Attachment 3.

Alternative Experimental Flow Regimes in WY 2002-2003 for Consideration by the TWG

Preliminary Draft (March 14, 2002)

Recently, the GCMRC proposed three experimental flow scenarios for implementation in WY 2002-2003. These scenarios are designed to address two issues: sediment conservation and non-native fish control. An alternative flow regime should be considered for sediment conservation immediately following sediment input from tributaries — an alternative which uses either short duration maximum power plant capacity releases (31,500 cfs) or load following. The ad-hoc sediment group recently identified these as priority 1 experiments, i.e., experiments that should be considered immediately in a suite of experimental flows.

There are several reasons to first examine alternatives to employing low steady flows for sediment conservation: (1) the GCMRC experiment, as structured, does not include flows that could increase sediment conservation following significant sediment inputs should they occur in July or August; (2) low steady flows in December would require approval through the Annual Operating Plan (AOP) process; (3) low-steady flows would have significant adverse impacts on power revenues during peak demand months (July, August, and December); (4) potential benefits to non-native fish (and subsequent net disadvantages to native fish) could result from extended periods of steady flows; and (5) current understanding of sediment transport processes below Glen Canyon Dam leaves little doubt that low steady flows would reduce transport of fine sediment downstream and thus limits the amount of learning that would be gained by an experiment of extended low steady flows. We believe that a better experiment would be to test whether sediment can be stored as it comes into the CRE while minimizing impacts to power and operating within the AOP and applicable governing regulations. The alternatives being proposed could be implemented without modification of monthly water volumes and with minimum impact to power revenues.

Rubin et al. (2000) suggested three approaches for restoring or retaining sand resources in the Colorado River Ecosystem below Glen Canyon Dam. Their first recommendation was to provide dam releases above power plant capacity immediately after substantial inputs of fine sediment from tributaries. In response to this recommendation, the ad hoc sediment group stated that "other dam release options exist that might promote potential eddy storage to conserve tributary inputs. Two of these options to be implemented immediately after substantial inputs of fine sediments are: (1) to implement Habitat Maintenance Flows (HMFs), or releases at power plant capacity; and (2) load following releases with fluctuations and magnitude greater than ROD restrictions." We propose that these two sediment storage methods be considered for implementation in WY 2002-2003 either as separate tests or as a combined strategy to maximize sediment conservation. The alternatives specifically focus on the period following sediment inputs in the late summer and fall. Either alternative could be combined with the GCMRC proposal of post-BHBF load following to disadvantage non-native fishes (and subsequently advantage native fishes).

Description of Alternative Experimental Flow Scenarios

1. Short-Duration Maximum Power Plant Capacity Spike Release

Habitat maintenance flows (HMFs) were included as an integral part of operations in the Record of Decision (ROD) for the Glen Canyon EIS. The purposes of HMFs, defined as high steady releases within power plant capacity for a period of 1 to 2 weeks, were to re-form backwaters and maintain sandbars. Since publication of the ROD, HMFs have been used on several occasions (Hazel et al. 2001). These HMFs have had varying degrees of success in performing their intended function depending on timing of the HMF relative to sediment input, amount of sediment input prior to the HMF, and duration of the HMF.

Lessons learned from previous experiments suggest that to increase effectiveness, HMFs should be timed to coincide more closely with inflows from tributaries and be of shorter duration. Closer coordination with tributary inflows would accomplish two objectives. The combined flow of the maximum power plant release and the tributary inflow would increase the stage elevation at which sediment was deposited and make that sediment less vulnerable to erosion from later operational releases. In addition, shortening the time elapsed between sediment inputs and the spike flow would reduce the amount of sediment transported downstream and lost from the system. Reducing the duration of spike flows (one day or less) would allow deposition of sediment at higher elevations while reducing transport downstream. In addition, small-bodied non-native fishes may be placed at a disadvantage by increased turbidity levels during and after these events and temporarily disrupting the relatively stable habitat conditions that favor their reproductive strategy.

The proposed experiment (Figure 1) is to produce one or more short-duration maximum power plant releases that coincide to the extent possible with inputs from tributaries (especially the Paria River, but also potentially the Little Colorado River). The duration of the peak that would be most effective in retaining sediment will vary according to the duration of the tributary inflow, the volume of sediment that accompanies inflow, and the size of sediment particles. One of the intentions of the proposed experimental flow is to develop guidelines for determining effective spike flow durations.

We propose that each tributary inflow event be matched with a short duration maximum power plant release. These spike releases could vary from several hours to a day in duration, but in general, release duration would be a function of duration of peak tributary sediment input. Testing several durations in a single year in response to multiple tributary inflow events, would improve learning. Rapid ramping rates would conserve water, maximize sediment entrainment on the ascending limb of the spike, maximize fine sediment deposition on the descending limb, and minimize downstream sediment transport. Between spike releases, normal ROD flows (i.e., modified low fluctuating flows) would resume. These fluctuations could serve to stabilize new sediment deposits until a BHBF was released in January. The goal of this scenario would be to maintain full sediment storage in eddies and channel margins pending the January BHBF while delivering AOP-mandated water volumes.

Null hypotheses to be tested

- H_o: short duration maximum power plant releases do not conserve sediment inputs from the Paria River in Marble Canyon.
- H_o: there is no relationship between the duration of maximum power plant releases and sediment storage.
- H_o: matching peak tributary input flows with short-duration maximum power plant releases does not increase sediment storage.
- H_o: there is no difference in the sediment storage resulting from short duration 31,500 cfs spike releases and ROD fluctuations.
- H_o: the effectiveness of short duration maximum power plant releases in storing sediment is not dependent on the availability of storage space in eddies.

Note that the above null hypotheses specifically focus on sediment, but other hypotheses could be tested regarding the effect of experimental releases on other resources.

2. Maximum Load Following

Load following was proposed by the ad hoc sediment group as a possible means to conserve sediment and this experimental scenario would test the efficacy of that approach. The stage changes that occur daily when load following have two important components that reduce downstream sediment transport. First, the daily peak transports in-channel sediment and deposits it at higher elevations. Second, under maximum load following, the minimum daily flows are lower than under ROD flows and these lower flows have less capacity to transport sediment downstream. Added benefits would include destabilization of non-native fish habitats and increased turbidity to enhance protective cover for native fishes.

With this alternative experimental flow scenario, a tributary inflow would be followed immediately by load following without ROD restrictions (Figure 2). An appropriate length for the load-following period should be determined before hand, but is not proposed here (Figure 2 shows a two-week period). The most effective length for conserving sediment is likely to be dependent on the amount and characteristics of sediment that is input by tributary events. As with duration of the spike flow of Alternative 1, the length of the load-following period could be tested as part of the experiment.

Null hypotheses to be tested

- H_o: load following does not conserve sediment inputs from the Paria River in Marble Canyon.
- H_o: there is no difference in the sediment storage capability of load following and ROD fluctuations.
- H_o: the length of the load-following period does not affect sediment storage.
- H_o: the effectiveness of load following in storing sediment is not dependent on the availability of storage space in eddies.

Note that as with Alternative 1, the above null hypotheses specifically focus on sediment, but other hypotheses could be tested regarding the effect of experimental releases on other resources.

Figure 1. Proposed Water Year 2002-03 Experimental Flow: Alternative 1

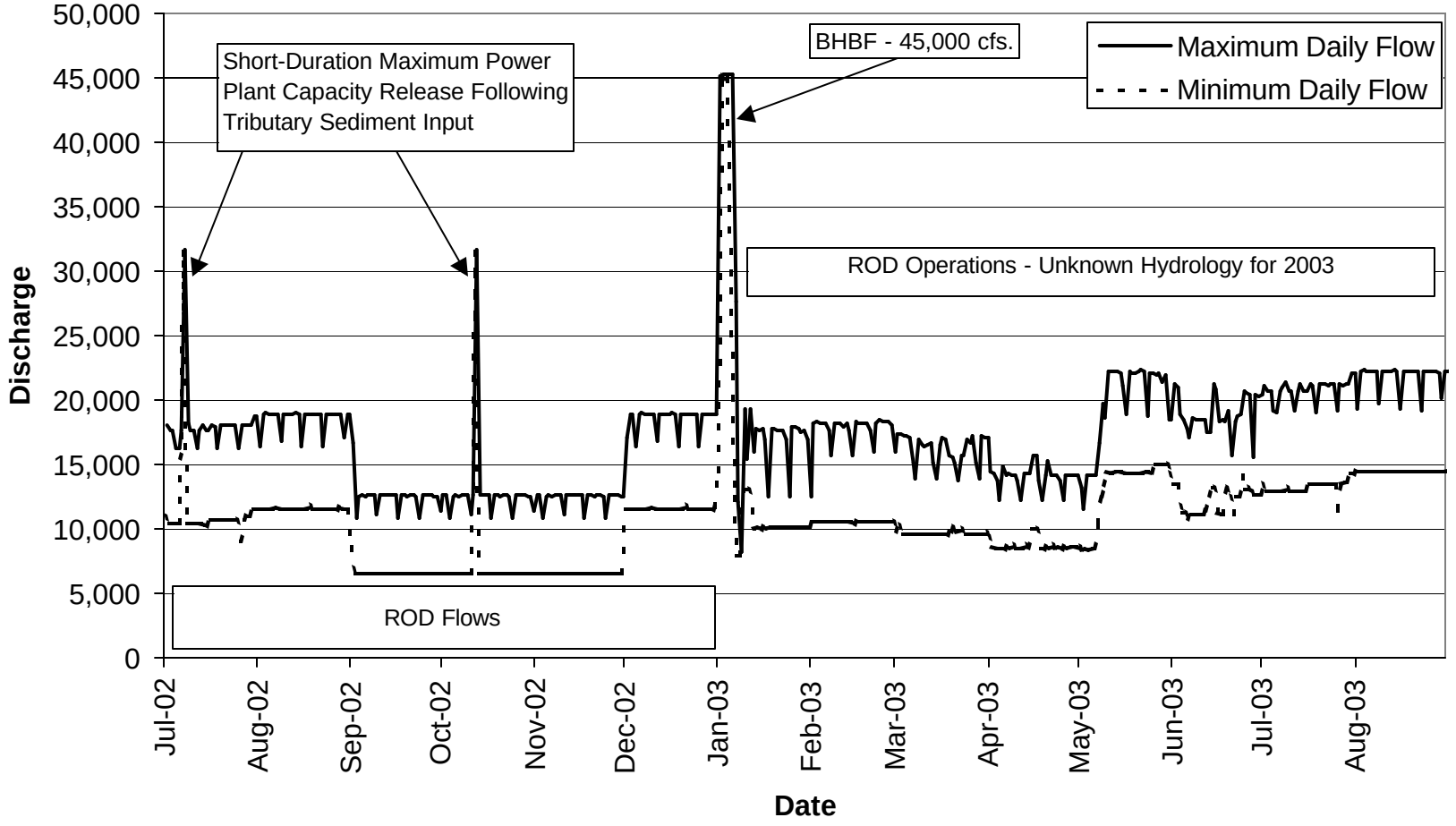

Figure 2. Proposed Water Year 2002-03 Experimental Flow: Alternative 2