Draft Scenarios and Rationale for Experimental Flow Design in WY 2002-2003.

For Consideration by the TWG, February 26-27.

Intended to address the Motion passed at the AMWG Meeting on January 18, 2002 instructing GCMRC, in consultation with the TWG to design experimental flows for WY 2002 – 2003. The full motion states:

Motion: ***In concert with RPA flows for native fish during 2002-2003 request that the GCMRC, in consultation with the TWG, design an experimental flow sequence that tests hypotheses for conservation of sediment. Report to AMWG in April 2002 on the proposed flow sequence.***

Introduction. This document was prepared by GCMRC staff and is intended to serve as the basis for discussion between GCMRC and the TWG in anticipation of agreeing on an experimental flow recommendation for WY 2002 – 2003 that is to be made at the April 2002 AMWG meeting. The WY 2002 – 2003 experimental flow recommendation is intended to have two primary purposes:

1) improve retention of sediment in the CRE, and
2) benefit native fish populations (primarily HBC).

In addition these recommendations consider impacts to other resource areas. The recommendations are consistent with goals of the AMP, especially goals 2 & 8.

[NOTE: A broader set of recommendations for experimental flows that should be tried over the next five to ten-years whether the hydrology is wet or dry is also being developed. The experimental flows being recommended here are consistent with that larger program of flows.]

Specific objectives of the WY 2002 – 2003 experimental flows recommendation include:

A) for sediment
- ♦ decrease downstream export of tributary input sediment from Marble Canyon
- ♦ increase retention of sediment stored in channel through BHBF or HMF's

B) for native fish
   - ♦ improve survival and recruitment of HBC by reducing competition and predation from non-native fish (primarily rainbow trout)[1]
   - ♦ improve and maintain habitat for young native fish

WY 2002 – 2003 Hydrology Assumption: These experimental flow recommendations assume that WY 2002 and perhaps WY 2003 will be relatively low runoff years with low antecedent reservoir storage in Lake Powell. Thus **these recommendations are based on an 8.23 maf water year scenario**. As noted above, GCMRC is also developing, with the experimental flows ad hoc group, a longer term set of flow recommendations in view of the need for repeated and long term experimentation as part of adaptive management and in recognition that basin hydrology over the long term will be variable.

Working Hypotheses:

- ♦ **Sediment-** Monitoring data indicate that tributary inputs of sand do not accumulate within the river channel over multi-year periods as predicted by the final EIS, and that such inputs are transported out of the CRE at a relatively fast rate under most ROD operations. On the basis of results from the summer 2000 flow experiment, as well as historical sediment-transport data, new inputs of sand should be retained more effectively within main channel storage sites during extended periods of dam releases at or below about 10,000 cfs. If such operations promote retention of sand (and finer sediment as well), then implementation of a Beach/Habitat-Building Flow following such periods should greatly increase the effectiveness of such controlled floods in restoring and maintaining terrestrial sand bars and related resources. More efficient retention of fine sediment and silt prior to controlled floods shall result in more rapid rates of sand bar deposition, as well as sand bars with finer grain-size distributions. Finer-textured sand bars may be less prone to rapid erosion following bar building. Enhanced conservation of tributary sediment inputs in the channel should result in elevated suspended-sediment concentrations during BHBF's, leading to rapid depositional rates during sand-bar building. Elevated rates of sand-bar deposition should reduce the required duration for BHBF's, and hence will limit spill volumes.

- ♦ **Native Fish**-The LCR population of HBC has not demonstrated a positive response to the mainstem flow regimes under ROD operations. Sediment loss has continued in the CRE under ROD operations as described above. Within the ROD, there is a need to implement experimental flows, which may conserve sediment and improve survival and recruitment of HBC. The LCR population of HBC is comprised of fish resident in the LCR and in the mainstem near the LCR confluence. Therefore flows, which affect changes in

[1] It is anticipated that reducing the population numbers of RBT will increase the average size of fish in the Glen Canyon reach and may lead to improvement in the overall quality of the Lees Ferry trout fishery.

HBC status in the mainstem, may positively influence the overall LCR/HBC population.

Initial flow experiments to modify habitat have not shown a strong response in increased HBC abundance. This could be due to a number of factors including both the power of the experiment, the ability of monitoring programs to detect a change, and the short time since the most recent experiment (LSSF) has been conducted. Another possibility is that non-native and native fish interactions (i.e., predation and competition) are over-riding any potential positive effects from flows that improve habitat conditions. The experimental flows described here are intended to test this possibility and produce a measurable affect on non-native fish and hence on non-native and native fish interactions. The hope is that this will result in a positive effect on HBC and lead to the designing of experimental flows or other management actions that also can improve habitat for native fish, including HBC that will address Goal 2 of the AMP strategic plan.

Scenarios: –We assume the antecedent and contemporary conditions for experiments conducted in WY 2002-2003 will be so called 8.23maf or at best average inflow years, thus allowing GCD operations to achieve constant Low-Flows in fall 2002 or load following flows below 10,000 cfs, and perhaps in subsequent seasons. GCMRC is recommending three versions of experimental flows for late in WY 2002 and during WY 2003. Each is described briefly below and a figure depicting a hydrograph for the particular flow is provided. While these hydrographs show specific daily flow levels, they are intended to be **conceptual hydrographs** whose precise nature (specific floors and ceilings, up-ramp and down-ram rates, and durations) will need to be determined.

A) **Figure 1.** This scenario provides for a set of experimental flows aimed at conserving sediment only. From October 2001 through June 2002 the dam follows normal ROD operations. **Following Sediment Inputs** in the July - October 2002 period the dam is operated at a constant 8,000 cfs following sediment inputs (or perhaps a low level, e.g. 5-9,000 cfs ROD flow) until January 2003. In January 2003 a BHBF of limited duration is conducted. Later winter, spring and summer 2003 operations would follow monthly volumes under the ROD. This hydrograph could be repeated in WY2003-04.

The BHBF to be released in January 2003 should have a magnitude of at least 10,000 cfs above peak powerplant discharge, or higher depending on lake elevation. **A year with significant sediment inputs would be defined as an instantaneous discharge of 2,000 cfs or greater from the Paria River or an instantaneous discharge of 10,000 cfs or greater from the LCR during the period August 1-October 31.**

B) **Figure 2.** This scenario provides for experimental flows aimed at **both** conserving sediment and benefiting native fishes. From October 2001 through June 2002 the dam follows normal ROD operations. **Following Sediment**

Inputs in the July - October 2002 period the dam is operated at a constant 8,000 cfs following sediment inputs (or perhaps a low level, e.g. 5-9,000 cfs ROD flow) until January 2003. In January 2003 a BHBF of limited duration is conducted. This is followed by experimental (non MLFF) Load-Following flows for the duration of the non-native spawning and emergent/juvenile season (perhaps several months). Spring and summer 2003 operations would follow monthly volumes under the ROD. This hydrograph could be repeated in WY2003-04.

The BHBF to be released in January 2003 should have a magnitude of at least 10,000 cfs above peak powerplant discharge, or higher depending on lake elevation. **A year with significant sediment inputs would be defined as an instantaneous discharge of 2,000 cfs or greater from the Paria River or an instantaneous discharge of 10,000 cfs or greater from the LCR during the period August 1-October 31.**

C). **Figure 3.** This scenario represents a year when there are no significant monsoonal sediment inputs but there are **sediment inflows in winter.** It also includes flows intended to benefit native fishes. If there are No Sediment Inputs in the July through October period the dam would be operated under normal ROD operations until December 2002. Beginning in January 2003 experimental (non MLFF) Load-Following for duration of non-native spawning and emergent/juvenile season (perhaps several months) would be implemented. Spring and summer operations would follow monthly volumes under the ROD. Under this condition, a BHBF would occur if significant sand inputs occurred during the winter/spring runoff period (e.g. LCR in Jan.-Feb. 1993). If sand inputs occur in winter/spring, then a BHBF would be released as soon as possible and in the same month that the sediment input(s) occur. The BHBF would have a magnitude of at least 10,000 cfs above peak powerplant discharge, or higher depending on lake elevation.

Hydrograph segment rationale

- The reduced-flow period (10,000 cfs or less) in August-December - is intended to provide some benefit to native juvenile fish, and conserve sediment in the main channel when significant tributary sediment supplies are introduced to the ecosystem. The potential advantage to native fish habitat would likely be marginal, and not accrue until year two under these recommendations. **H1**: Reduced-flows following sediment inputs reduce downstream transport while turbidity levels are elevated, such conditions provide some additional predator avoidance benefit to YOY native fishes. **H2**: Reduced flows in the August-October period do not decrease juvenile HBC mortality in the main channel of the Colorado River. **H3**: Reduced flows following sediment input does not conserve fine-sediment in the main channel.

- January BHBF, following Sediment Inputs and Reduced Flows - is intended to mobilize channel-stored fine sediment from the river bed and re-deposit them as sand bars along shorelines under optimal conditions of high suspended-sediment concentrations and grain sizes approximating natural bar textures. **H4**: The January BHBF does not result in sand-bar deposition that is equal to the response measured in April 1996 (sand bar area and volume above the 25,000 cfs stage). **H5**: The January BHBF results in a more rapid depletion of the ecosystem's fine-sediment supply then was measured during the 1996 BHBF (2-3 days). **H6**: The grain-size distribution of sand bars deposited during the January BHBF is not as fine as grain-size distributions measured from sand bars deposited during the 1996 BHBF.

- Experimental (Winter) Load-Following – this element of the hydrograph is mainly intended to disadvantage non-native fish recruitment in the main channel, thereby achieving the most effective long-term control on predation/competition through reduced population size. This reduction in population size in non-native fish would result from a combination of spawning disruption and creating unfavorable conditions for survival of young non-native fish. Winter Load-Following, similar to operations that occurred under "No-Action" era would provide the greatest disadvantage to non-native fish, and might be most effective at reducing the non-native fish populations by causing lower recruitment over several years of implementation. This may actually improve the quality of the Lees Ferry trout fishery. Over the course of multiple years, reduction of RBT and BNT abundance is intended to result in increased HBC recruitment. **H7**: Winter load following does not reduce recruitment of RBT and BNT in Grand Canyon. **H8**: Winter load following does not increase export of ecosystem sand. **H9**: Winter load following does not produce eddy-bar morphologies that are more conducive to recreational and other ecosystem uses. **H10**: Winter load following will not adversely impact food base resources. Only the lower limit of the diurnal range would be constrained for purpose of limiting detrimental impact to phyto-benthos resources. **H11**: HBC recruitment is not limited by RBT or BNT predation.

Figure 1. Proposed Water Year 2002-03 Experimental Flow *with* Sediment Input

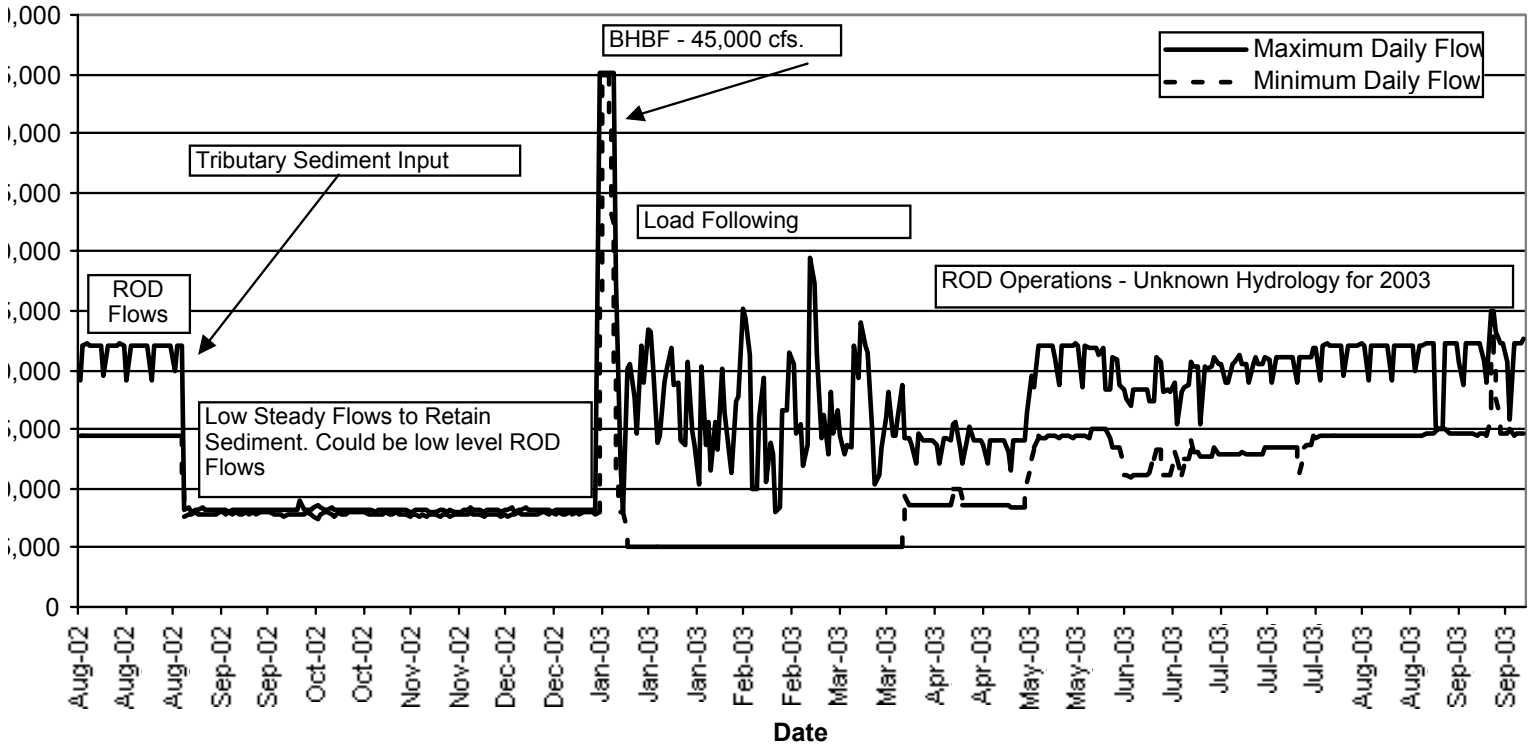

Figure 2. Proposed Water Year 2002-03 Experimental Flow *with* Sediment Input

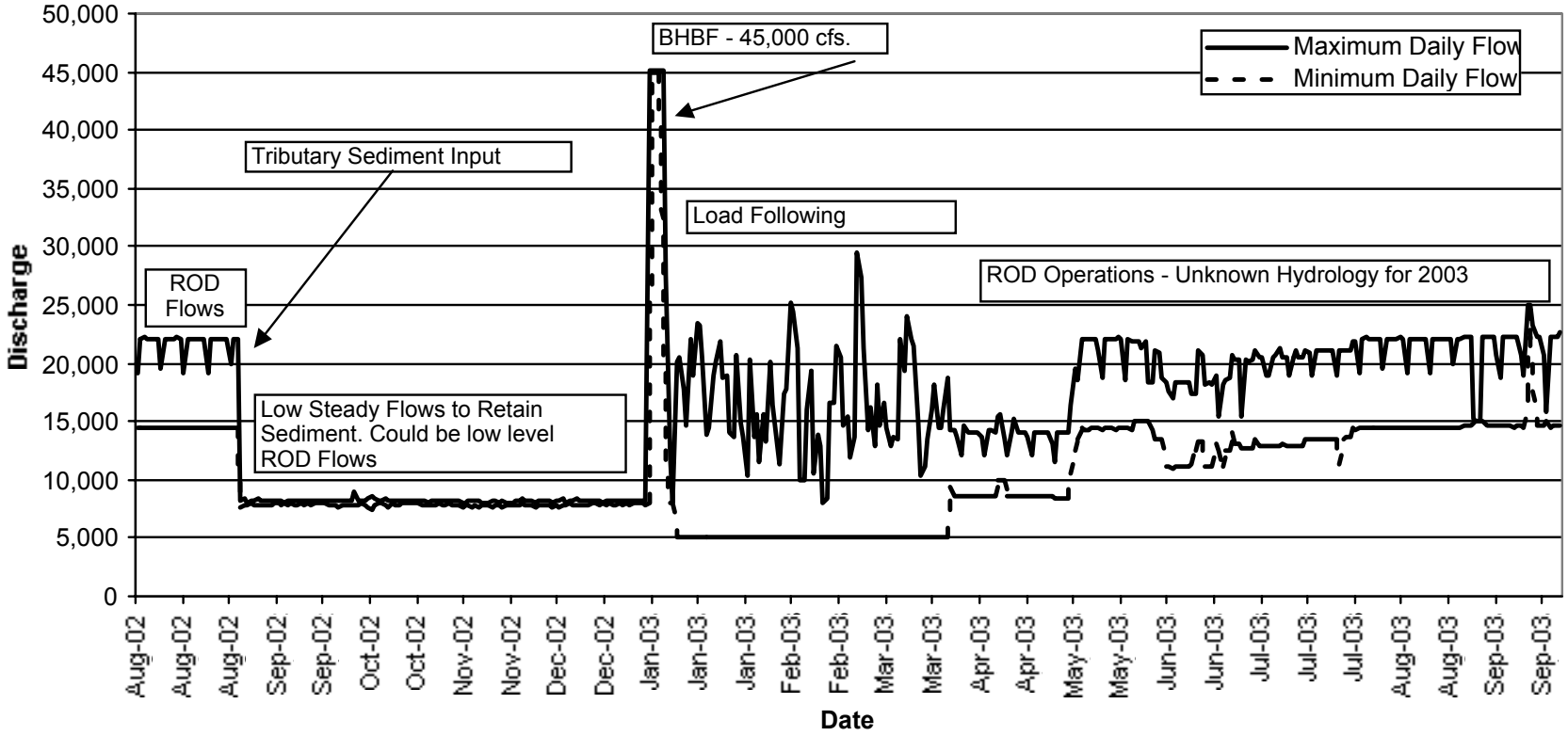

Figure 3. Proposed Water Year 2002-03 Experimental Flow *with* Winter/Spring Sediment Input

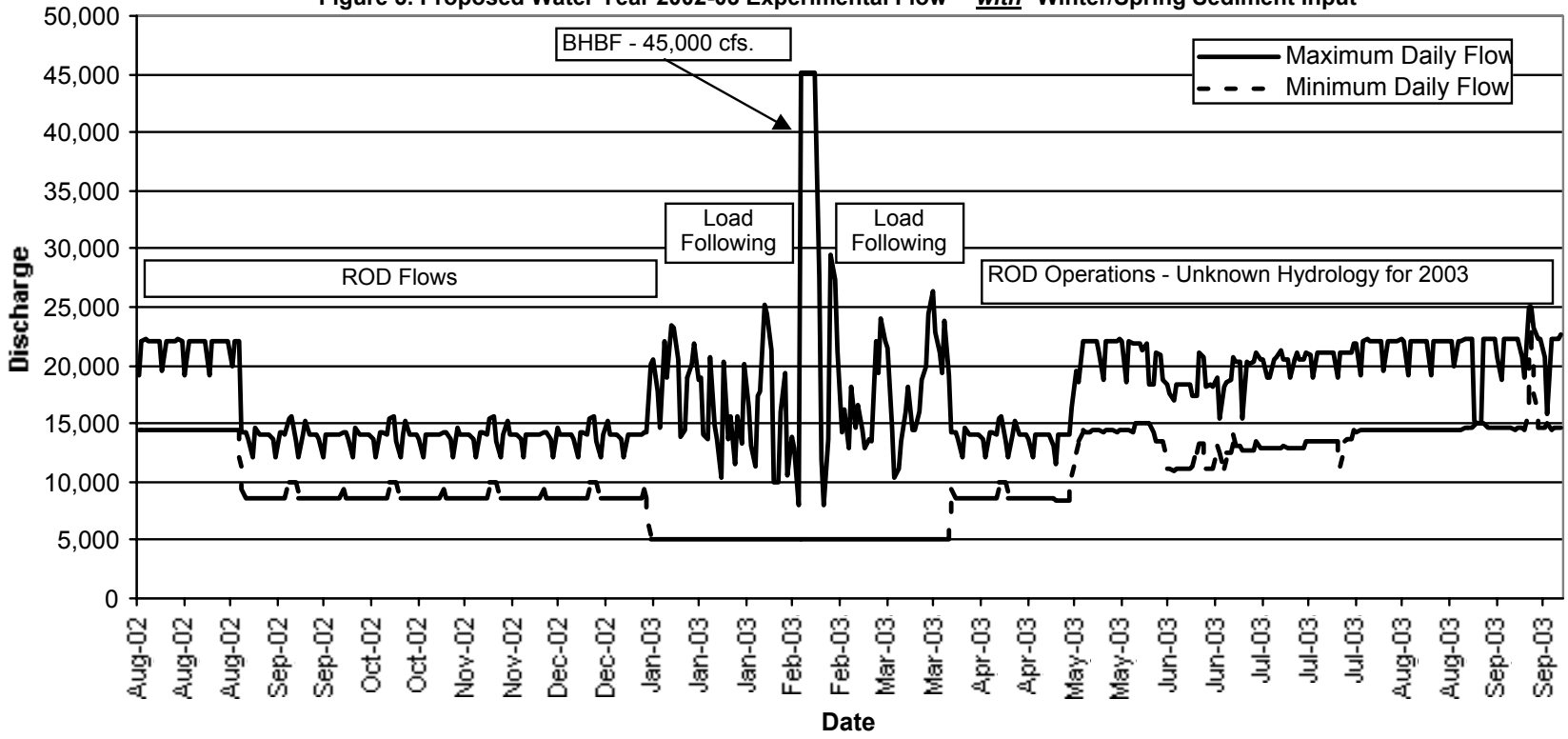

Table 1. Plausible causes of HBC decline and likelihood that the proposed experimental flow load-following scenarios would have no impact (0), possible impact (+), or probable impact (++).

Flow Scenarios Habitat limitations (1-6) Biological interactions (7-11)	Dry year, low storage, Sediment Inputs	Dry year, low storage, NO sediment	Wet year, high storage Sediment Inputs	Wet year, high storage NO Sediment
1. Water too cold for spawning	0	0	0	0
2. Water too cold for juvenile (70-150mm) growth	0	0	0	0
3. Foodbase limitation	?	?	?	?
4. Near shore stable habitat loss	+	?	?	?
5. LCR confluence habitat loss	?	?	?	?
6. Reduction in turbidity increasing predation/competition	+	0	?	0
7. Predation from RBT &BNT in mainstem (HBC<150mm)	++	++	++	++
8. Parasites & disease	0	0	0	0
9. Competition for habitat or food	+	+	+	+
10. Predation by Non-natives in LCR	0	0	0	0
11. Intraspecific predation	0	0	0	0