not take into account sediment loads. Western, as one of many cooperating agencies, assisted in writing the purpose and need statement. In the conversations among these agencies, Western repeatedly brought up the possibility of HFEs to be included in the protocol that were powerplant capacity and that would be timed to match a Paria flood. It is quite a surprise to us to read that the Rapid Response HFE is outside of the purpose and need statement. Further, Western doesn't see references to either release windows or safety concerns in the purpose and need statement that would preclude the Rapid Response HFE. Finally, as we describe in greater detail below, sediment loads in the Paria and thence in the Colorado River are a proportional to the velocity and duration of Paria River floods. The establishment of a "trigger" or "threshold" for a Paria River flood to which GCD would respond would be a matter of statistical analysis by scientists familiar with the river. An appropriate trigger would ensure that an HFE would occur in a sediment enriched condition.

Page 31: Reference is made to the procedural difficulty of testing the Rapid Response variety of HFE. As noted in the EA, the increase in water release from GCD to match a Paria flood would require development of a Western/Reclamation operating procedure and a method of notifying the public to reduce the risk of injury or damage to public property. However, the Rapid Response HFE closely parallels increased releases by GCD to respond to electrical system emergencies. Most notably, during 2000 – 2001, GCD provided electrical energy to the California Independent System Operator (ISO) a total of three times when blackouts were considered to be imminent. Operational and public notification procedures have been developed by Reclamation and Western. These procedures are still in place. Documents that describe these procedures include the *Operating Agreement Associated with Glen Canyon Dam Operating Criteria* (Interagency Agreement No. 97-SLC-0333) and the Emergency *Responses at Glen Canyon* (Draft of February 7, 2001). The latter was prepared specifically to describe and clarify the purpose and context of GCD continued response to California ISO emergencies. A public notification procedure was also developed. It included a "phone tree" through which Western notified Reclamation, Reclamation notified the National Park Service and a fishing guide outfitter group, and the Park Service and the outfitter group notified others that may have been on the river. Interestingly, the time between the request by the California ISO to provide emergency service and the time that GCD began a ramp up was less time that would be needed to implement the Rapid Response HFE.

As an example, on September 18, 2000, GCD ramped up to 16,320 cfs to respond to Cal ISO emergency. The ramp up exceeded the ramp restrictions set for normal operations. In one hour the GCD water release increased by 7,590 (as allowed for electrical system emergencies). Another event occurred on February 15, 2001. GCD increase to 19,950 cfs, ramping up in one hour by 5,320 cfs. In both instances, the ramp up and maximum daily change exceeded the operating criteria allowed during non-emergency

conditions. In total, during 2000 – 2001, GCD responded three times to emergency calls from the Cal ISO.

The description of the Rapid Response HFE suggests that Reclamation would monitor weather patterns so as to determine the likelihood of a Paria flood. This description suggests that no thought has been given to how a Rapid Response HFE would be timed. Moreover, it suggests that the timing of a Rapid Response HFE would be difficult. Actually, consideration has been given to the timing of a Rapid Response HFE. The Paria River gage near Kanab, Utah would likely serve as an "advance warning" for Paria River floods. The Kanab gage records a Paria River flood about eight hours before the flood reaches the Colorado River. Based on Western's investigations of Paria River floods in 2010, the Kanab gage is a good indicator of Paria River floods. The Kanab gage recorded significant flood events three times during the Summer/Fall of 2010 and served as an advance indicator of significant Paria River floods at the Colorado River. The placement of the Kanab gage was recommended by the GCD TWG and installed by USGS in 2002 to serve as an early warning indicator of Paria River floods so that GCD could respond in kind and release a matching flood.

2b: The Development of a "Flow Only" Trigger

Page 32, 1st paragraph: In order for Reclamation to develop a "flow only" trigger and then adaptively manage HFEs, Reclamation would develop an outline of how the two science paradigms will be tested. The language in the EA indicates that Reclamation may or may not consider the development of a "flow-only" trigger. Previously, on page 31, Reclamation declares that it will use the protocol model to determine if sediment is or is not present, but may consider a Rapid Response experiment if there are sediment-enriched flows in the Paria River. This, indeed, is not a description of an experiment. It appears to relegates the testing of the paradigm associated with the Rapid Response HFE to further, unspecified considerations.

Western suggest that the method for identifying a "flow only" trigger is through the judicious application of statistical analysis to the data already available. 90% of Paria sediment is introduced into the Colorado River through monsoonal floods. The Paria River contributes twice as much sediment to the Colorado River system as the LCR and it contributes sediment at the upstream end of a critical reach. GCMRC scientist know this and send sedimentologists to the Paria River to measure the sand contributions of promising floods when they see them occur. Statistically, one might identify the magnitude of Paria River floods that are the major contributors of sediment. The Rapid Response HFE would require the development of a flow trigger. Scientists would likely be able to develop triggers for experimenting under this paradigm, as they have developed triggers for the store and transport HFE.

The experiment of the Rapid Release HFE would be a comparison of this type of HFE in contrast to the store and transport HFE. If the Rapid Release HFE appears to have promise, further experimentation could be done by testing the flow triggers.

2 c: The October/November – March/April HFE windows

This EA offers only limited description of why the HFE release windows are confined to the months indicated. However, the purpose statement suggests HFE occur in sediment enriched conditions. The information presented in Figure 6 indicates that sediment inputs from the Paria River are most likely to occur in August and September. Sediment inputs from the LCR are most likely to occur in January. (One can make the argument that if an HFE occurs in September as a response to sediment inputs in that

month, one will have lost the opportunity to conduct an HFE in an even more sediment-enriched condition should more sediment come into the system in October. This lost opportunity points out one of the advantages of the Rapid Response HFE.)

We can find no science nor can we find a policy that would limit powerplant capacity HFE to the Oct/Nov, Mar/Apr timeframe. To the contrary, the GCD EIS describes HMFs and does not include these limits. More recently, the 2008 EA on MLFF and 5 years of experimentation as well as the court required rewrite of the BO includes no such limits. Western wonders if this limitation related to a possible impact on humpback chub. This limit then, would seem to be predecisional. The proposed action has not been presented and no formal ESA consultation has occurred. Often an action agency will enter into informal ESA consultation to prevent problems during formal consultation. If the HFE release windows are a result of informal consultation, Western requests that this consultation be expanded to include Western so that we can understand the concerns and perhaps offer alternatives. Further, if the window has been established based on other resource considerations, the EA should clearly describe them. Western would then have an opportunity to suggest other mitigation measures aside from this four-month restriction.

Chapter 3, page 42, refers to tamarisk seed germination. This risk of the further spread of tamarisk by seed dispersion is described as the period from May to September. It does not explain the release windows being confined to Oct/Nov and Mar/Apr. However, a possible mitigation action for floods that occur during these months is the recent introduction of the tamarisk beetle. According to some recent accounts, this beetle will inflict significant damage to tamarisk production in the Grand Canyon.

Limiting the Rapid Response HFE to the release windows of Oct/Sep and Mar/Apr may doom the Rapid Response HFE to failure. As we've noted previously, the most sediment-rich Paria River floods occur during the monsoon season, with most floods occurring in August and September. A scientific experiment that tests the science paradigm embraced by the Rapid Response HFE, would require HFEs to occur during these months. Limiting this test to the months of Oct/Nov would limit the testing of this HFE to a time when only 15% of the total Paria-borne sediment is available. Ninety percent of the sediment that is delivered by the Paria occurs in the monsoon period.

<u>2 d: Description of the Rapid Response HFE</u>

Page 30: little is said about the possible advantages of a release from GCD timed to match a Paria River flood. We suggest that Reclamation include an explanation of the Rapid Response HFE that includes why it may be useful relative to a Store and Transport HFE. The alternative description Western provided to the Cooperating Agencies is one source. The GSA Today article from April 1999 entitled, *Flood and Sandbars in the Grand Canyon* is another. While this article deals with the Little Colorado River, it is similar in concept to the Rapid Response HFE.

Another advantage of HFEs that are limited to powerplant capacity is that it is an HFE that can be used for experimentation and as a management action without challenging the legality of bypasses. Some Cooperating Agencies and AMWG members have concerns about the legality of HFEs that include bypass.

3.1.8 Sediment Under Proposed Action, page 62. This impact analysis provided here is emblematic of the dismissal of the Rapid Response HFE. In this section, only the BHBFs of 2004 and 2008 are discussed and the conclusion drawn also reflect this. While the proposed protocol includes 13 HFE varieties, the experimentation to date have only been the implementation of HFE #3 Reclamation has, however, drawn conclusions about the implementation of this protocol, but not on the Rapid Response HFE. This represents a lack of attention. The EA should be amended to include a full evaluation of the science experiment, including the Rapid Response HFE.

Page 64. Ignored in this explanation is the positive effect on sandbar volume of floods at powerplant capacity. Here in Figure 9, BHBFs are labeled. The narrative notes that they produce an increase in sandbar volume. The "bumps" in sandbar volume in 1997 and 2000 also are conspicuous. These were HMFs or, earlier in 1997, high release volumes. From the NAU data presented here, they certainly add to sandbar volume. These increases in sandbar volume with HMFs and high fluctuating releases occur at times in which there may or may not have been a sediment-enriched condition. Western suggests that the NAU data presented here underscores the possible utility of HMFs and/or the Rapid Response HFE.

<u>General Comment #3: The Store and Release HFE and the Significant Water Requirement of These Flows</u>
Page 26: There are 13 varieties of this type of HFE. Western is concerned about the amount of water required to conduct the largest of these and about the occurrence of multiple HFEs in a single year. The HFE # 1, with ramping, requires approximately 450,000 acre feet to implement. Moreover, as indicated in Table 5, page 28, two HFEs occur in the same year in 5 of 10 dry years for two of the sediment conditions (3 of 10 years for the 3rd sediment condition). In the year 2013, two #1 HFEs are implemented. In 2013, therefore, 900,000 acre feet are used for HFEs; a minimum release year. This is 11% of the entire water allocated for release in 2013. The following year, in 2014 another two HFEs are implemented; a #1 and a #8.

We do not have sufficient information regarding the redistribution of water from other purposes to implement the HFEs listed in Table 5, but such a redistribution is likely to have an adverse impact on other canyon resources and on electrical power. To implement just one HFE, significant water must be moved from within the month in which an HFE is implemented or water needs to be redistributed from other months or both. To the extent water is redistributed within a month, there will be a few days of high release for the HFE bracketed by three weeks of 8,000 cfs during the day and 5,000 cfs during the night. Not only does this eliminate electrical load following for the entire month, but it would likely have effects on downstream resources and on recreation. Compound this effect by two for each year that there are two HFEs. In addition, in many cases, water will need to be distributed to an HFE month from other months – affecting power production, water deliveries and other downstream resources.

Western believes that there may be significant impacts on electrical power production from the implementation of the HFEs as described in Table 5. In some months, Western would have to purchase electrical power from the market to meet its contractual commitments. This is not likely to have an immediate impact to end users of electrical power as long as sufficient monies are available in the Basin Fund. One impact comes from those months in which Western could otherwise offer its customer AHP capacity, but is unable to do so because of water redistribution to accommodate an HFE. We suggest a "litmus test" for determining a significant impact: an HFE or set of HFEs in which the redistribution of water to implement an HFE requires that the GCD target release falls below a ROD threshold value: 800

kcfs or 600 kcfs. If this occurs, then the HFE protocol has a significant impact on electrical power production. To conclude an EA with a FONSI, a mitigation measure would have to be identified that precludes an HFE that requires this sort of water redistribution (or requires a "higher numbered" HFE). As a practical matter, this reintroduces a water limitation.

HFEs and the Error of the Forecast: Western believes that the implementation of HFEs, as identified in Table 5, may not be implementable. Suppose an HFE is implemented in November of a year in which an equalization release is forecasted. The HFE and the release in the months that precede a forecast would "use up" a significant volume of water. If another HFE were to be implemented in March/April and at the same time, the forecast fell to a minimum release level, there may not be water available in the rest of the water year to stay within the ROD minimum flows and implement an HFE. Either that or the remainder of the water year (May – September) would have to be very low water months. At the very least, Reclamation should do a model run with the proposed action AND including the error of the forecast. This would tell us if two HFEs in a year and a minimum release year (with a forecast error) are compatible.

The last two comments reflect on the lack of a hydrological limitation to the HFE protocol. Earlier, the cooperating agencies considered model runs in which hydrology was limited. The model runs in the EA present no hydrological limits. Western believes hydrological limits are necessary. They are also practical, as they require consideration how the use of water for HFEs impacts other resources in other months.

<u>General Comment #3: Description of the Effects of HFEs on Rainbow Trout and the Likely Link to HBC. The EA Understates the Potential Impact of HFEs on HBC and Overstate the Advantages</u>
Recent scientific analysis presented to the TWG at science workshops indicate that HFEs produce significant numbers of rainbow trout. These trout are likely to drift downstream, prey on and compete with HBC. The EA appears to understate or mischaracterized this risk.

Pages 68, 69: This section discusses the beneficial effects of the store and release paradigm on backwaters and generally supports the hypothesis that backwaters are important to native fish. This section overstates our level of knowledge and fails to cite the ongoing efforts of the near-shore ecology project to study the relationships between backwaters and humpback chub success. Backwaters could act as predator pits within the river and may not actually be important habitat for humpback chub or other native fishes. Given the small number of major backwaters in the LCR reach, this section could be more balanced in discussing the potential negative impacts on habitat for native fish and the potential that backwaters are not important. Sediment during high flows could actually fill in important interstitial habitat in the LCR reach potentially important to juveniles native fishes.

Page 88: Why would the effect not be expected for age-0 and larval trout to be the same as in 2008? This paragraph is confusing and could be clearer. Certainly effects on adult trout seem minimal due to displacement and body condition, but effects on recruitment were substantial in 2008 and similar but smaller in 1996 and can't be ignored. This should be stated clearly in this paragraph.

Page 91, Section 3.1.16.6: The document concludes that other than the creation of backwater habitat, the other habitat types would not be adversely impacted. We suggest another mechanism which could

have substantial impact to habitat for humpback chub. Repeated HFEs could reduce interstitial habitat for juvenile humpback chub in talus slopes due to siltation and sand deposition. This could result in decreased juvenile survival rates especially for humpback chub. The perspective of this document seems to lean towards a hypothesis that backwaters are essential habitat for humpback chub and that other habitats are much less important. We would propose that it is just as likely if not more so that talus slopes and other complex habitats are important for humpback chub recruitment and that backwaters are important for the overall ecosystem function but not very important for chub recruitment and that HFEs may adversely affect important habitat (talus slopes, interstitial spaces) through filling in with sand.

General Comment #4: The EA's Description of the Purpose of HFEs – Is it for the general conservation of sand or for building beaches and sandbars?

A major assumption for selecting the "store and release" method is the knowledge about antecedent sand enrichment prior to a HFE resulting in a positive mass balance on sand within the specific reaches. The assumption is that you can store tributary inputs, flood, and then get the needed high suspended sand concentrations. This really only happened for the 2008 HFE because it had 2 large Paria floods in the prior year (each with a return interval of about 7 yrs).

Something that is missing from the EA in terms of a science question is: What are the operating conditions which promote the greatest amount of storage of tributary sand inputs? There is not enough attention paid to what constitutes storage of sand for the "store and release" method. If you logically carry this thought process out, the rapid response HFE (flood with the Paria) becomes a testable method for the storage mechanism. Overall, the rapid response HFE has very short duration floods so most of sand storage would occur upstream of the LCR. One can argue that it is better to store tributary inputs prior to a HFE in the channel (as store and release would do), or would it be better to store the sediment in the backwaters and sandbars of Marble Canyon (rapid response)?

Page 30, Par 3: The term "conservation" of sediment should be discussed in more detail. It is hard for the reader to follow in this EA what it is Reclamation is trying to do. If we were trying merely to conserve sediment (see page 6 second par.) then we might not run HFEs at all, we would run some sort of steady flow regime for maximum sediment conservation. This EA is geared around trying to build sandbars and backwaters at the expense of using high flows and substantial sediment transport out of Marble and eastern Grand Canyon. This concept deserves more discussion in the EA. We aren't necessarily trying to maintain mass balance, although the modeling approach strives for it over the long term. The goal here is bigger beaches and backwater habitats, and obvious consequences might be siltation of talus slopes and other complex habitat structures which may be very important to juvenile humpback chub.

Page 62, Section 3.1.8: The document again mixes sand conservation goals with bar building and high elevation sand. It would be helpful if the goals of this EA were clarified throughout the document because in paragraphs following the first one in this section the discussion moves to building high elevation bars at the expense of sand conservation (i.e., high export amounts). Top of page 64 talks about the retention of sandbars, which appears to be the real goal of this EA and we would suggest re-writing the document to describe that.

Specific Comments by Page Number

Page	Paragraph	Comment
General		Suggest refraining from the use of "believe" and "it is believed" or other variant in this technical document. Other terms such as the "data suggests" we hypothesize, we can speculate… data indicate, etc. are more appropriate.
1	2	"Action area" is a term used in ESA Section 7 compliance documents rather than NEPA documents, which typically use the term "affected environment."
5	Footnote	The definition of sediment provided in the footnote does not seem to include inorganic clays and silts.
6	Sec 1.3	DOI has announced its intent to develop an LTEMP EIS. It should be clearly stated her that the HFE Protocol EA will develop a protocol that may change as a result of the LTEMP EIS.
11	1	Section 1.5 lists 6 HFE events, 3 of which are powerplant capacity (1997 and 2 in 2000). It states that "For the purpose of this EA, all of these releases are considered high-flow experiments (HFEs)." – yet the rest of the document generally talks about the three HFEs above 31kcfs as the only HFEs. These inconsistencies should be corrected, and should be consistent with the statement on page 11, that all 6 were HFEs. Example, page 13, par 5 (last) it is stated that Reclamation has conducted 3 high flow tests (1996, 2004, and 2008), yet Reclamation has done 6 (page 11). Other portions of the EA (e.g., page 24, second and third par.; page 25 first par.; page 26 section 2.2.3.1) could be clearer with regard to the three 31kcfs HFEs.
12	Section 1.6	AMWG should be an important advisory voice in the decision to implement an HFE. Perhaps we should consider an advisory group like the FGTWG to help craft recommendations and consider environmental impacts to key resources. Figure 5 from the document titled "HFE SB Model and Followup Process" was provided by Dennis Kubly in an email on 10-14-2010 and described the decision-making loop in greater detail. Was this lost/forgotten or did Reclamation change the approach?
13	Section 1.6	This section lists a series of new research questions. These seem well thought out and pertinent, but what seems missing is a discussion of previous SSQs, RINs, 2004 priority questions, etc. – what have we answered from the past and how does that influence this now? It would benefit the program if we could first tie up the related questions from the past and then move to the new questions showing how things had changed and showing how we think we either answered the previous questions or how they have become obsolete.
14	Research Question	The "rapid response" HFE approach has been hypothesized to improve retention of organic matter and finer sediments that would improve the

Page	Paragraph	Comment
	#4	stability of sandbars. This should be added to the text.
14	Research Question #5	The "rapid response" HFE approach has been hypothesized to reduce scouring of the food base. This should be added to the text. The concept is mentioned in Research Question #8.
15	Research Question #7	It is not clear to me why consecutive fall and spring HFEs need to be tested. The "rapid response" HFE approach includes the possibility of multiple consecutive HFEs in a single season. Perhaps that is the example that should be provided.
18	4	I believe this is the first place that there is a statement regarding the months when an HFE is being considered. A rationale for the "release windows" chosen needs to be clearly stated. Summer months (July through September) should be considered for HFEs that are within power plant capacity.
21	Section 2.1	BHBFs and HMFs were elements of the ROD and MLFF. The expected occurrence of these flows over the planning horizon should be presented here in order to allow a meaningful comparison of the effects of no-action vs. the proposed action.
21	4	Suggest adding Coggins and Walters 2009 to last citation in paragraph as modifications due to aging error were incorporated into the ASMR methods.
27	1	Definitions of dry, moderate, and wet hydrology should be provided. It is also not clear how hydrology factors into the decision making process as presented here, because it is stated that "There is an assumption here that water is not limiting because reallocation of water from other months will be used to ensure that sufficient water is available for the HFE."
27	3	This last section seems to confuse probabilities with occurrences in the table. The table needs to consider the likelihoods of the various scenarios occurring, for example the various hydrologic conditions and sediment conditions have probabilities of occurring, this should be factored into the results such that we have a true measure of likelihoods of various HFE results. The current description uses an incorrect application of likelihood of occurrence and does not represent the true likelihoods. This should be addressed and the results should be much more helpful in showing the real likely occurrence intervals. This continues into page 28 (only paragraph), it is true that certain scenarios are more likely to occur under various hydrologic-sediment conditions, but this is confusing to the reader in understanding which is actually more likely to happen – thus the likelihoods of the hydrologic-sediment conditions should be factored in explicitly.
28	Table 5	A much better explanation should be given of the store and release protocol. It is not clear how hydrology plays into the protocol since it is stated earlier that

Page	Paragraph	Comment
		water is considered "not limiting." For example, why would the identified HFE for April 2011 in a low sediment, dry year be 45,000 cfs for 36 hr, but in a high sediment, dry year be only 45,000 cfs for 12 hr? Presumably, these years would have the same antecedent conditions. And why are there no HFEs identified for moderate sediment conditions in this month?
30	5	Add "store and release" before "HFE" in line 4 to distinguish from the rapid response HFE that could occur earlier in response to a Paria River flood.
31	1	The last sentence is very awkward and should be rewritten to simply state that if the rapid response flow does not occur (no Paria input during the time period available for the test) then the scheduled HFE would occur at the end of the month as planned.
31	4	Given that the magnitude of the proposed rapid response HFE is within ROD operations, it is difficult to see how that would release would have "negative impacts on private property, recreation and safety, and dam operations." This statement seems to apply more to HFEs that are above power plant capacity. Similarly, the statement that the "NPS has indicated in the course of the HFE Protocol EA preparation that having 3 weeks' notice in order to fully inform the public and mitigate negative impacts is the most desirable course of action" would seem to be more applicable to above power plant capacity HFEs. Of course, three weeks' notice would not be possible for a rapid response HFE.
32	Sec 2.2.4	Given Western's involvement in dam operations, its legal requirements to meet electrical contract commitments and its relationship with Reclamation as defined by interagency agreements, should Western be one of the agencies involved in the decision making process?
32	Sec 2.2.4.1	Study plans were developed for Past BHBFs. The implementation of these plans was expensive. Western suggests that a criterion for implementing an HFE be that funds are available through either the AMP biannual budget process of through DOI to complete a scientific analysis of each HFE.
32	2	Western's description paper for the rapid response alternative presents a number of other potential advantages including retention of very fine, organically rich sediments, greater stability of newly formed sandbars, enhanced primary and secondary productivity, and reduced scouring of the aquatic food base.
32	5	"biannual" should be changed to "biennial"
33	1	"would not drive the model" should be changed to "would not affect the model," as LCR inputs are not considered in the HFE model as far as Western

Page	Paragraph	Comment
		understands the modeling. Please check this and modify as necessary.
34	Figure 6	Suggest that important data such as Figure 6 be cited as GCMRC, and that GCMRC prepare a white paper including these important pieces of data/analysis into one document that is citable in the record by Reclamation, and signed off by the GCMRC Director.
34	3	Suggest avoiding terms such as “extremely” in last paragraph, that section could read “relatively large quantity of sand”
34-35	This section	Suggest considering changing the way the accounting periods are described. Because the accounting period does not go to zero if there is no HFE, the sediment budget carries over to the next time period. Really you have two high flow windows and the accounting period is anything since the last HFE up until the rising limb of the potential next flow. The concept of accounting periods is really a misleading description of the process. Instead change this to a description of accounting since the last HFE and the two HFE windows.
35	3	The term “tributaries” is used in the middle of this paragraph, but are we specifically talking about the Paria River? If so, this should be changed to Paria River, if not, then the document should be edited to describe all the tributaries that will be considered under inputs into the sediment budget in the model.
36	Section 2.2.4.3	The decision-making process seems incomplete. More discussion and consideration of Reclamation’s role, the AMWG, and potentially a technical sub-group is needed. The flow-chart on page 37 appears to be missing a management loop that was in earlier discussions. Figure 5 from the document titled “HFE SB Model and Followup Process” was provided by Dennis Kubly in an email on 10-14-2010 and described the decision-making loop in greater detail. Was this lost/forgotten or did Reclamation change the approach?
38	Section 2.2.5	The presentation in this section is not coherent, and it is not clear what the intent of the section is. For instance, under “Trigger Criteria,” the proposed trigger criteria are not described, but previous and alternative criteria are. The last bullet is not a complete sentence. The bullets in this section should be cleaned up and a brief introductory paragraph describing the intent of the section should be provided.
38	Section 2.2.5.1	It may not be technically true that the 2008 flood was based on a specific sediment trigger as is described here. The GCDAMP certainly did consider some, and the sand may have been above that level, but the final research plan removed the discussion of the sediment trigger.
38	Section 2.2.5.2	Again the document talks of only 3 HFEs when there were 6, suggest fixing this inconsistency. Either all four are HFEs and should be discussed or they are not and earlier sections should describe that. Page 11 states that all 6 are HFEs and

Page	Paragraph	Comment
		will be talked about together, but then the document goes on to use a different approach.
39	1	It is confusing exactly where the sand budget is. This section talks about past export from Marble Canyon. Is this where the positive balance will be measured/modeled? This could be clarified throughout the document.
39	Third bullet	It is hard to follow the top 3 bullets, one does not necessarily lead to the next. The third bullet starting at "thus" seems to be on its own. Also, I cannot follow the calculations here. It looks like the range of export during an HFE is 300,000 to 800,000 metric tons of sand under the possible scenarios (expect for those longer than the 2008 HFE), but I can't see how you get to the third bullet for 800,000 tons for "Paria River sand supply" – perhaps you mean Paria River retained inputs just prior to the HFE – that would result in net zero under the high scenario. But if "sand supply" to the mainstem was 800,000 tons then a portion of that would be exported, and thus more would actually be needed. Please clarify this section, I generally like that you are putting numerical bounds on the sediment needed as that is a calculable amount and should be described.
39	Third bullet Section 2.2.5.4	The third bullet is a bit confusing – I don't think we want to maximize sand transport in order to maximize sand retention? Seems logically at odds. I think it might be clearer to say maximize turbidity or sand in suspension to maximize the deposition rates in bars. Transport may be the correct terminology but may not be clear to the reader.
39	last bullet	It seems contradictory to say that the 3 powerplant flows were not designed for sandbar building, when in fact they did result in sandbar building. This section dismisses the potential for 31,000 cfs flows to build sandbars without any discussion or data to support that. It does state it could be tested, but again treats these 3 flows differently than is described on page 11 which grouped the 6 HFEs together.
41	Section 2.2.7.1	The rapid response HFE alternative has comparable and addition advantages (e.g., greater retention of organic matter and very fine sediments, primary and secondary productivity enhancements, reduced scouring of the food base). In fact, for the first two bullets listed (i.e., HFE timed to maximize sediment input and HFE duration to use less water), the rapid response HFE has clear advantages.
43	First bullet	Missing from this description is the cost of bypassed water which cannot be mitigated, so maybe not having it here is ok but the discussion is lacking without acknowledgement of the bypassed water.
43	First	The rapid response HFE alternative would little if any cost to hydropower production because releases would be within powerplant capacity and of very

Page	Paragraph	Comment
	bullet	limited duration. Very little volume would be used to implement this alternative. Text that explains this should be added here.
51	Figure	This figure should be renumbered as Figure 1.
51		Change Section title to: "HYPOTHESIS TESTING FOR ALTERNATIVE HIGH FLOW EXPERIMENTS."
52	Figure	This figure should be renumbered as Figure 2.
57	Section 3.0	This section is poorly organized. The description of the affected environment is provided in with the effects of the no-action alternative, but these two topics are not the same. The affected environment results from all of the preceding events and conditions including operations. In the case of Glen Canyon Dam, a large number of operational decisions and management actions have occurred that have resulted in current conditions. "No action" refers to the expected operations over the planning horizon. There should be a clear presentation of these expected effects that is provided separately from the description of the affected environment. In addition, the effects of daily fluctuations appears in many cases to be attributed to the no-action alternative alone, but fluctuations are an element of the proposed action as well.
63	Table 9	It is hard to follow the math, either having sand in excess of the imported amount or less than the imported amount. The data in the table is hard to follow – it is impossible to have sediment conservation in excess of the imported amount, how was that sand created? It makes more sense to say net accumulation from time zero or net loss (inputs minus exports). It can't be related to an amount in excess of the imported amount?
69	Last	This discussion of aquatic food base in backwater habitats would be better presented in Section 3.1.14.
77	1	Reads "powerplant flows of 31,500" but on page 11 it is listed at 31,000 and in an earlier section it is stated that there has been no flows between 31,000 and 41,000 – so 31,500 seems not to fit with other statements, please determine which flows were correct and modify as needed.
78	2	This paragraph is highly speculative and should be changed from "Reclamation believes…" to a sentence structure that incorporates the high uncertainty, speculative nature, and importance of testing these hypotheses. It could very well be that repeated disturbances (HFEs) could leave open niches that could be colonized by less desirable flora and fauna regardless of what order in which they occur.
79	1	The recovery goals are still in development after a remand, thus the original goals are in effect, although Reclamation has chosen to rely on draft goals in

Page	Paragraph	Comment
		the 2009 BiOp. This paragraph could really use a rewrite to separate the usage of "population" and aggregation. Under the recovery goals (draft) the Grand Canyon is one recovery unit based on the LCR population. Multiple aggregations exist, and contribute to the LCR population to the extent that they spawn in the LCR and are available to be counted in the survey and thus included in the ASMR modeled "population."
79	2	The word "many" relating to the Warm Springs population should be reconsidered. "Many" may not be the best term for the number of juveniles in that aggregation.
80	1	The data that supports low juvenile survival in the mainstem may be changing, since the 2001 increasing population and evidence of high survival rates from the NSE project. This may not be citable now, but it warrants some discussion. We know more than in 2000 when these papers were published. That information should be brought in here to the extent possible.
80	2	First sentence is misleading as written, could be something like… the population decline from 11,000 adults in 1989 to a low of 5,000 in 2001. Since 2001, the population has increased by 50% to 7650… As written that sentence ends at 5,000 but that isn't the whole story and leaves the reader to wait until the next sentence to get the real story. By saying it reached a low at 5,000 it conveys that the population has increased and I think is more understandable.
86	1	This paragraph and accompanying Fig. 15 seems like a description of methods rather than a description of the expected effects under no-action. What is the purpose of this discussion?
87	1 & 2	This presentation of adverse effects is simply stated without any supporting data or information. What are the bases of the adverse effects presentations? Flows of this magnitude should not have an adverse effect of displacement given the species adaptation to much higher annual peak flows. The hypothesized adverse effect of increased trout predation also is not explained. Reference should be made to the subsequent discussion on the effects of the proposed action on trout.
87	2	This section talks about consultation with FWS to offset predation by trout but should really be a paragraph on the nonnative fish EA and results from that EA process, which isn't mentioned here. This is where there should be solid cross-referencing to the nonnative EA.
87	4	Suggest not using the term "adverse" to talk about effects on native fish, "adverse effect" is a term of art under the ESA and should be used sparingly and only for ESA listed species when you mean an adverse effect under the ESA. Otherwise the terminology should be clarified and made clear to the

Page	Paragraph	Comment
		reader whether you mean adverse in the ESA terminology or not.
87	4&5	It is not clear why adverse impacts are not expected on non-listed native fish when they are predicted to occur for the humpback chub.
89	2	The discussion of the effects on eggs of different timing of floods needs some further review. It may be more complicated than discussed here. For example, during the 2008 flood it occurred near peak spawning. For eggs spawned after the flood their survival was greater than average – but for eggs spawned before the flood survival was average (not below average). Thus timing of the flood would only be likely to reduce survival if it was late enough to affect post-hatched larvae. I'm not sure that an April flood would have that ability. The discussion here talks about the mechanism of an April flood and how it may work, but I think the discussion above confuses the timing effects of the 2008 flood to be negative for pre-spawned eggs when it was neutral for those eggs.
89	5	Please describe how the 2004 HFE exported large numbers of young trout downstream but then the document concludes that this would not adversely affect trout (first sentence)? These statements appear in conflict to one another.
90	3	The discussion here of adverse effects of high flow tests on fish habitat misses the mark because it emphasizes very short-term decreases in habitat quality related to species' preferred flow velocities. These short-term perturbations are most likely inconsequential compared to longer term effects on habitat structure and function. The same inappropriate focus is made in the discussion on fish habitat (Section 3.1.16.6). No discussion of effects on habitat structure and function is provided.
90	4	Awkward and confusing sentence starting with "Trammel et al."
94	Section 3.1.18	The impacts to birds of high magnitude HFEs are understated. It is stated here that many birds using the Colorado River below Glen Canyon Dam depend on the aquatic food chain associated with Cladophora. There is another statement that long-term effects to Cladophora are not expected, and it is implied that no effects would occur to birds. However, Table 7 indicates that scouring of algal beds has been observed following BHBFs of 41,000 cfs or higher and that many months were needed for recovery. A 41,000 cfs HFE in October or November could significantly deplete the food base for overwintering species.
96	Section 3.2 and 3.3	These two sections do not present the effects of either the no-action alternative or proposed action on cultural resources. Although an adverse effect is attributed to the proposed action, the nature of that adverse effect is not described.

Page	Paragraph	Comment
105	Section 3.4.4.1	Some discussion should be provided of the relative effects of the timing of a 41,000 cfs release on fishing. There appears to be many more fisherman participating in April compared to other months.
106	Section 3.4.4.2	Some discussion should be provided of the relative effects of the timing of a 41,000 cfs release on whitewater boating. There appears to be more commercial boating activity in April compared to other months.
109-116	Tables 13-16	These summary tables appear in Section 3 with no explanation. Also, they do not appear to be consistent with the presentation in the text. For instance, the text does not mention that a single 41,000-45,000 cfs HFE could eliminate wetland vegetation in backwaters. The effects of a 31,000-33,200 cfs HFE are not discussed at all in the text. The authors should thoroughly review and contrast the table with the text to ensure a consistent presentation.
113	Table 14	It is not clear why this table includes a limited number of resources (compared to Table 13). Also, the column headings (e.g., high occurrence probability, low resource risk) have not been described, and their meanings are not clear.
116	Table 15	This table is not consistent with previous tables or the text. For most resources, “no adverse impact” is stated in the table, but both the text and Table 13 present quite a few impacts. A table comparing the impacts of the no-action alternative to the proposed action would be a valuable addition to the EA.
117	Row 4	Change species name to “southwestern willow flycatcher.”
120	Table 16	The stated impacts in this table do not correspond with those in earlier tables or the text. For instance, positive impacts are shown for vegetation in the first three columns, but only negative impacts are presented in Table 13.
121	Section 3.6	Environmental justice impacts are not fully discussed. A conclusion is provided only for the cost of electricity, but not for other resources or pathways.
13 and Appendix B		The Research Questions listed and numbered starting on Page 13 are different from the HFE protocol science questions in Appendix B – are we really creating two different sets of overlapping questions? Suggest we consolidate these and update both sections.
Appendix B		In general, this science plan approach seems sound, builds on current abilities and includes additional funding in the budget to provide the sampling frequency needed to detect changes from HFEs on key resources. However, our concern is that Interior may find that these studies are not enough and that other studies similar in scope to the 2008 test are needed which would severely impact the GCDAMP budget, especially with repeated tests. We support building the science plan into the biennial budget process in the

Page	Paragraph	Comment
		manner proposed by GCMRC in Appendix B. We haven't reviewed the details of these programs and look forward to future conversations regarding the science plan and the key questions (see above comment) but support the general approach. We would propose a workshop format or other similar sharing of ideas to further develop the science plan similar to the approach in Appendix B and in the biennial budget.
Appendix B		As written, the science plan draws heavily on other GCMRC activities and plans, but does not provide appropriate reference to these plans. As a consequence, the study plan is confusing or not interpretable in parts (see references to CMINs, RINs, SSQs, EINs which are not explained).

Editorial Comments

Page	Paragraph	Line	Comment
6	1	4	question mark on “Glen”
6	2	3	insert “flow”
11	4	1	question mark on “third”
13	bullet 1	2	change “frequent” to “periodic”?
14	5	7	change “will” to “would”
16			not sure what “BHBFs” means- whether to change it or what
17	sec 1.9, paragraph 1	3	insert “including monitoring of experimental releases” replace “will” with “would”
18	4	1	replace “has to” with “must”
21	3	9	change “stable” to some other word choice?
24	2	8	change “HFEs” to “BHBFs”
24	3	3	change “HFEs” to “BHBFs”
25	1	1	insert “BHBFs”
25	2	2	insert “because the presence of the dam blocks sediment.” remove “and” capitalize “Ongoing”
25	2	6	replace “opportunities” with beaches insert “the”
25	2	8	insert “or during”
25	heading 2.2.2		insert “store and release approach”
25	5	1	insert “for”
25	5	5	insert “This model” remove “It”
26	2	2	replace “storage” with “store”
26	2	6	insert comma after “storage”
26	2	10	period after “projections” remove “and” capitalize “The” insert “projections”
27	1	15	replace “will” with “would”
30	1	7	remove “and”
31	3	6	replace “will” with “would”
31	4	8	replace “will” with “would” twice on same line
31	6	1	replace “will” with “would”
32	5	6	remove “the”
32	5	8	replace “will” with “would”
35	5	5	replace “in” with “within”

Page	Paragraph	Line	Comment
			replace “year” with “12-month period.”
37	footnote 1		replace “annual” with “seasonal” replace “meeting” with “meetings”
38	sec 2.2.5.2, bullet 1		insert “BHBF”
39	sec 2.2.5.5, bullet 2		insert “BHBF”
40	bullet 2		insert “and if [??] outcomes are likely.” insert “BHBF”
43	bullet 1	1	remove “Purchase Alternative Sources of”
43	bullet 1	3	replace “May” with “July” remove “February”
43	bullet 2	1	remove “Relocate”
43	bullet 2	12	replace “will” with “would”
43	3	1	replace “Public Outreach” with “Recreational Users”
46	7	2	replace “our” with “this”
47	4	5	replace “Our” with “This”
47	5	2	insert “BHBF”
47	5	4	remove “and have been called beach habitat building flows (BHBFs).”
48	4	1	replace “is” with “may be”
49	1	7	replace “The” with “This”
49	1	9	replace “over” with “more than”
49	2	3	replace “the” with “this”
49	2	8	remove “we propose”
49	footnote 9	1	insert “through the power plant alone”
50	2	1	replace “flood” with “dam”
52	2	6	insert “from GCD”
52	3	5	insert “HFE” ?
53	1	1	replace “We propose” to “This proposal”
53	1	2	replace “will” with “would”
53	1	3	insert “, while minimizing impacts on other resources”
57	1	10	replace “ten” with “10”
57	3	2	replace “possible” with “practical”
57	4	3	insert “on aquatic resources”
57	4	5	insert “BHBF”
61	2	2	insert “of energy”
62	1	2	insert “above GC Dam”
63	2	2	replace “5” with “4”
76	2	6	replace “its” with “their”
76	2	7	replace “it is” with “NZ mud snails are”
77	3	3	insert “BHBF”
78	2	1	replace “will” with “would”
78	2	7	replace “will” with “would”
78	2	10	replace “will” with “would” twice
78	3	2	replace “will” with “would”

Page	Paragraph	Line	Comment
78	3	4	replace “will” with “would”
78	3	5	replace “will” with “would”
78	3	11	replace “will” with “would”
79	2	3	insert “draft”
79	2	9	insert “thought to be”
89	4	8	remove “on”
90	1	1	remove “species”
91	1	6	remove hyphen in “short-term”
94	4	1	insert “BHBF”
97	4	10	replace “SLCA/IP” with “CRSP MC”
98	1	5	remove “:00”s on 7:00 and 11:00
98	1	9	insert “flow”
99	1	4	replace “takes” with “had taken”
99	1	5	replace “be” with “have been”
99	1	7	replace “would be” with “was” replace “is projected to be” with “was”
99	1	11	replace “is currently underway” with “was conducted in 2008”
99	2	6	insert comma after “demand”, remove comma after “power”
99	2	11	insert “year”
99	2	15	insert “and [something- can’t read] the impact.”
99	3	6	insert “, thus negatively impacting both the Basin Fund and the power customers.”
109	in table, columns 3, 4, 6, 7		replace “will” with “would” in several places
110	in table, columns 2, 3, 4, 5, 6, 7		replace “will” with “would” in several places
112	in table, columns 2, 3, 4, 5, 6, 7		replace “is” with “would be” in several places
114	in table, columns 2, 3, 4, 5, 6, 7		replace “will” with “would” in several places
116	in table, column 5	1	replace “will” with “would”
121	3	3	replace “Over 50” with “Fifty-seven”
123	2	1	replace “will have been” with “was”
125		7	replace “serving as” with “providing”
136	7	1	capitalize “functions”
150	1	1	insert “BHBF”
150	1	3	insert hyphen in “short-duration”
150	1	10	replace “Notices” with “Notice”
156	2	7	insert comma after “2000s”
163	1	3	insert “o” in “paleo-conditioned”
167	bullet 5		replace “HFE’s” with “HFEs”