

DFC Ad Hoc Group Progress Report and Recommendation on Technical Adequacy of  
the GCMRC BHBF Science Plan  
September 27, 2007

Charge to the Desired Future Conditions (DFC) Ad Hoc Group of the AMP-Technical Working Group (TWG):

Technical options for resource target levels should consider **what would be desired over the long term and identify what may be achievable within the next 10 years to correspond to the potential duration of the Long Term Experimental Plan (LTEP)**. As these targets are considered, we would encourage that an ecosystem perspective be utilized as individual targets are discussed, while recognizing that dam capabilities and hydrology may limit actions to achieve these targets. **The TWG should consider targets for each of the strategic plan management objectives but should initially concentrate on the two main resources of focus in the LTEP, i.e., humpback chub and sediment conservation.** Ideally, options for these targets should be:

- Easily understandable
- Measurable
- Geographically specific
- Feasible both financially and scientifically
- Written at a level of detail consistent with current knowledge
- Compatible with the AMP goals and management objectives

Maps, photos, graphs, or other materials that would **assist the AMWG in understanding the technical aspects of the target levels should be included.** In addition, **the TWG should assess such things as the potential effects of such target levels (including effects on other resources).**

Reclamation updated the AMWG and TWG on the benefits of defining these targets to assist in the development of the LTEP EIS. Accordingly, after discussion within DOI, **Reclamation would like to request that the TWG dedicate sufficient effort to develop a set of technical options for these desired resource condition targets, and present its approaches on these targets for consideration by the full AMWG by December 2007.**

AMWG Priority Goals of 2003:

**AMWG Priority 1: Why are the humpback chub not thriving, and what can we do about it? How many humpback chub are there and how are they doing? (GCDAMP Goal 2)**

AMWG Priority 2: Which cultural resources, including Traditional Cultural Properties (TCP), are within the Area of Potential Effect, which should we treat, and how do we best protect them? What is the status and trends of cultural resources and what are the agents of deterioration? (GCDAMP Goal 11).

AMWG Priority 3: What is the best flow regime? (GCDAMP Goals 1-11)

**AMWG Priority 4: What is the impact of sediment loss and what should we do about it? (GCDAMP Goal 8)**

**AMWG Priority 5:** What will happen when we test or implement the Temperature Control Device (TCD)? How should it be operated? Are safeguards needed for management? (GCDAMP Goals 1-4 and 7-10)

**DFC Ad hoc Process and Task Schedule:**

**By August 22, 2007,** Review the draft DFC document and provide comments to ad hoc chair:

- The ad hoc is to review the attached draft document for format and accuracy; and
- Review the proposed NPS supplied DFC's and develop the short/long-term target actions to accomplish/satisfy the DFC (e.g. using the AMP goals (2003 AMWG priority goals), science questions, AMP Management Objectives (MOs) etc.);
- Respond back to ad hoc chair with acceptance as is, or offer modifications to, or submit alternative DFC's or actions that meet the BOR charge to the group.

**By August 30, 2007 -** Review the GCMRC BHBF Science Plan for technical adequacy as an off-the-shelf plan by which a BHBF could be implemented if approved by AMWG;

- Provide a recommendation to ad hoc chair (e.g. move for TWG acceptance in October for the January AMWG meeting; Not recommend approval (with reasons why not); return to GCMRC for revisions before a TWG decision can be made.

**By September 14, 2007 –** Ad hoc chair to consolidate group comments and recommendations on DFC's and BHBF Science Plan, and provide consolidated version and Science plan recommendation to the ad hoc group by the week of September 10.

**By September 28, 2007 –** Ad hoc group to discuss comments and recommendations and come to consensus on each topic, or prepare list of needs and requirements on each topic (DFC's, targets, and BHBF science plan) and recommendation to TWG at October 2-3 TWG meeting.

**By September 28, 2007 –** Prepare progress report and recommendations and submit to TWG Chair for use at October TWG meeting (as possible to accompany mailing of TWG meeting materials).

**October 2-3, 2007 -** Present ad hoc progress to TWG members.

**Week of November 13, 2007 –** Conduct facilitated workshop on DFC's and targets for CRE resources (2-day workshop).

**By December 21, 2007 –** Provide TWG approved DFC list, CRE resource targets, and BHBF recommendation(s) to BOR for use at winter (January?) AMWG meeting.

**Ad Hoc Report Development:**

An initial draft of the DFC list and targets ad hoc report is attached at Appendix A. This report begins the process to address the charge:

**“what would be desired over the long term and identify what may be achievable within the next 10 years to correspond to the potential duration of the LTEP.”**

Within this report, the National Park Service has provided DFC's for park resources within the CRE that are tied to the AMP priority management goals. The DFC's and AMP goals are key components of the LTEP, EIS process that is to provide resource target levels for analysis in the LTEP. A secondary role for this report is to use the same DFC's, from the LTEP process, to update and complete the desired future conditions portion of the AMP Strategic Plan. As you recall that part of the larger strategic plan has not been finalized by the AMP program.

Both long-term and short-term CRE resource targets are being developed for each of the DFC's as required of the TWG ad hoc. The charge to the group is:

**“The TWG should consider targets for each of the strategic plan management objectives but should initially concentrate on the two main resources of focus in the LTEP, i.e., humpback chub and sediment conservation.”**

The DFC ad hoc group is providing examples for the sediment and Humpback chub resources as charged. The two priority resources are addressed in the following AMP goal(s):

**AMP Goal 1:** Maintain or attain viable populations of existing native fish, remove jeopardy for humpback chub and razorback sucker, and prevent adverse modification to their critical habitats; and

**AMP Goal 6:** Maintain or attain levels of sediment storage within the main channel and along shorelines to achieve GCDAMP ecosystem goals.

The ad hoc group is providing the discussion comments on the initial list of DFC's, and the process the ad hoc group is taking to address the Bureau of Reclamation task of the AMP-TWG. The entire list of DFC's is presented below, in Appendix A, however this ad hoc has prioritized its initial efforts to just the Humpback chub and sediment resource conditions. The ad hoc group is not in full agreement with, nor taken any definitive position on policy, or the background material presented in this report, including Appendix A.

What the ad hoc group has done is prioritized their initial efforts to just two resource conditions and agreed to work towards a recommendation to the TWG on the use of the BHBF Science Plan and the list of DFC's in the near term. The remaining DFC's that are to be used for revisions to the AMP Strategic Plan and LTEP EIS process, will be addressed in future ad hoc group efforts, culminating in a 2-day workshop set for November 6-7, 2007. The goal of the DFC workshop is to compile a list of accepted DFC's, to construct the associated parameters and/or metrics to be used to define a DFC, and to finalize the ad hoc group progress report for presentation to TWG at the next winter TWG meeting.

## Group Discussions and Comments on the proposed list of DFC's:

- I **strongly** disagree with the DFC's for both HBC and sediment. I haven't reviewed where you're at with the others.
- I do not agree with basing the DFCs on the invalidated 2002 Recovery Goals. The 2100 adults number is completely bogus, and is one of the main reasons why we were sued. The recovery goals are currently being revised.
- Secondly, I'm uncomfortable with the qualitative measures (e.g., "consider refugia"). Although I'm willing to consider lots of things, the DFCs should be quantified so we don't feed the endless debates.
- Finally, I'm still very uncomfortable with this being an AMP product. From my perspective, DFCs are an NPS responsibility, not something open to being watered down in the AMP. It seems that NPS needs to insure that any DFCs are consistent with park resources and values.
- I'm not at all convinced that the DFC process as I understand it makes sense, at least right now. I feel strongly that any quantification of DFC should be aligned with the perspective of the 2006 Management Policies and the management plans for the parks.
- As I understand the policies, DFCs should represent the closest approximation of natural patterns and processes that is possible (given the presence of Glen Canyon Dam and other human impacts (e.g., introduction of non-native species)), or a "substantially restored ecosystem" in Schmidt's classification.
- For this ad hoc, we simply don't have the information to quantify NPS DFCs in a legally and scientifically defensible way. I would be strongly opposed to developing "incremental" DFCs that a majority of the AMP could agree with, as they would not be legally and scientifically defensible, and they would become the NPS DFCs in the conventional wisdom of the AMP.
- Although DFC quantification may not be possible, we do know enough about the system that the DFCs can not represent: a negative mass balance of sediment; restriction of spawning and rearing of humpback to the LCR; or accelerated erosion of those archaeological sites that were protected pre-dam with aeolian sediment.
- Instead, the NPS DFCs need to represent:
  - a positive mass balance of sediment up to the level that is achievable given the restricted sediment inputs possible and creative use of BHBFs.
  - an expansion of the abundance and distribution of humpback chub and other native fish by achieving spawning and rearing into the mainstem. I understand that some disagree with the merits of at least spawning in the mainstem, however, I believe that the literature, the best professional judgment of fish biologists, and the precautionary principal, all point in this direction.
  - the in-situ protection of archaeological sites by providing high and dry sediment for aeolian transport.
- Given the above, I believe that the LTEP does not need contrived incremental DFCs. Instead, I believe it simply needs to focus experimentation mainly on how to:
  - attain a positive mass balance of sediment (including providing chub habitat, and high and dry sediment for aeolian transport); and
  - attain chub spawning and rearing in the mainstem.
- Once this information is in hand, then NPS will likely be able to craft legally and scientifically credible DFCs. (RJ)
- My notes and recollection of the 8/15/07 call indicate that the ad hoc would initially only address the DFC's for sediment and HBC, not the whole package of DFC proposed by NPS.

- You would draft short term DFC for two (resources) objectives only, and send back to ad hoc for review.
- You would work from the NPS drafts for these two items and also the draft HBC DFC prepared by WAPA for the HBC. These two items would then be discussed by the ad hoc to see if any agreement could be reached.
- This direction is somewhat different from what your notes indicate. I don't recall there was any agreement on proceeding with the entire package of NPS draft DFCs.

Re your draft DFC:

- In general, I and the stakeholders I represent cannot agree at all with the broad scope of DFCs as drafted. In particular we do not agree that the body of law under which the AMP was undertaken gives NPS the sole responsibility/authority to prepare DFC for the TWG, the AMWG nor the AMP program in total.
- The AMP is intended to be a collaborative process among all stake holders, that is why the DFC ad hoc was created.
- If the TWG ad hoc DFC group is to make any progress and reach any kind of agreed upon recommendation to TWG and AMWG we must do it as a group, and as agreed to already, it must be done in increments, starting with DFCs for HBC and Sediment only.
- Based on the above, I cannot accept, and think there is no point in any further discussion at this time of any part of the draft sent out on Aug 17 until the ad hoc group has reached some agreement on these issues.
- We will then prepare comments to you on those parts of your draft that deal directly with the HBC and Sediment DFCs. (CB).
- The format (report) looks OK to me.
- The DFCs sent you by WAPA are pretty much in line with our thinking. Using his draft as a base we suggest the following additions - to short term goals:
  - add a 4. "Threats to the LCR population from hazardous material spills that could result in catastrophic loss of population are significantly reduced or eliminated" and 5. "Other priority projects listed within the HBC Comprehensive Plan are implemented."
- For Short Term Sediment DFCs we suggest adding to your draft:
  - Establish sediment deposits that are sustainable with periodic Paria inflows and current dam operations.
  - We suggest deleting the reference 1983-1985 post flood levels as these were attained using sediment deposited before dam closure.
  - We question if there is science to support the Aeolian transport of sediment to protect cultural sites.
- For Long Term Sediment DFC's we agree with the WAPA draft (CB).
- One concern I have is that, while science is recognized as part of the AMP, the DFC's as presently written do not promote the use of science directly (there is no mention of science in the DFC's themselves).
- Given the importance of science in the Antiquities Act, which underpins the 1916 Organic Act and subsequent enabling legislation for Grand Canyon National Park and Glen Canyon National Recreation Area, I recommend that reference to the use of appropriate scientific methods be emphasized throughout the DFC's. Presumably, it will be at least in part that science will be used for interpretation of inventory and monitoring data, and that decision-making will have to be at least informed by scientific information. (LS)
- We understand that in an effort to move this group along you added quite a bit of text on various resource goals and AMP policy to this document. This information could be very useful in a final

product, but we feel goes beyond what was discussed on our most recent call and complicates our task at hand.

- Therefore, WAPA has taken the liberty of editing your draft to provide an example of the direction WAPA would like to take. Our intention is to focus our efforts on the primary goals of this group \* HBC and sediment targets for the LTEP.
- We kept the details in from your draft that relates to resource targets for short-term and long term goals. Items that are in [ ] indicate a choice or potential target(s) and are just examples or areas that we need to debate and come up with appropriate values (we tried to provide some examples of choices, these do not necessarily represent our choice but provide a context to begin discussion).
- We tried to use this approach to show some areas we may have agreement and highlight areas we may need to focus on as group. (SC/MB)

(Note: This example is included in the List of DFC's, Appendix A)

### **Task:**

The final task requested from the DFC ad hoc group was to **provide a recommendation on the technical adequacy of the BHBF Science Plan** for the TWG October meeting. The draft ad hoc group science plan recommendation is located at the end of this section, and is provided to TWG for discussion and acceptance.

### **Ad Hoc Group Discussion and Recommendation on the technical adequacy of the BHBF Science Plan:**

- The ad hoc Chair asked several questions. Recognizing that there are several policy/non-technical issues which must be addressed by AMWG and the Department, here are our initial responses to your questions:
- Is the plan technically acceptable as is for an off-the-shelf planning tool?
  - No. We lack targets (Management Objectives) by which to judge a hypothesis' success or failure.
  - We lack understanding of how this experiment is nested within a larger LTEP. In fact, if we insist on this BHBF being adequate to be used as an off-the-shelf planning tool, then it would have to be as detailed as we expect the future LTEP.
- Does it contain all the steps and associated cost that the AMWG charge was seeking?
  - No. See above. Also, spilling and bypassing hydro to preserve sand in the upper ½ of Marble Canyon has not been adequately justified.
- Are all the resources targeted for study adequately addressed and a process clarified as to what study (studies) is/are to be conducted?
  - No. Some examples include: Impacts to hydro are not addressed. Negative impacts to socio-cultural resources are not addressed. A trade-off analysis has not been done. We have not seen how the revised BHBF Science Plan addresses concerns about additional biological sampling to deal with serious limitations to interpretations of fish monitoring data.
- Do you agree with the plan direction and layout from a science or technical perspective?
  - No. See response to above questions. Also, it appears the justification for doing a BHBF followed by steady flows is that "theory and monitoring data have shown that fluctuating flows transport more sand than equivalent-volume steady flows" (pg. 5, Paragraph 2 of revised BHBF).
  - Therefore, it appears the trade-offs being considered by conducting this test are more sand beaches in exchange for lowered hydropower production. This trade-off analysis should be done to ascertain whether this should be a goal of this program, regardless of its technical feasibility.

- If not, what changes are you supplying/providing to have the plan meet your concept/acceptance criteria? Please explain how you think it does/does not meet the AMWG charge.
  - We provided comments on the May 14, 2007 version that pointed out what we thought were deficiencies. The responses to these comments and the revised BHBF Science Plan have attempted to resolve these deficiencies but some concerns remain. In addition to the technical issues there are several policy issues that have yet to be resolved and we are committed to working through that process as outlined at the AMWG meeting".
  - In addition, regarding studies of HBC, GCMRC appears aware of the limitations of monitoring effects of a BHBF on HBC and has offered some good ideas on how to approach the problems in general. One idea not explored is use of surrogate native fish and ones that are not listed to track effects of a BHBF on distribution and habitat use. Rationale for this approach is as follows: There is some thought that native fish are better adapted to withstanding high flows than are nonnative fish. Young HBC is the life stage of greatest concern during high flows but are too rare for a good statistical test of this hypothesis. Sonic tagging of similar sized and more abundant native speckled dace could enable GCMRC to learn what happens to native fish during a flood event. Extrapolating data from abundantly tagged speckled dace to HBC may be less a stretch than attempting to extrapolate data from a few sonic tagged HBC to the entire population.
  - We have heard from AZ Game and Fish comments (53) on the May version of the BHBF, and feel they are quite insightful about the value of backwater fish sampling. In looking at the proposed study (Appendix C of the latest BHBF Science Plan), there does not appear to be any recognition of the limits Bill Persons raised. Of what value is a measure of a backwater environment or fish presence if the AMWG is simultaneously recommending MLFF following a BHBF? We see the strong likelihood that backwater environments will be highly variable and fish presence values unreliable. Therefore, given that MLFF is the likely flow scenario, we suggest a study plan be developed that considers how to assess impacts to fish from the conditions we are most likely to encounter rather than a steady flow scenario which is an unacceptable flow (CB).
- The technical aspects of the plan are good, including how the plan is to be scheduled and conducted;
- Format and layout of the plan could use some small revisions, especially moving key components of the BHBF Science Plan (e.g. logistics, scheduling, permit needs, etc..) to the front portions (section 2 or Section 3) of the plan, ahead of the ancillary projects associated with a BHBF test.
- It would be helpful to see a prioritized approach to the most important river studies.
- Not selectively prioritizing key studies for this science plan, and putting forth numerous ancillary projects makes it difficult to follow.
- We suggest that GCMRC consider "linking" proposed projects to the overriding or "key" sediment questions to be addressed by the BHBF test.
- Please consider refining the final product/results time schedules to show how the LTEP process will likely influence these ancillary studies.
- There are no "completion time tables" for the key tasks (or questions) as currently written in the "Products and Reports" section. Setting a schedule for showing results from the BHBF will be most helpful for the ancillary projects listed.
- Given the current drought conditions (past 5 years) and projected BOR drought and climate/hydrologic conditions, what changes in dam operations (flows) can be expected and how will this affect sediment inputs and BHBF tests?
- It would be nice to have a proposed ending date for the initial sediment side of the study, within an expected timeframe (6-12 months of test). Test studies would need to be focused on the overriding questions the BHBF is to address. For example:

- What are the best flows to condition the river, distribute, and conserve the sediment resource for ecosystem function?
- Is there enough sediment coming into the mainstem, from the Paria and LCR, to adequately maintain, enhance and improve sediment dependent resources and recreation activities?
- Can park management objectives for the CRE (e.g. DFC's) be accomplished given current sediment loads and frequency of sediment inputs?
- What are the possible management actions necessary to protect and enhance camping beaches, near shore habitat, and native fish backwater habitat development in the mainstem?
- What is the role and frequency of sediment inputs and seasonal flow patterns for native fish habitat development?
- We agree that the BHBF test(s) is necessary sediment driven activity that should consider offering a suite of studies. However, we feel that GCMRC, in this BHBF science plan, has/has not:
  - Prioritized studies that emphasize the sediment questions,
  - Prioritized the questions to be answered by LTEP driven experiments or Core monitoring efforts that are currently underway or planned for FY2008,
  - Looked at food base, cultural resource protection, and riparian biological responses as equally important resources to land managers, it would be helpful if a BHBF test would look at how sediment deposition is utilized in the system as the highest priority.
  - Considered studies that depend on sediment deposition as longer-term studies that may take 4 years or more to begin to get answers as to how the BHBF affects that target resource.
  - Some of these longer term and non-sediment linked BHBF test studies may be better addressed after the LTEP is completed, or research experiments and Core monitoring efforts are implemented and should not be added to the BHBF near-term costs.
- Prioritize the BHBF Plan to just a few key or "most important" questions thereby reducing the costs to the AMP program when implementing the science plan.
- Can GCMRC provide the TWG with a "stripped down" budget that is more in line with the 2004 BHBF project and cost structure? This revised budget may be more palatable to TWG/AMWG if focused more on prioritized questions/needs.
- The TWG, with AMWG support, should give guidance on the priority studies for the BHBF science plan. By advising GCMRC to develop a "standardized" plan, overall costs could be reduced and the funding discussed during the budget development for the 2009 year, and beyond.
- Adjustments to the "standard costs" for a BHBF could be addressed in the bi-annual discussions of the Budget Ad Hoc Group.
- Are the projected costs to the AMP program to conduct a BHBF "press only" river trip really necessary? With the ever increasing USGS "burden rate" applied to each project, and other rising costs in the program, this seems to be an unnecessary expenditure. Could the AMP public outreach group handle the press and public information aspect of the BHBF test instead?(KM)

**Proposed DFC ad hoc Recommendation on the BHBF Science Plan:**

The DFC ad hoc provides to TWG the following recommendation on the technical adequacy of the BHBF Science plan, and provides a means to correct the plan for use in the 2008 water year:



**DFC AD Hoc Recommends:** To not accept the plan as presented, but with slight modifications of the plan as listed below, the ad hoc recommends the plan to be technically sufficient for use in planning a BHBF test for 2008.

**Recommended modifications to the plan include:**

1. Limit the BHBF test studies to answer short-term **sediment focused** resource questions like:
  - With sediment conservation and use can enriched conditions successfully build target beach and near shore and backwater habitat?
  - Does the sediment trigger volume provide enough sediment into the river to create needed camping beach and habitat restoration, and meet longer-term maintenance requirements?
  - Does the BHBF successfully develop the near shore and backwater habitat?
2. What are the flows necessary to accomplish successful beach, shoreline, etc. restoration to DFC levels?
3. What are the changes to the HBC population after the BHBF test (pre and post sampling efforts required);
4. A BHBF is a substantial perturbation to the system which may result in humpback chub mortality, changes in recruitment, and modification of habitat. What may be the impact of a BHBF test right before the implementation of the LTEP?
5. Assess the impacts of a BHBF test on other resources in the long term, identifying linkages to ongoing MRP and LTEP designed flows and studies (e.g. assess timing, scope and coordination, etc. with ongoing GCMRC efforts as necessary to accomplish longer-term studies); and
6. Refocus and reduce the overall BHBF science plan proposed budget to just the topic studies listed above, logistics, etc., and move longer term studies of other impacted topics to a separate section (the appendix?). This section should address LTEP linked research studies, changes to MRP efforts necessary to answer the BHBF questions, and applicable tasks necessary to address the need to conduct multiple BHBF tests that reflect the priority of resources as recommended by AMWG.

## **APPENDIX A**

# *Draft TWG Desired Future Conditions Ad Hoc Recommendations*

September 14, 2007 Version 3

The Desired Future Conditions (DFCs) are developed to supplement the Adaptive Management Program's (AMP) **Strategic Science Plan** that left development of these important science and resource management goals for a later date, after the plan's initial development.

These DFCs were developed to complete this remaining task under the direction of the U. S. Bureau of Reclamation (BOR). On July 20, 2007 the BOR made a request to the AMP Technical Working Group (TWG) to "prepare technical options for resource target levels" that would be "desired over the long term" and those that would be "achievable within the next 10 years."

The Desired Future Conditions Ad Hoc group was created from the AMP-Technical Work Group (TWG) following the BOR's request. The TWG ad hoc group (DFC Group) is utilizing AMP guidelines, goals and management objectives, with updated scientific information from GCMRC developed for the AMP program. Also utilized are scientific information from the Knowledge Assessment Workshop and numerous documents produced by the Grand Canyon Monitoring and Research Center, a branch of the U.S. Geological Survey, and the draft version of Proposed Desired Future Conditions developed by the National Park Service, Grand Canyon National Park (as presented to the TWG at the June 25-26 meeting, 2007).

## Background information

AMP Management Objectives (MOs) define "desired future resource conditions" to mean that resource conditions should be: 1) Specific; 2) Measurable; 3) Achievable; 4) Results-oriented; 5) Time-specific, and 6) within the legal and policy framework of the Adaptive Management Program.

Some selected guiding principles from the Glen Canyon Dam Adaptive Management Program are utilized to frame the DFC ad hoc task:

1. The Colorado River ecosystem is a managed ecosystem. An ecosystem management approach, in lieu of an issues, species, or resources approach, will guide our efforts. Management efforts will prevent any further human-induced extirpation or extinction of native species.
2. An adaptive management approach will be used to achieve Adaptive Management Program goals, through experimentation and monitoring, to meet the intent of the Grand Canyon Protection Act, Glen Canyon Dam Environmental Impact Statement, and the Record of Decision.
3. Understanding cause and effect relationships is essential for managing the Colorado River ecosystem. The adaptive management approach will be geared toward gaining an improved understanding of the cause and effect relationships that occur within the Colorado River ecosystem, and their connection, if any, to dam operations, while also documenting resource status and trends.
4. Dam operations and management actions will be tried that attempt to return ecosystem patterns and processes to their range of natural variability. When this is not possible, experiments will be conducted to test other approaches.

5. Because management actions to achieve a goal may benefit one resource or value and adversely affect another, those action alternatives that benefit all resources and values will be pursued first. When this is not possible, actions that have a neutral impact, or as a last resort, actions that minimize negative impacts on other resources, will be pursued consistent with the Glen Canyon Dam Environmental Impact Statement and the Record of Decision.

Compliance with NPS Policies

Grand Canyon National Park (GCNP) is required to follow and implement larger NPS 2006 Management Policies and park management objectives as presented in its 1995 General Management Plan (GMP), and other resource planning documents and applicable policies. To this end, GCNP is utilizing the following table and list of Desired Future Conditions (DFC's) to express applicable policy direction for the Colorado River Ecosystem (CRE), and to meet NPS responsibilities under the Grand Canyon Protection Act:

**Table 1.** NPS Management goals for the Colorado River Ecosystem in Grand Canyon National Park and Glen Canyon National Recreation Area (based on Schmidt et al. 1998).\*

Management Goal	Management Philosophy	Engineering Approach	Results
Traditional river management	Maximize power production at times of maximum price	Maximize revenues from power production	Maximum power revenues result in rapid, erratic, non-seasonal dam releases; flood control with occasional unplanned releases; minimal protection of ecosystem resources
Naturalized ecosystem	Manage existing ecosystem, including "desirable" non-native species	Use existing structures to manage existing resources	Maximize biodiversity, productivity; constrain maximum and minimum releases
Simulated natural ecosystem	Simulate some pre-dam processes; restore some pre-dam resources	Use existing structures to increase pre-dam resources	Increase endangered fish habitat; increase growth of old high water zone riparian vegetation; increase size of sandbars
Substantially restored ecosystem *	Extensive restoration of pre-dam processes and ecosystem resources	Modify existing structures to include thermal modification (i.e., temperature control device) and sediment bypass (e.g., pipeline)	Substantially restore pre-dam hydrology, sediment transport and annual water temperature cycle; restore pre-dam riparian landscape and endangered fish habitats and populations
Fully restored ecosystem	Attempt complete restoration of pre-dam processes and resources	Remove dam and remove non-native species	Restore pre-dam hydrology, sediment transport and annual water temperature cycle; resource native species and remove exotic species

The NPS stresses that a **substantially restored ecosystem** as described by Schmidt et al, and summarized in Table 1 above, is the basis of the following desired future condition for the Colorado

River ecosystem. Ecosystem processes and resource conditions in the CRE, as presented by Schmidt 1995, provides appropriate guidance for future park management decisions. The NPS recognizes that not every resource or process in the CRE can be substantially restored (due to excessive costs or lack of effective restoration techniques, constraints on water delivery, etc.), however the basis for park management policy for the CRE is derived from the 2006 NPS Management Policies on restoration of natural ecosystems and processes. Section 4.1.5, of the 2006 NPS Management Policies states:

"The Service will seek to return such disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated. The Service will use the best available technology, within available resources, to restore the biological and physical components of these systems, accelerating both their recovery and the recovery of the landscape and biological community structure and function."

The following desired future conditions reflect the policies mentioned above and park management requirements, while incorporating the applicable concepts of numerous AMP Management Objectives and AMP **priority goals** of the program as detailed below:

### **DFC Group Proposed Desired Future Conditions**

**(To be addressed in order of Adaptive Management Work Group (AMWG) priority goal setting of 2003).**

**AMP Goal 2/AMWG Priority 1:** Maintain or attain viable populations of existing native fish, remove jeopardy for humpback chub and razorback sucker, and prevent adverse modification to their critical habitats.

**(NPS version: Maintain or attain viable populations of existing native fish, and prevent adverse modification to their habitat (including critical habitat).**

***DFC: Humpback chub (HBC) populations have been enhanced and jeopardy status has been removed through recovery and improvement of habitat in the Little Colorado River, other tributaries, and the mainstem.***

Short-term Objectives (Expect accomplished within 10 years or less)

1. The Grand Canyon population is maintained as a core over a 5-year period, starting with the first point estimate acceptable to the Service, such that the trend in adult (age 4+) humpback chub estimates does not decline significantly, and
2. Highest population estimate is achieved based on historic population records from 1989 and 1990s (e.g. 10,000 adults as per AWRC 2006);
3. Mean estimated recruitment of age-3 (150–199 mm TL) naturally produced fish equals or exceeds mean annual adult mortality, and
4. Consider refugia and translocation or reintroduction into appropriate park tributaries as defined in the final version of the 2006 HBC Management Plan or supporting documents;
5. Some HBC can be utilized for research/experimental purposes.
6. Threats to the LCR population from hazardous material spills that could result in catastrophic loss of population are significantly reduced or eliminated"
7. Other priority projects listed within the HBC Comprehensive Plan are implemented.

Long-term Objectives (Expect to take 10 years or more to accomplish)

1. All aspects of recovery goals for the lower Basin Recovery Unit have been achieved.
2. The species are removed from jeopardy
3. HBC population and distribution will meet or exceed short-term goals, based on further evaluation of the CRE habitat an carrying capacity of the river, and active tributaries (Douglas and Marsh 1996, Valdez and Ryel 1995).

***WAPA proposal for - HBC***

**DFC:** The Grand Canyon recovery unit of humpback chub (HBC) has recovered as described in the 2002 Recovery Goals. Recovery actions necessary to meet recovery goals have been implemented and threats have been removed or eliminated to ensure the long term survival of the recovery unit.

*Short-term goal (within a 10-year period)*

1. For a 5-year time period, the trend in adult (age 4+) humpback chub estimates does not decline significantly,
2. Each population estimate within that 5-year time period exceeds 2,100 adults,<sup>1</sup> and
3. Mean estimated recruitment of age-3 (150–199 mm TL) naturally produced fish [equals or exceeds mean annual adult mortality, is indicative of a stable population].

*Long-term goal (beyond 10 years)*

1. HBC are removed from the list of threatened and endangered species and remain a viable component of the Colorado River Ecosystem within the Grand Canyon recovery unit, and
2. HBC adult population and estimates meets or exceeds a total of 10,000 within the Grand Canyon recovery unit (based on the estimated 1990 population estimate). (end)

Continue with NPS proposed DFC's:

***AMP Goal 2:***

***DFC: Distribution and enhancement of the razorback sucker (RBS) has occurred and jeopardy status has been removed through recovery and improvement of habitat.***

Short-Term:

1. Full compliment of age classes in the mainstem and LCR, etc.;
2. Spawning aggregations are documented in the mainstem and selected tributaries and there is evidence of spawning success or recruitment;
3. Grand Canyon RBS management plan is completed and being implemented;
4. Consider refugia and translocation or reintroduction into appropriate park tributaries to be defined in future management plan or recovery plan.

Long-Term:

---

<sup>1</sup> The Recovery Goals require management actions to remove threats to the recovery of the Grand Canyon recovery unit. Many of these management actions are likely to be outside of the scope of the AMP, but may be important in reaching the recovery goals. The AMWG recommended that a recovery implementation program be developed in order to begin to address these needs.

1. Pertinent management objectives and recovery goals for population, recruitment, etc., to be developed.

**DFC: *Native fish populations in Grand Canyon have been enhanced through and improvement of habitat in the Colorado River and tributaries.***

Long-Term:

1. Pertinent management objectives and recovery goals for population, recruitment, etc., to be developed.
2. Translocation into park tributaries to be assessed or evaluated in future.

Other DFC's:

- Threats to native and threatened and endangered species from warm water and cold water non-native fish species, parasites, etc... have been reduced.
- Viable populations of naturally occurring native fish (e.g. flannelmouth sucker, bluehead sucker, and speckled dace, etc...) are maintained in the CRE.

**AMP Goal 11/AMWG Priority 2:** Preserve, protect, manage and treat cultural resources for the inspiration and benefit of past, present and future generations.

**(NPS: Preserve, protect, manage and treat cultural resources for the inspiration and benefit of past, present, and future generations.)**

**DFC: *Cultural resources (including archaeological, ethnographic, architectural, historic trails and cultural landscapes) are preserved, protected, treated and understood to ensure their long-term viability and integrity.***

Short-term Objectives (Expect accomplished within 10 years or less)

1. The integrity of all National Register eligible or listed historic properties is maintained, *in situ* where possible, with preservation methods or treatment employed on a site specific basis;
2. Cultural resources are maintained to convey their significance to present and future generations;
3. Site condition is regularly assessed according to service wide standards and data is input into NPS data storage program(s) (e.g. Archaeological Sites Management Information System (ASMIS)) regularly;
4. In consultation with the NPS, implement appropriate types of data recovery if integrity is threatened and properties cannot be preserved *in situ*

Long-term Objectives (Expect to take 10 years or more to accomplish)

1. Sacred places are maintained to convey their significance to present and future tribal people;
2. Continue consultation efforts with tribal representatives;
3. Develop and maintain, with tribal input, an ethnographic resource database

Other DFC:

- The integrity and condition of American Indian sacred places is preserved, and access to them for traditional uses is maintained.

**AMP Goal 7/AMWG Priority 3:** Establish water temperature, quality and flow dynamics to achieve GCDAMP ecosystem goals.

**(NPS: Establish water temperature, quality and flow dynamics to achieve GCDAMP ecosystem goals.)**

***DFC: Anthropogenic impacts do not exceed Federal and State standards of water quality.***

Short-term Objectives (Expect accomplished within 10 years or less)

1. Quality meets or exceeds Federal water quality and State (AZ) water quality standards or thresholds;
2. Consider seasonally adjusted steady flows to affect water temperature in support of park resource management.

Long-term Objectives (Expect to take 10 years or more to accomplish)

1. Use of selective water withdrawal (TCD) to affect warmer water temperature
2. Ensure tributary water quality supports natural processes for that tributary (include the Paria, Little Colorado River; Havasu, Clear Creek, Shinumo, etc.)
3. Work to change AZ water quality classification regarding turbidity “penalty” for Colorado River water quality standard at GCNP

Other DFC:

- Correct State of Arizona water quality assessment of the Colorado River as “impaired waters of the U.S.” based solely on turbidity of the river.
- Promote a natural range of annual temperature regimes in the river (mainstem).

**AMP Goal 8/AMWG Priority 4:** Maintain or attain levels of sediment storage within the main channel and along shorelines to achieve GCDAMP ecosystem goals.

***DFC: Maintain or attain levels of sediment storage within the main channel and along shorelines to achieve NPS and GCDAMP ecosystem goals.***

Short-term:

- 1) Sediment inputs tied to established sediment “trigger” volume is adequate to provide ample sediment to sustain and enhance shoreline habitat and protection and enhancement of camping beaches;
- 2) Promote near shore and backwater habitat development and maintenance of key resources at key locations;

***DFC: Sufficient sediment exists in the river to achieve sediment storage and conservation to achieve the following:***

Short-term:

- 1) Protection and enhancement of camping beaches;
- 2) Maintenance of a positive mass balance in the mainstem;
  - Rebuild and stabilize sandbars and campsites to 1983-1985 post flood values as hydrologic conditions permit (e.g. 40,000 - 45,000 cfs release);
  - Dam operations promote enhancement of sandbars and camping beaches using repetitive BHBF flows,
  - Sediment deposition from BHBF flows promote nearshore and backwater habitat development;
  - Promote aeolian transport to upper benches and enhance native riparian community function.



- 3) Control of non-native vegetation encroachment onto sandbars (control exotics);

Long-term:

- 1) Conserve sediment throughout the system to enhance near shore habitat and restore riparian function.
- 2) Adequate sediment available to “restore” ecosystem function (TBD)
- 3) Protect and maintain OHW zone/terrace deposits and vegetation
- 4) Continue maintenance of a positive mass balance in the mainstem
  - Determine if sediment inputs can be managed to restore and stabilize sandbars and campsites to 1983-1985 post flood values as hydrologic conditions permit using available dam operation and flow regimes (e.g. 60,000 - 80000 cfs release);
- 5) CRE cultural resources are protected through sediment aeolian transport and enhanced native riparian community function.

### **WAPA Proposal for Sediment -**

**DFC:** Sufficient sediment exists along the Colorado River downstream of Glen Canyon Dam [define geographic locations or all areas from GCD to Mead]

*Short-term goal (within a 10-year period)*

1. Camping beaches are maintained/established [where] to the following extent [1983-1985 post flood values],
2. Through the conservation of sediment, backwater habitats exist to the [extent] to meet HBC goals [if necessary], is located in [specific] locations to [assist] in aeolian transport, and promotes the protection of [the following] cultural resources, and
3. Sediment within the [system, reach] is [conserved, rebuilt, maintained].

*Long-term goal (beyond 10 years)*

1. The conservation of sediment [throughout the system] has [enhanced] near shore habitat and [restored] riparian function to allow the following to occur [fill in ecosystem targets here such as reaching 10,000 HBC]
2. Active management of incoming sediment resources allows sediment conservation goals to be met through the development of tools such as [BHBFs/HMFs].

Continue with NPS Proposed DFC's:

**AMP Goal 1/AMWG Priority 5:** Protect or improve the aquatic foodbase so that it will support viable populations of desired species at higher trophic levels (e.g. water temperature and flow related).  
**(NPS: Protect or improve the aquatic food base so that it will support viable populations of desired species at higher trophic levels)**

***DFC: Primary and secondary producer composition (algae, macrophytes) is understood and the biomass and community composition is managed to maintain or enhance the aquatic food base in the full length of the river system GRCA (to include carbon loads and drift materials).***

Short-term Objectives (Expect accomplished within 10 years or less)

1. Determine and track composition and biomass of primary producers in the Colorado River Ecosystem (below Glen Canyon Dam to Paria tributary, including **below the Paria riffle** to Diamond Creek)

2. Determine and track composition of biomass and benthic invertebrates in the Colorado River ecosystem, and include measurements of release flows, nutrients, water temperature, and light regime ;
3. Determine organic mass balance of the mainstem, and work to develop a monitoring program that quantifies trends in the organic flux of the system under a defined flow regime(s).

Long-term Objectives (Expect to take 10 years or more to accomplish)

1. Restore carbon input to mainstem and maintain organic inputs (autochthonous vs. allochthonous) that approach pre-dam levels and types;
- 2.

Other DFCs:

- For GLCA: Define, maintain and enhance the food base at or above 5000 cfs (GCNRA - Fish Management Plan (FMP)).

**AMP Goal 6/AMWG Priority 6:** Protect or improve the biotic riparian and spring communities within the Colorado River ecosystem, including threatened and endangered species and their critical habitat.

**(NPS: Protect or improve the biotic riparian and spring communities within the Colorado River ecosystem. Including threatened and endangered species and their habitat.)**

***DFC: Stands of native vegetation of sufficient density and extent to support naturally occurring riparian fauna exist below the old high water zone; invasive exotics plants in the new high water zone are minimal***

Short-term Objectives (Expect accomplished within 10 years or less)

1. Minimize the encroachment of new high water zone vegetation onto sandbars through return to a more natural flow scenario;
2. Determine the current extent of exotic and invasive plant abundance and distribution throughout the riparian corridor;
3. Minimize exotic plant species in the riparian corridor through use of more natural high discharge flows and targeted control programs;
4. Document, map and monitor the composition of old high water zone plant communities and selected native species of management and ecological significance, including mesquite, hackberry, apache plume, catclaw, and Gooddings willow.
5. Map vegetation and assess changes in pre-dam old high water woody species at 5-year intervals
6. Document and understand potential changes in new high water zone vegetation, associated wildlife, and the aquatic food base;
7. Document the presence and extent of exotic species, both plant and animal, at natural springs and wetlands and at the mouth of targeted side canyons (e.g. based on population dynamics; or aerial coverage by %, etc.);
8. Determine dam effects of natural wetlands and springs and associated biota;

Long-term Objectives (Expect to take 10 years or more to accomplish)

1. Maintain old high water zone vegetation to pre-dam conditions where possible, or at least post 1983-1985 composition and condition, and prevent further loss of principal old high water zone species;
2. Document and understand potential changes in new high water zone vegetation and associated biota that may occur with return to a more natural flow scenario or LTEP design;

3. Determine recruitment levels to sustain old high water zone (OHWZ) plant communities and encourage recruitment of old high water zone vegetation through a return to a more natural flow scenario;
4. Document the composition, and species ecology of these communities, including work on the rare endemic (*Flaveria macdougallii*);
5. Map and track changes in the biota of selected springs and wetlands at 5-year intervals
6. Determine pre-dam extent and condition of selected spring and wetland communities where feasible;
7. Determine the potential effects of the new flow scenario on peregrine falcons, bald eagle, Mexican spotted owl, and the Condor;
8. Backwater and riparian habitats are maintained for bird and bat food, and chain of support needs to sustain peregrine falcon population.

Other DFC's:

1. Encroachment of invasive exotic plant species below the level of dam operations and at seeps and springs is negligible.
2. Pre-dam naturally occurring wetlands (e.g. Horeshoe Bend in GCNRA, and Warm Springs at Prospect Canyon in GCNP) seeps, and springs exist that support native biotic communities.
3. Important habitat of SWWF below Separation Canyon and native riparian vegetation valuable for the neotropical songbird community for migratory and nesting uses is maintained.

Short-term:

1. Verify amount and characteristics of potential habitat along the river corridor, focusing on areas below RM 238;
2. Verify mapping of suitable habitat for the SWFL and monitor change at 3-year intervals;
3. Monitor known nests at yearly intervals using USFWS and USGS protocols or improved technology (e.g. acoustic monitoring);

Long-term:

1. NPS to seek funding to observe trends in population size and distribution of the SWFL.
2. -

**AMP Goal 9/AMWG Priority 7:** Maintain or improve the quality of recreational experiences for users of the Colorado River ecosystem, within the framework of GCDAMP ecosystem goals.

***DFC: Maintain or improve the quality of recreational experiences for users of the Colorado River ecosystem, within the framework of GCDAMP ecosystem goals.***

Short-term:

- 1) Ensure number and condition of camping beaches is maintained or enhanced;
- 2) Promotes near shore and backwater resource habitat development and maintenance;
- 3) Stabilization of existing beach areas, and no net loss of sediment inputs is defined;
  - Rebuild and stabilize sandbars and campsites to 1983-1985 post flood values as hydrologic conditions permit;
  - Dam operations promote enhancement of sandbars and camping beaches using repetitive BHBF flows, and
  - sediment deposition from BHBF flows promote nearshore and backwater habitat development;

- 4) Control of non-native vegetation encroachment onto sandbars is practiced (control of exotics);

Long-term:

- 1) Conserve sediment throughout the system to enhance near shore habitat and restore riparian function.
- 2) Adequate sediment is made available to “restore” ecosystem function (TBD);
- 3) Protect and maintain OHW zone/terrace deposits and vegetation
- 4) Determine if sediment inputs are sufficient to maintain or restore CRE function under selected dam operation and flow regimes;
- 5) CRE cultural resources are protected through sediment aeolian transport and enhanced native riparian community function;
- 6) Ensure that visitor use levels and types of use enhance the overall visitor experience by minimizing crowding and user conflicts;
- 7) Provide visitors the opportunity to access educational information on the potential risks associated with recreational activities in the Grand Canyon wilderness setting, including whitewater rafting and hiking.
- 8) Recreation campsites are provided that emulate the 1983-1985 conditions in number, distribution, size and quality as feasible.

**AMP Goal 5/AMWG Priority 8:** Maintain or attain viable populations of Kanab ambersnail.

***DFC: Maintain or attain viable populations of the Kanab ambersnail***

(Desired Condition will be revised pending further evaluation by Fish and Wildlife Service).

**AMP Goal 4/AMWG Priority 9:** Maintain a wild reproducing population of rainbow trout above the Paria River, to the extent practicable and consistent with the maintenance of viable populations of native fish.

***DFC: Maintain a recreational trout fishery above Lees Ferry.***

Short-term Goal:

1. Continue management to provide for recreational trout fishery in the Lees Ferry reach upriver to Glen Canyon Dam consistent with NPS, Arizona Game and Fish Department, and Fish and Wildlife Service management needs and provide for a native species fishery below this reach through the remainder of Marble and Grand Canyon to support endangered species recovery for primarily humpback chub and secondarily razorback sucker and other native fish.

**AMP Goal 3/AMWG Priority 10:** Restore viable populations of extirpated species.

***DFC: Restore populations of extirpated species of warm water native fish (Colorado pikeminnow, bonytail, roundtail chub, and leopard frog, river otter (Sonoran) as feasible.***

**AMP Goal 10:** Maintain power production capacity and energy generation, and increase where feasible and advisable, within the framework of GCDAMP ecosystem goals.

**(NPS: There is no Power Production Goal** as energy production is not considered a park natural resource to be covered under the GCPA).