Glen Canyon Dam Adaptive Management Work Group
Agenda Item Form
Conference Call – January 17, 2008

Agenda Item

Update on plans for a March 2008 high flow test

Action Requested

√ Information item only; we will answer questions but no action is requested.

Presenters

John Hamill, Grand Canyon Monitoring and Research Center
Randy Peterson, Bureau of Reclamation
Steve Martin, National Park Service
Amy Heuslein, Bureau of Indian Affairs
Larry Stevens, Policy Issues Ad Hoc Group

Previous Action Taken

√ By AMWG:
AMWG passed the following motion at its December 2006 meeting (see response from DOI below):

> AMWG recommends to the Secretary of the Interior to charge GCMRC to develop a science plan for a BHBF that addresses the concerns raised at the AMWG meeting on Dec. 6, 2006, and AMWG further charges the TWG to work with GCMRC to review the Draft Science Plan and make a recommendation to the AMWG.

√ By TWG:
TWG passed the following motion by a vote of 13 yes and 7 no, on October 3, 2007:

> The TWG considers that the GCMRC's BHBF Science Plan to be technically adequate and recommends that AMWG accept the plan, but suggests that AMWG consider the following issues in relation to priorities and budgeting:
>
> 1. Sandbar and nearshore habitat responses
> 2. Assessment of nearshore and foodbase responses
> 3. Native and nonnative fish movement and population responses to the BHBF and in relation to changing thermal conditions, where seasonally appropriate, and in relation to the adequacy of overall HBC monitoring
> 4. A comprehensive economic analysis of BHBF costs and impacts
> 5. Integration of past BHBF and related ecosystem information into overall ecosystem structure and function, including assessment of future BHBF timing and hydrography, and discussing objectives, results learned, and remaining questions to be answered in upcoming BHBF tests.
>
> TWG recognizes that the GCMRC Science Plan should be evaluated from a policy standpoint by the AMWG.

TWG considered and did not pass, by a vote of 4 yes, 13 no, and 1 abstention, the following motion on October 3, 2007.

The TWG recommends to the AMWG that an experimental BHBF take place in 2008 as follows:

a. The hydrograph should resemble the November 2004 hydrograph
b. The BHBF will be implemented in late March or early April.
c. A science plan specific to a spring BHBF will be provided for TWG review by mid-January 2008

At a minimum, the BHBF experiment should address the following general questions:

a. To what extent can BHBFs be used to rebuild and maintain sandbar habitats?
b. Do sandbars deposited by BHBFs contribute to the preservation of archaeological sites?
c. Do nearshore habitats created by BHBFs (under enriched sediment conditions) benefit humpback chub and other native fishes?

Additional priority questions include those that would benefit the selection of the most beneficial alternative in the LTEP. A science symposium to synthesize information derived from BHBFs and HMFs will be slated for WY 2009. Recommend AMWG convene a conference call in early November.

√ Other:

Following is the DOI response to the above AMWG recommendation (May 21, 2007 memo from Deputy Secretary Lynn Scarlett to AMWG):

. . . While high flow events are the only mechanism to redeposit sediment on Grand Canyon beaches, the Adaptive Management Program has not yet addressed the long-term sustainability of beaches using these releases in conjunction with Paria River and Little Colorado River sediment inputs. Critical to this phase of the AMP is the inclusion of BHBF testing as part of the ongoing development of a long-term experimental plan.

Consistent with this recommendation, GCMRC has been actively working to further refine its science plan for a BHBF, which will then be reviewed by the TWG and provided to the AMWG for its further consideration. Further details on the Department's consideration of the issues raised by this recommendation were thoroughly discussed in a memorandum to Adaptive Management Work Group members from Assistant Secretary Limbaugh dated February 2, 2007. . . .

Guidance provided by DOI in the February 2, 2007 memo from Mark Limbaugh to the AMWG:

. . . While we fully understand that many members of the AMWG view a spring 2007 BHBF as an important opportunity to advance resource management, the best way to address a number of issues currently affecting the Adaptive Management Program, including the need for additional BHBFs, is through the development of a long-term and carefully planned program of experimental and management actions. In accordance with the AMWG's recommendation, staff at the GCMRC have been working since the December meeting to prepare a draft science plan regarding additional BHBFs. We expect that the draft science plan will be available for initial review and comment in early February.

As I have mentioned in my remarks to the full AMWG, and in many of the conversations I had earlier this week, it is my hope that we can work effectively together to have well-considered, approved, "off-the-shelf" action plans to take advantage of these types of important research opportunities in the future. . . .

Memorandum to AMWG from Brenda Burman, Secretary's Designee, December 20, 2007 (excerpt):

As you know, the Department has been actively considering a high-flow test at Glen Canyon Dam for over a year. The potential experiment is under consideration in light of unique, sediment-enriched conditions in the Grand Canyon as a result of intense storms over the past 18 months. . . .

Earlier this month, the DOI Glen Canyon Dam Policy Group met to consider the Department's approach to the potential high-flow test.

The Policy Group discussed and considered the factual circumstances and the comments of the AMWG representatives. Ultimately, the Policy Group made three decisions 1) DOI agencies should actively proceed with environmental compliance activities for a potential test, 2) GCMRC should actively work to prepare for such a test, though such efforts must recognize that the high flow experiment is only a proposal at this time, and no decision will be made on whether to proceed until completion of appropriate environmental compliance, and 3) we should seek to identify approaches that could minimize potential adverse impacts as a result of the potential test. To be clear, DOI has not yet made a final decision as to whether to proceed with a test, and a final decision on this question will await preparation and completion of appropriate environmental compliance documents and further consideration of the pending GCMRC Science Plan. . . .

Relevant Science

√ The following describes the relevant research or monitoring on this subject:
GCMRC sent its final Science Plan to AMWG members on December 31, 2007 and it is posted at the Adaptive Management Program website at http://www.usbr.gov/uc/rm/amp/amwg/mtgs/08jan17CC/index.html. Please see the executive summary of the Science Plan, attached.

Background Information

The following is an outline of the presentations that will be made during the AMWG conference call.

1. Grand Canyon Monitoring and Research Center – John Hamill, Chief
   a. Overview of the Science Plan (please see the executive summary of the Science Plan, attached)
   b. Description of the experiment, including the questions that are expected to be answered and the parameters: length and magnitude of flows, etc.
   c. Recent updates to the Science Plan following TWG approval in October: increased emphasis on humpback chub, new section on long-term strategy, addition to the workplan

of a synthesis of results of the test, responses to TWG recommendations, and budget refinements (including BOR and NPS contributions).

d. Implementation and timeline.

2. Bureau of Reclamation – Randy Peterson, Manager, Environmental Resources Division
   a. Compliance update, including NEPA, ESA, and NHPA.
   b. Schedules of compliance and high-flow test.
   c. Impact on LTEP EIS and development of DFCs.

3. National Park Service – Steve Martin, Superintendent, Grand Canyon National Park
   a. Presentation on preparations for the experiment.

4. Bureau of Indian Affairs – Amy Heuslein, Regional Environmental Protection Officer
   a. Update on tribal consultations.

5. Policy Issues Ad Hoc Group – Larry Stevens, Grand Canyon Wildlands Council, AHG Chair
   a. Update on the Ad Hoc Group's progress.

In cooperation with the Glen Canyon Dam Adaptive Management Program

Science Plan for Potential 2008 Experimental High Flow at Glen Canyon Dam

Prepared by the Grand Canyon Monitoring and Research Center

December 27, 2007

U.S. Department of the Interior
U.S. Geological Survey

Executive Summary

This science plan describes proposed monitoring and research activities to be conducted by the U.S. Geological Survey's Grand Canyon Monitoring and Research Center (GCMRC), should the Secretary of the Interior approve an experimental high flow at Glen Canyon Dam in spring 2008. A high-flow release from the dam has been proposed in 2008, not only to rebuild sandbars and aid the endangered humpback chub, but also to benefit various downstream resources, including rainbow trout (*Oncorhynchus mykiss*), the aquatic food base, riparian vegetation, and archaeological sites. Additionally, the system is currently enriched with sediment as a result of repeated tributary floods from the Paria River in late 2006 and fall 2007; the current level of sand enrichment is greater than it has been since at least 1998.

The international prominence of Grand Canyon National Park and public concern about the impacts of Glen Canyon Dam resulted in Federal efforts to protect downstream resources. In 1992, the Grand Canyon Protection Act (GCPA) was enacted "to protect, mitigate adverse impacts to and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established." The 1996 Record of Decision on the Operation of Glen Canyon Dam Environmental Impact Statement established an adaptive management program, of which the GCMRC is a part, to ensure that the primary mandate of the GCPA is met.

Before the dam, the Colorado River swelled with spring snowmelt from the Rocky Mountains in most years, producing flood events and transporting large quantities of sediment that created and maintained sandbars in Grand Canyon. In Grand Canyon, sandbars provide camping beaches for river runners and hikers, serve as a source of sediment needed to protect archaeological resources from weathering and erosion, and create habitats used by native fish and other wildlife. Today, the river usually runs clear below Glen Canyon Dam, because Lake Powell traps all of the sediment upstream from the dam (Wright and others, 2005). As a result, Grand Canyon receives 6%–16% of its predam sand supply, which comes primarily from the Paria and Little Colorado Rivers when they enter the mainstem below the dam (Wright and others, 2005).

The native fish community found in Grand Canyon evolved in the large, turbid, and seasonally variable predam Colorado River. Today, three of the eight native fish species have been eliminated from the Colorado River in the study area and two are federally listed as endangered, razorback sucker (*Xyrauchen texanus*) and humpback chub (*Gila cypha*), under the Endangered Species Act of 1973. The razorback sucker is widely thought to no longer be present in Grand Canyon. Only six populations of humpback chub are known to exist, five in the Colorado River Basin above Lees Ferry, Ariz., and the one in Grand Canyon, Ariz., which is the largest population remaining in the basin.

Importantly, the design of the proposed 2008 high flow and the accompanying experimental studies outlined in this plan build on learning that occurred as the result of high-flow experiments conducted in 1996 and 2004. For example, from the 1996 high-flow, scientists learned that tributary-supplied sand does not accumulate on the riverbed over multiyear periods under typical dam operations. In fact, erosion of low-elevation sandbars caused by the 1996 high flow actually resulted in a net reduction in overall sandbar size. Approval of a supplemental environmental assessment (U.S. Department of the Interior, 2004) allowed scientists to evaluate the efficacy of

conducting a high flow following tributary floods in 2004 for the first time and generated the following conclusions:

- The 2004 experiment resulted in an increase of total sandbar area and volume in the upper half of Marble Canyon, but further downstream, where sand was less abundant, a net transfer of sand out of eddies occurred that was similar to that observed during the 1996 experiment (Topping and others, 2006).
- More sand will be required than was available during the 2004 high flow (800,000 to 1,000,000 metric tons) to achieve increases in total sandbar area and volume throughout all of Marble and Grand Canyons in the future (Topping and others, 2006).
- Sandbars created by the 2004 high flow increased the windborne transport of sand toward some archaeological sites in Grand Canyon (Draut and others, 2005; Draut and Rubin, 2006). This led to the hypothesis that increased sand carried by the wind from restored sandbars may reduce erosion and increase preservation potential at some archaeological sites.

The sediment-related data that researchers propose to collect for a possible 2008 high flow would facilitate comparison with data collected during the two previous experiments. Proposed experimental studies will also generate new data that can be compared to previous tests on the physical processes regulating sandbar erosion and deposition during high-flow experiments, sediment deposition at archaeological sites and camping areas, ecosystem flux measurements related to organic tributary inputs, effects of flood disturbance on vegetation, and formation of backwater habitats used by native and nonnative fishes. These comparisons are required to determine whether greater and more geographically extensive sandbar rebuilding is possible with a future high flow than occurred in 1996 and 2004. The data are also needed to determine if consecutive high flows in the future might cause sand to accumulate through time to reverse erosion documented after the closure of Glen Canyon Dam in 1963.

Sandbar rebuilding is thought to be important in creating backwater habitat that may lead to increased production of young fish by native species. Overall, recruitment of humpback chub has been increasing from 1994 to 2002, a period that includes the 1996 high flow, though the uncertainty in these estimates is large. These data suggest that high flows have not been detrimental to humpback chub. It is also possible that high flows offer advantages to humpback chub, including the temporary displacement of nonnative fishes (Valdez and others, 2001) and the maintenance and construction of backwater habitats, which may offer growth advantages to humpback chub and other native fishes (Arizona Game and Fish Department, 1996).

The best timing to conduct a high flow to maximize resource benefits or to avoid undesirable impacts has yet to be determined. For 2007–08, the earliest practical time for a high flow would be early March 2008, given the logistical, administrative, and compliance requirements associated with conducting the research outlined in this plan.

The GCMRC proposes replication of the 2004 hydrograph in a potential 2008 high flow (41,500 cubic feet per second (cfs) for 60 hours). These conditions would allow scientists to determine whether the locally robust and consistent sandbar-building responses that occurred in upper Marble Canyon in 2004 can be repeated and possibly enhanced. However, a possible 2008 experiment would be different from the two high-flow experiments conducted previously in several important ways. In November 2007, for example, sand supplies in the main channel of the Colorado River were two to three times larger and distributed differently than in 2004. The system is currently enriched with sediment as a result of repeated tributary floods from the Paria River in October 2006 and August–September 2007 that delivered 2,500,000 metric tons (±500,000 metric

tons) of sand into the Colorado River ecosystem below Glen Canyon Dam. Based on the entire period of record on the Paria River (1923–present), this annual magnitude of sand supply from the river occurs, on average, once in every 10 years. A second important difference is that a 2008 high flow would be followed by normal Record of Decision operations associated with annual release volumes, unlike previous experiments, which were followed by higher fluctuating flows than would have otherwise occurred.

Additionally, this science plan focuses on a wider range of research questions than previous high-flow experiments. For example, experimental study 1 (parts A–D) addresses questions related to sediment and seeks to determine not only if high-flow releases are an effective tool that will rebuild and maintain sandbars over time, but also if they have the ability to create additional backwater habitats for native fish and how new sand deposits affect archaeological sites. Experimental study 1 expands on work begun with the 2004 high flow to document the connection between high-flow releases and the transfer of sand to cultural sites by the wind and the formation and persistence of backwaters as the result of high flows. Additionally, data gathered as a result of a possible 2008 high-flow experiment would provide information to inform the continued development of a sediment model, which will help determine the optimum frequency, timing, duration, and magnitude of future high flows under varying sediment enrichment conditions. Experimental studies 2–5 address the impacts of high-flow experiments on riparian vegetation, the food base, rainbow trout, and Lake Powell water quality, respectively. Study 7 will provide a comprehensive synthesis of the results of all of the experimental studies conducted in association with a possible 2008 high-flow experiment. A well-calibrated, robust predictive sediment model will help minimize the impacts of high-flow tests on Glen Canyon Dam hydropower production.

The experimental studies outlined in this plan are designed to address strategic science questions identified in the Grand Canyon Monitoring and Research Center's monitoring and research plan; strategic science questions are designed to guide science activities over the next 5 years. Questions specific to the impacts of a high-flow flow are also identified for each study and would be addressed during the 2008 high-flow experiment, if it occurs.

The table that accompanies the executive summary briefly describes the various experimental studies and estimated costs. The total cost of the research activities associated with a possible 2008 high flow is approximately $3.73 million for fiscal years 2008–09. Thus, based on current and anticipated deposits into the experimental fund, additional support will be required to fully implement the science plan.

Based on the two previous high-flow experiments conducted to date, scientists cannot say at this time whether such experiments are an effective strategy for stopping the ongoing erosion of sand and sandbars in the Colorado River ecosystem. A long-term research strategy involving further high-flow experimentation and model development will be necessary to assess whether high flows can effectively conserve sediment and help achieve other related resource benefits (increased humpback chub recruitment, enhanced camping beaches, protection of cultural resource, minimized hydropower impacts, etc). At this time, it is not anticipated that a single high-flow release can answer all such relevant questions: accordingly, it is very likely that additional high-flow experiments will be needed to address the major uncertainties associated with the use such dam operations as an effective long-term management tool.

It is expected that a long-term experimental strategy, including the number and future frequency of high-flow experiments, will be determined through the Glen Canyon Dam Adaptive Management Program.

Table E.1. Description of experimental studies proposed by this science plan, including cost estimates for fiscal years (FY) 2008–09.

Experimental study	Description	FY 2008 cost estimate	FY 2009 cost estimate
	Sediment, archaeological sites, and backwaters		
1.A. Sand budgeting	Data will be collected to determine the amount of sediment available in the system and its availability for restoring sandbars and camping beaches, patterns of erosion and deposition, and changes in sediment grain size	$313,212	$94,102
1B. Eddy-sandbar studies	Data will be collected on the evolution of specific eddy sandbars before, during, and after a high flow. These data may be used to improve the predictive capabilities of the existing sediment model and determine the optimal peak flows of future high-flow experiments.	$103,797	$92,057
1.C. Response of sandbars and select cultural site	Data will be gathered to determine (1) if sandbars throughout the Colorado River ecosystem gain or lose sand as the result of a sand-enriched high flow, (2) if new sand can offset gully erosion, and (3) if enlarged sandbars provide source material for the windborne transport of sand upslope into archaeological sites.	$604,180	$360,374
1.D. Backwater habitats	Measure backwater habitats and sample them for fish in spring and fall to evaluate how (a) backwaters formed by a high flow change over time and (b) how fish, particularly humpback chub, use backwaters.	$851,461	$191,275
	Riparian vegetation		
2. Riparian vegetation studies	Study will document changes in riparian vegetation (native versus nonnative) following a high flow to determine if disturbances influence the success rate of nonnative species.	$42,709	$30,738
	Aquatic food base		
3. Food availability	Data will be collected to determine how high-flow experiments affect the quantity and quality of food available to invertebrates and, ultimately, fish.	$216,903	$44,175
	Rainbow trout		
4.A. Redds study	Data will be collected to determine how high-flow experiments affect spawning and survival of early-life stages of rainbow trout in Lees Ferry	$130,371	$100,861
4.B. Movement study	Study will collect data to determine if high-flow experiments displace rainbow trout from Lees Ferry and if displacement varies by fish length	$110,648	$2,057
	Lake Powell		
5. Lake Powell	Data to determine if a high flow results in higher nutrient releases and changes in the hypolimnion	$35,274	$5,022
	Conservation measures		
6. Kanab ambersnail	To minimize impacts to an endangered species, Kanab ambersnail habitat at Vaseys Paradise will be moved	$16,316	$0
	Knowledge synthesis		
7. Synthesis of knowledge	Data and knowledge gained as the result of the high-flows test will be synthesized in an attempt to address strategic science questions	$0	$258,000[1]
	Logistical support		
8. Logistical support	Logistical support costs not associated with specific research activities	$122,673	$0
Totals		**$2,547,543**	**$1,178,660**

[1] An additional $400,000 will be needed in FY 2010 to complete the synthesis of results from a possible 2008 high-flow test with previous high-flow tests