



THE SECRETARY OF THE INTERIOR
WASHINGTON

MEMORANDUM

To: Anne J. Castle
Secretary's Designee, Glen Canyon Dam Adaptive Management Work Group
Assistant Secretary – Water and Science

From: Secretary *Ken Salazar* APR 30 2012

Subject: Report and Recommendations From the Glen Canyon Dam Adaptive Work Group
Federal Advisory Committee Meeting, February 22-23, 2012

I have reviewed and considered the two documents containing the recommendations of the Glen Canyon Dam Adaptive Management Work Group (AMWG). First, I want to convey my sincere thanks to the AMWG for the dedication, passion, and wealth of knowledge they provide in guiding our efforts to appropriately manage the operations of Glen Canyon Dam. Without this important Federal Advisory Committee we would not have the breadth of input that factors into the many complex decisions to be made, and our overall resources management would be less effective.

As requested, I have reviewed the Desired Future Conditions (DFC) document, and recognize it as a milestone for the Adaptive Management Program. I am directing the AMWG to utilize these DFCs to inform and guide the AMWG's future considerations, including advice and recommendations to me concerning the operations of Glen Canyon Dam and other related actions.

With respect to the report of the Socioeconomic Ad Hoc Group, I appreciate the comprehensive nature of the program and plan proposed, and the support of the AMWG for the implementation of these socioeconomic impact assessment studies. I am directing the interagency team from the Department of the Interior to communicate to the AMWG the specific studies and activities that should be prioritized for utilization as part of the ongoing National Environmental Policy Act process to develop a Long Term Experimental and Management Plan (LTEMP) for Glen Canyon Dam. The Technical Work Group can then identify information needs and research priorities not addressed through the LTEMP process so that the Glen Canyon Monitoring and Research Center can refine and develop a work plan.



United States Department of the Interior

OFFICE OF THE SECRETARY

Washington, D.C. 20240

MEMORANDUM

To: Secretary

APR 26 2012

From: Anne J. Castle 
Secretary's Designee, Glen Canyon Dam Adaptive Management Work Group
Assistant Secretary – Water and Science

Subject: Report and Recommendations from the Glen Canyon Dam Adaptive Management Work Group Federal Advisory Committee Meeting, February 22-23, 2012

The Glen Canyon Dam Adaptive Management Work Group (AMWG) convened on February 22-23, 2012, in Tempe, Arizona. The meetings were well attended and positive. The following issues were discussed and actions taken:

Desired Future Conditions

I am very pleased to report that the AMWG has adopted a set of Desired Future Conditions (DFCs) to help guide future experimentation, research, and monitoring, and the proactive development of future experimental plans. The previous lack of a guiding set of principles was a deficiency in the program that hampered productive discussion concerning recommended operations. The adoption of the DFCs is a major accomplishment for the AMWG, and will help inform future decisions on the operation and management of Glen Canyon Dam. The AMWG members and the Regional Directors and staff from the Department of the Interior Federal agencies who worked very hard on the DFCs should be commended for the time they devoted to many complex issues. Given the broad range of interests represented on the AMWG, it is important to note that the following motion was adopted by consensus at the February meeting:

AMWG commends the Secretary of the Interior on his collaborative efforts to develop and clarify desired future conditions (DFCs) for the Colorado River ecosystem. The AMWG recommends the attached review of the 24 August 2011 DOI DFC document, including the background information and discussion of non-consensus issues, to the Secretary for his consideration.

Socioeconomics

Another deficiency in the Glen Canyon Dam Adaptive Management Program (GCDAMP) has been the absence of a socioeconomics program for the evaluation of the impacts of differing dam operations. With expert advice from Dr. Dave Garrett and the Science Advisors and the leadership of Shane Capron, Technical Work Group (TWG) chair, the Socioeconomic Ad Hoc Group (SEAHG) has documented the importance of such a program and further, the group identified the significant social science needs of the Adaptive Management Program and the gaps that must be filled to better inform future discussions and recommendations concerning Glen Canyon Dam operations and related activities, as well as the scope and costs associated with each project and potential funding sources. The SEAHG has recommended both a

comprehensive socioeconomic program for the GCDAMP and a recommended socioeconomic implementation plan. The recommended socioeconomic program also has implications with regard to important analyses in the Long-Term Experimental and Management Plan (LTEMP) Environmental Impact Statement currently being prepared, as well as potential overlap with a socioeconomic survey covering the entire Colorado River being funded by the National Park Service.

The SEAHG report contains a very detailed work plan for a suite of socioeconomic studies for the period of 2012-2016. As stated by the SEAHG, however, the information needs and recommended studies are not prioritized. As a result of the pressing needs created by the commencement of the LTEMP process, it was recognized that further refinement and prioritization would be necessary so that the studies required to inform the LTEMP could be commenced and completed first. The AMWG agreed that determination of the elements of the recommended plan that should be tackled first in order to provide input to the LTEMP process should be accomplished by the Department of the Interior.

The following motion was adopted by consensus:

The AMWG requests the Secretary's Designee to transmit the revised SEAHG report to the Secretary and advise him that the AMWG supports implementation of socioeconomic impact assessment studies to further our understanding of adaptive management decisions within the GCDAMP. The AMWG requests that the Secretary advise the AMWG regarding those elements of the proposed socioeconomic implementation plan that will be developed within the LTEMP development process.

The AMWG directs the Technical Work Group to identify information needs and research priorities not addressed through the LTEMP process so that Grand Canyon Monitoring and Research Center can refine and develop a work plan.

I continue to be grateful for the manner in which the AMWG members have been willing to work with each other to address issues that arise during the meetings. While the sessions provide a deluge of complex information, much of the important work occurs during informal times (over breakfast, lunch, and on breaks, etc.). The knowledge and expertise that this group brings to bear on important Colorado River issues is unsurpassed, and the Department of the Interior benefits greatly from the time and effort provided.

The attached approval document is provided for your consideration.

cc: Acting Assistant Secretary, Fish, Wildlife and Parks
Acting Assistant Secretary, Indian Affairs
Director, U.S. Geological Survey
Commissioner, Bureau of Reclamation
Director, U.S. Fish and Wildlife Service

Director, National Park Service
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Grand Canyon, Arizona 86023
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Attention: Mr. Frederick H. White

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Attention: Mr. Arden Kucate

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Southern Paiute Indian Consortium, Kaibab Paiute Indian Reservation,
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Attention: Ms. Perri Benemelis

Executive Director, Colorado River Board of California, 770 Fairmont Avenue,
Suite 100, Glendale, California 91203-1035
Attention: Mr. Christopher Harris

Colorado Water Conservation Board, 1313 Sherman Street, Room 718,
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Attention: Ms. Jennifer Gimbel

Colorado River Commission of Nevada, 555 E. Washington Avenue, Suite 3100,
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New Mexico Interstate Stream Commission, PO Box 25102,
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Attention: Mr. Estevan López

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Attention: Mr. John W. Shields

Director, Division of Water Resources, PO Box 146201, Salt Lake City, Utah 84114
Attention: Mr. Dennis Strong

Grand Canyon Wildlands Council, PO Box 1315, Flagstaff, Arizona 86002
Attention: Mr. Larry Stevens

Grand Canyon Trust, 2601 North Fort Valley Road, Flagstaff, Arizona 86001
Attention: Mr. Nikolai Lash

Grand Canyon River Guides, 453 W. Mulberry Drive, Phoenix, Arizona 85013-4349
Attention: Mr. Sam Jansen

Colorado River Energy Distributors Association, 10429 S. 51st Street, Suite 230,
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Attention: Ms. Leslie James

Utah Associated Municipal Power Systems, 2825 E. Cottonwood Parkway,
Suite 200, Salt Lake City, Utah 84121
Attention: Mr. Ted Rampton

Federation of Fly Fishers, 4510 E. Joshua Tree Lane, Paradise Valley, Arizona 85253
Attention: Mr. John Jordan

Deputy Regional Director, Upper Colorado Region, U.S. Bureau of Reclamation,
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Attention: Ms. Ann Gold

Regional Director, Upper Colorado Region, U.S. Bureau of Reclamation,
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Attention: Mr. Larry Walkoviak

Adaptive Management Work Group Alternates
Technical Work Group Members and Alternates
(via e-mail)

MEMORANDUM TO AMWG

TO: AMWG
DATE: 23 January 2012
FROM: The DFC Review Ad Hoc Committee
RE: Submission of DFC Review, Description and Critique of Process, Summary of Non-consensus Issues, and Draft AMWG Motion

DFC Review Charge and Progress

In August 2011, AMWG charged the reconstituted Desired Future Conditions Ad Hoc Committee (DFCAHC) to review the Department of the Interior's response to the November 2010 AMWG DFC document. Specifically, AMWG charged the DFCAHC

"To reconstitute the DFCs Ad Hoc Group, with Larry Stevens and Perri Benemelis as co-chairs, with participation from federal agencies, with members who volunteer in the spirit of full participation, to provide a final review of the DFCs, focusing on changes made to the DFCs by the federal agencies, and submit the final draft DFC document for consideration by the AMWG."

The DFC Ad Hoc Committee met twice in Phoenix, on 6 October and 22 November 2011, to review the Department of the Interior's August 2011 response to AMWG's previous recommendations. The edited ("redlined, commented") review and the table of comments (in Excel format) resulting from these meetings is attached to this memorandum to demonstrate the intensity of discussion. Both meetings resulted in clarification of AMWG DFC recommendations to the Secretary, but both meetings also identified non-consensus issues, which are described in detail below. Most of the non-consensus issues were resolved at another meeting on 10 January 2012, but two issues remained unresolved.

The Review Process

Before discussing non-consensus issues that arose at these meetings, the DFCAHC recommends that the AMWG examine the process used to develop its Phase I narrative (qualitative) DFCs document. The AMP program employs adaptive ecosystem management to arrive at the DFC's. This necessarily implies continued improvement of the science-based aspects of the program. The DFCAHC believes that it is worthwhile to review the process utilized to develop DFCs so that it can learn from, and improve its process in the future to benefit the Program.

- In August, 2010, the AMWG recommended the narrative DFCs to the Secretary for consideration, revision, and approval, subsequent to comments received by the DFC Ad Hoc group. This recommendation initiated a process in which individual Ad Hoc members and others suggested additional changes to the document. While the development of the August 2010 document was largely accomplished with in-person meetings, the subsequent comment process was handled in a less direct manner. The co-chairs were responsible for reconciling comments (provided to the Ad Hoc via mail, e-mail or by phone communication) and appropriately modifying the document. The resulting document was issued in November 2010.
- The two-step process (described above) to develop the November 2010 DFC recommendation led to confusion. The first part of the process was accomplished mostly through in-person meetings. The second part of the process was accomplished mostly via e-mail. The November 2010 recommendation inadvertently omitted provisions of the August recommendation. Omissions from the November 2010 document were not identified until the reconstituted DFC Ad Hoc 2 process began.

- The Interior agencies subsequently initiated a review of the November 2010 document for consistency with existing law and policy. The resulting document was reformatted, reorganized and rewritten. The undated DOI document and table of changes was included with the AMWG materials for the August 2011 meeting. We note some confusion over interpretation of the formatting of the November 2010 document, which resulted in additional confusion in the August 2011 document.
- The shift from the in-person process to the e-mail communication process resulted in unintended changes to the AMWG recommendations. These omissions were not identified until much later. The Interior agencies' changes resulted in additional confusion.
- The Ad Hoc was under significant time pressure to complete its work by the identified deadline.

The DFCAHC Review members and co-chairs devoted considerable time and effort to this process, and intend that their efforts result in a positive outcome for the program. Future Ad Hoc efforts could benefit from recognition of the role of the public deliberation part of the process. Both the Ad Hoc group and the greater advisory council benefit from open, frank and respectful communication between the stakeholder representatives. Although the stakeholders represent varied and sometimes competing interests, all have a responsibility to clearly communicate issues and concerns and to openly deliberate with the goal to reach a reasonably balanced and workable solution or recommendation.

Non-Consensus DFC Issues

At the 22 November 2011 meeting, 9 non-consensus topics were identified, and are presented below. This list follows the order of presentation in the DFC Reviewed document, and does not imply a priority or importance.

1. Resolution of Kanab ambersnail taxonomy
2. Additional CRE information text to add
3. Funding responsibility for extirpated species
4. Use of the term "balance" with respect to resource management
5. The scope of cultural concerns is broader than just archeology
6. The use of the term "unimpaired"
7. Use of the phrase "blue ribbon trout fishery"
8. Additional CRE issues in GLCA
9. A Recreation DFC for a well-informed visiting public

All topics except 2 and 3 (above) were resolved with further discussion during the 10 January 2012 meeting, as described in the Background section attached to the DFCs. Below we describe the two remaining non-consensus issues. The two unresolved issues are highlighted in red in the January 2012 DFC Review, which will be presented to AMWG for discussion.

- 2. Pp. 7, 21: Additional text suggested for the CRE Additional Information, Linkages section by the State of Colorado. The suggested text modification reads:

"In addition to physical and biological interactions, the CRE is linked to Native American cultural resources such as archeological and cultural properties. Recreation benefits have resulted from both dam operations and healthy ecosystem conditions. It is critical to recognize the linkage between the body of law known as the "Law of the River," the 1992 GCPA, laws pertaining to the NPS, and these DFCs. The "Law of the River" defines how the

Secretary of the Interior must operate Glen Canyon Dam for water storage, water management, river regulation and hydropower. The ability to achieve the DFC's identified herein depends in large part on the ability of the Secretary of Interior to find an appropriate balance given the competing legal mandates within the operational flexibility those laws provide."

- Pp. 7, 21-22: Disagreement among stakeholders exists over responsibility for funding the reintroduction of extirpated native fish and non-fish species (Colorado, Arizona, Western; contested by GCT, GCWC). The following text on this subject originally agreed to by AMWG and included in the AMP Strategic Plan was inadvertently omitted in the final November 2010 DFCs passed along to the Secretary:

"Achieve the balance of resource benefits envisioned by the Grand Canyon Protection Act, GCD EIS Preferred Alternative, and NPS 2006 Management Policies; maintaining, enhancing and where practical, restoring native species, natural habitats, and natural ecosystem processes. Native and non-native species are to be managed in accord with federal regulations, policies, and guidelines. Goal 3 in the AMP Strategic Plan ("Restoring populations of extirpated species as feasible and advisable") is to be achieved in accord with the direction in RIN 3.1.1, which states:

'RIN 2.1.1 What information (including technical, legal, economic, and policy issues) should be considered in determining the feasibility and advisability of restoring pikeminnow, bonytail, roundtail chub, river otter, or other extirpated species? (Category C)'

A Category C Information Need is defined in the Strategic Plan as: 'Information Needs that are funded and accomplished under authority of an entity other than GCMRC.'

Restoration of extirpated species should be guided by Goal 3 of the GCD AMP Strategic Plan and AMWG agreements from its August 2003 meeting, and such activities are not to be funded by the Adaptive Management Program. While AMP funding may not be used for such activities, AMWG may still advise the Secretary about the feasibility of reintroduction activities, and may request monitoring and information integration about such reintroduction activities."

The above text was requested for inclusion in the CRE Extirpated Species DFC by some stakeholders but it was agreed to identify and move the issue here in Appendix for discussion by AMWG at a more appropriate time in the future. This issue pertains primarily to cases in which the construction or operations of Glen Canyon Dam have been clearly identified as contributing to the extirpation or precipitous decline of a native species in the CRE. The issue of actions outside the scope of the AMP and the funding of those actions was initially addressed in a January 2000 informal opinion by Scott Loveless, legal counsel for Interior and Reclamation. The argument of whether or not the reintroduction of extirpated species was within or outside the AMP lead to the above language.

AMP assumption of funding responsibility for extirpated species may affect the funding available for other AMP activities as well as having impacts on power marketing both from costs accrued from the conduct of restoration activities as well as potential

limitation of flows to accommodate restored populations. However, NPS and FWS missions oblige Interior to engage in restoration, and some AMWG stakeholders are committed to the restoration of native extirpated and declining species. The DFC AHC noted that positive benefits may accrue from AMWG advice on such actions and resolution of conservation issues that limit flow management (e.g., humpback chub management, Kanab ambersnail taxonomic status). The consequences of an AMWG recommendation to the Secretary at this time that does not address responsibility for extirpated species management simply means extirpated species management continues under existing federal laws. Nothing prohibits AMWG offering advice to Secretary at a later date through the Adaptive Management Program.

The 10 January 2012 Meeting, Conference Call, and Final Wrap-up

A conference call held on 10 January 2012 clarified many points of disagreement in the December 2011 draft documents. The 13 January draft DFC review, cover letter to AMWG, and table of comments were circulated to the DFCAHC for a final review. That meeting and further discussion during the following week resolved the non-consensus issues, except for points 2 and 3 (above). These two non-consensus issues are described in the DFC AHC Background and are highlighted in red for discussion and decision-making by AMWG. The documents were forwarded to Reclamation for inclusion in the February 22-23 AMWG meeting package.

Draft AMWG Motion Language

If the two non-consensus issues can be resolved by AMWG and the DFCs Review is accepted, the DFCAHC recommends the following language for a motion from AMWG to the Secretary regarding the DFCs review:

“AMWG commends the Secretary of the Interior on his collaborative efforts to develop and clarify desired future conditions (DFCs) for the Colorado River ecosystem. AMWG recommends the attached review of the 24 August 2011 DOI DFC document, including the background information and discussion of non-consensus issues, to the Secretary for his consideration.”

DESIRED FUTURE CONDITIONS FOR THE COLORADO RIVER ECOSYSTEM IN RELATION TO GLEN CANYON DAM: DFC AD HOC COMMITTEE REVIEW 23 JANUARY 2012

PREFACE

Purpose

The following Desired Future Conditions (DFCs) are intended to be used within the Adaptive Management Program (AMP), including by the Adaptive Management Work Group (AMWG), to help guide the development of recommendations concerning management of Glen Canyon Dam operations and related activities, and dam impacts on Grand Canyon National Park (Grand Canyon) and Glen Canyon National Recreation Area (Glen Canyon). The focus of this document is to identify DFCs that can be accomplished through dam operations. However, for the sake of completeness, this document also includes DFCs that might be achieved through non-operational measures.

Justification

The Secretary is authorized to consider and implement both operational and non-operational measures to address downstream effects of Glen Canyon Dam if those measures meet the Grand Canyon Protection Act's goal of protecting, mitigating adverse impacts to, and improving the resources downstream of the dam. Section 1802 of the Grand Canyon Protection Act provides:

- a) In General.—The Secretary shall operate Glen Canyon Dam in accordance with the additional criteria and operating plans specified in section 1804 and exercise other authorities under existing law in such a manner as to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established, including, but not limited to natural and cultural resources and visitor use.
- b) Compliance With Existing Law.—The Secretary shall implement this section in a manner fully consistent with and subject to the Colorado River Compact, the Upper Colorado River Basin Compact, the Water Treaty of 1944 with Mexico, the decree of the Supreme Court in *Arizona v. California*, and the provisions of the Colorado River Storage Project Act of 1956 and the Colorado River Basin Project Act of 1968 that govern allocation, appropriation, development, and exportation of the waters of the Colorado River basin.
- c) Rule of Construction.—Nothing in this title alters the purposes for which the Grand Canyon National Park or the Glen Canyon National Recreation Area were established or affects the authority and responsibility of the Secretary with respect to the management and administration of the Grand Canyon National Park and Glen Canyon National Recreation Area, including natural and cultural resources and visitor use, under laws applicable to those areas, including, but not limited to, the Act of August 25, 1916 (39 Stat. 535) as amended and supplemented.

Reclamation is charged with balancing a complex set of interests in operating the dam. Those interests include not only the endangered species below the Dam, but also tribes in the region, the seven Colorado River basin states, large municipalities that depend on water and power from Glen Canyon Dam, agricultural interests, Grand Canyon National Park, and national energy

needs at a time when clean energy production is becoming increasingly important. The DFCs will assist the AMWG in providing recommendations to the Secretary of the Interior for future decision-making. The DFCs have evolved from discussions during the entire sixteen year history of the AMWG, and were generated in the following form from the concerted work of the DFC Ad Hoc Group and the federal agency regional leadership during 2010 and 2011.

The vision and mission of the AMWG (adopted on July 21, 1999) was developed to guide adaptive management of Glen Canyon Dam, and helps explain how and why definition of desired conditions is important.

“The Grand Canyon is a homeland for some, sacred to many, and a national treasure for all. In honor of past generations, and on behalf of those of the present and future, we envision an ecosystem where the resources and natural processes are in harmony under a stewardship worthy of the Grand Canyon. We advise the Secretary of the Interior on how best to protect, mitigate adverse impacts to, and improve the integrity of the Colorado River ecosystem affected by Glen Canyon Dam, including natural biological diversity (emphasizing native biodiversity), traditional cultural properties, spiritual values, and cultural, physical, and recreational resources through the operation of Glen Canyon Dam and other means.

We do so in keeping with the federal trust responsibilities to Indian tribes, in compliance with applicable federal, state, and tribal laws, including the water delivery obligations of the Law of the River, and with due consideration to the economic value of power resources.

This will be accomplished through our long-term partnership utilizing the best available scientific and other information through an adaptive ecosystem management process.”

These DFCs are intended to be statements of qualitative goals and objectives for the AMP, realistic and achievable through the operation of Glen Canyon Dam and related activities, subject to the Law of the River and other laws and authorities and consistent with the Grand Canyon Protection Act. These DFCs may not be entirely or collectively achievable – there will be tradeoffs and inherent limitations. This fact does not diminish their value. These desired future conditions of the affected resources have been identified by the stakeholders as appropriate goals for the AMP and are based on information available at this time. As new information develops, the DFCs may need further revision and refinement. Therefore, these DFCs are neither fixed nor final. This is intended to be a “living document” that reflects advances in learning and understanding. This is consistent with the process – and application -- of adaptive management.

Scope of the DFCs

The Colorado River ecosystem (CRE) which is defined as the Colorado River mainstream corridor and interacting resources in associated riparian and terrace zones, located primarily from the fore bay of Glen Canyon Dam to the western boundary of Grand Canyon National Park. It includes the area where the dam operations impact physical, biological, recreational, cultural,

and other resources. The scope of GCDAMP activities may include limited investigations into some tributaries (e.g. the Little Colorado and Paria Rivers).

The CRE is a human-dominated ecosystem, one whose aesthetic appeal, goods and services, and spiritual services are widely used and appreciated and needed by a broad cross-section of society. Adaptive management of the CRE has been adopted to ensure the sustainability of the natural environment with the least impact to goods and services provided by the CRE to society. As such, and as information about the CRE has increased, its stewardship is moving towards an ecosystem perspective, fully recognizing the role of humans, and this approach is reflected in the structure of this document.

DFC Organization

These DFCs are divided into four categories, including the Colorado River Ecosystem, Power, Cultural Resources, and Recreation. There are many direct and indirect, short-term and long-term ecosystem responses to dam existence and operations. These DFCs are directly or indirectly linked on short and long-term bases through dam-related flows, sediment retention and distribution, hydropower production, fish and wildlife populations, recreation, and visitor experience.

DESIRED FUTURE CONDITIONS (DFCs): COLORADO RIVER ECOSYSTEM

DFC DESCRIPTION

Ecosystem Definition

The term **ecosystem** refers to the combined physical and biological components of an environment. An ecosystem is generally an area within the natural environment in which physical (abiotic) factors and processes of the environment, such as geology, climate, and soil development, function along with interdependent (biotic) organisms, such as plants and animals, in the same habitat and create a dynamic and interconnected system. Ecosystems usually encompass a number of food webs. An ecosystem is a functional unit within a given area consisting of living things and the non-living chemical and physical factors of their environment, linked together through nutrient cycle and energy flow.

DFC Background and Legislation

Glen Canyon Dam has had a profound impact on the aquatic and terrestrial domains of the Colorado River ecosystem from lower Lake Powell downstream to Lake Mead. The CRE DFCs are designed to be consistent with the 1992 Grand Canyon Protection Act, Law of the River, and other appropriate laws and mandates. The CRE DFCs apply the requirements of the Grand Canyon Protection Act, and are the goals that AMWG members will consider when making recommendations to the Secretary.

Why the CRE DFCs are Important

These CRE DFCs address the natural resource values for which the GCNP and the GCNRA were established. The DFCs aim to comply with the GCPA and describe the individual resource objectives sought with the realization that they may not be achievable in the process of finding the most desirable mix of resources in the CRE and the natural habitats, and natural ecosystem processes. Native and non-native species are to be managed in accord with Federal regulations, policies, and guidelines. The CRE described herein includes most of the native natural resources found in the Colorado River. Those resources are managed, consistent with the “Law of the River” (described in part in Section 1802(b) of the GCPA”, under the National Park Service (NPS) Organic Act, the Redwoods Amendment, NPS 2006 Management Policies, the Wilderness Act, the Antiquities Act, the Endangered Species Act, the Grand Canyon Protection Act, the Fish and Wildlife Coordination Act, and other Federal legislation. The health of the river ecosystem and the protection of the resource values of GCNP and GCNRA are important to the nation, many Native American Tribes, the economy of the Southwest, and the millions of visitors to the parks and the region.

The CRE DFCs will provide a foundation for and help define the components of the Core Monitoring Program under development by the Grand Canyon Monitoring and Research Center (GCMRC). The Core Monitoring Program will be essential to ultimately quantifying, measuring, and reporting the status of the natural resources, allowing the Secretary and the AMP to track progress toward desired outcomes. DFCs will also provide foundation support in the development of other planning and management assignments associated with the GCDAMP.

CRE DFCs

Sediment-related Resources

High elevation open riparian sediment deposits along the Colorado River in sufficient volume, area, and distribution so as to provide habitat to sustain native biota and desired ecosystem processes

- Nearshore habitats for native fish
- Marsh and riparian habitat for fish (food chain maintenance)
- Cultural resource preservation
- Maintenance of camping beaches

Water Quality

- Water quality with regards to dissolved oxygen, nutrient concentrations and cycling, turbidity, temperature, etc., is sufficient to support natural ecosystem functions, visitor safety and visitor experience to the extent feasible and consistent with the life history requirements of focal aquatic species
 - Ecosystem-sustaining nutrient distribution, flux, and cycling.
 - Hydro-physical conditions and characteristics of the CRE necessary to sustain aquatic biota.
 - Acceptable water quality for human health and visitor experience.

CRE Aquatic Domain

- The aquatic food base will sustainably support viable populations of desired species at all trophic levels.
- Assure that an adequate, diverse, productive aquatic foodbase exists for fish and other aquatic and terrestrial species that depend on those food resources.

Native Species:

- Native fish species and their habitats (including critical habitats) sustainably maintained throughout in each species' natural ranges in the CRE.
 - A healthy, self-sustaining populations of other remaining native fish with appropriate distribution (flannelmouth sucker, bluehead sucker, speckled dace, so that listing under the ESA is not needed.
- Humpback chub
 - Achieve HBC recovery in accord with the Endangered Species Act (ESA), , the HBC comprehensive management plan, and with the assistance of collaborators within and external to the AMP.
 - A self-sustaining humpback chub (HBC) population in its natural range in the CRE.
 - An ecologically appropriate habitat for the HBC in the mainstem.
 - Spawning habitat for HBC in the Lower Little Colorado.
 - Establish additional HBC spawning habitat and spawning aggregations within the CRE, where feasible.
 - Adequate survival of young-of-year or juvenile HBC that enter the mainstem to maintain reproductive potential of the population and achieve population sizes consistent with recovery goals.

Rainbow trout:

- A high quality trout fishery in GCNRA, as further described in the Recreation DFC that does not adversely affect the native aquatic community in GCNP.
 - Minimize emigration of non-native fish from the Lees Ferry reach in Glen Canyon National Recreation Area to downstream locations.
 - Minimize emigration of non-native warm water fish to the mainstem Colorado River.

Extirpated Species:

- Re-establish fishes extirpated from Grand Canyon, where feasible and consistent with recovery goals for HBC and the recovery goals of those extirpated fishes. See the linkages that follow for further information.

Nonfish Biotic Communities:

- Native non-fish aquatic biota and their habitats are sustainably maintained with ecologically appropriate distributions.
 - Populations of native non-fish species (invertebrates and vertebrates, including Northern Leopard Frog).
 - AMP Support, actions and funding are limited to incorporation of dam operations which are conducive to restoration of extirpated species.
 - Minimize the abundance and distribution of non-native species in the CRE.
 - Sustainable dam-influenced aquatic, wetland, and springs plant communities and associated biological processes, including those supporting threatened and endangered species and their habitats.

CRE Riparian Domain

- Native riparian systems, in various stages of maturity, are diverse, healthy, productive, self-sustaining, and ecologically appropriate.
 - Native, self-sustaining riverine wetlands, and riparian vegetation and habitat, with appropriate mixture of age classes.
 - Healthy, self-sustaining populations of native riparian fauna (both resident and migratory).
 - Habitat for sensitive species within the CRE
 - Encourage the resolution of the taxonomic status of the Kanab ambersnail (e.g., completely describe the taxa and subspecies).
 - Habitat for neotropical migratory birds, waterfowl, and other appropriate native bird species.
 - Ecological functions of tributary mouths and riverside springs, including habitat for native species.

CRE DFCs ADDITIONAL INFORMATION

Linkages

Ecosystem Structure: Physical characteristics, including climate, site-specific geomorphology, dam-related discharge and flow, and tributary flows, generally predominate over biological processes. The aquatic and riparian components of the CRE are linked to fluvial habitat distribution and the collection, composition, structure, and population dynamics of living

organisms. “Lateral” bio-ecological processes, such as competition, and “top-down” processes, such as predation, parasitism, and decomposition, can influence some elements of these linkages over time.

In addition to physical and biological interactions, the CRE is linked to Native American cultural resources such as archeological and cultural properties. Recreation benefits have resulted from both dam operations and healthy ecosystem conditions.

Metrics

These DFCs are intended to guide the gathering and analysis of data pertinent to the CRE in Grand Canyon National Park and Glen Canyon National Recreation Area. The CRE DFCs and the related documents will be used to provide direction towards development of the core monitoring program under development by the Grand Canyon Monitoring and Research Center (GCMRC). Through diligent and consistent monitoring, GCMRC may inform the Secretary as to whether as to what degree these DFCs are being achieved.

- Percentage of critical habitat lost or gained
- Condition of species variability (native population, abundance, distribution)
- Carrying capacity thresholds
- Population estimates

POWER DESIRED FUTURE CONDITIONS

DFC DESCRIPTION

Power Definition

Hydroelectric power is generated by the release of stored water through Glen Canyon Dam. The dam's eight generators can produce up to 1,320 megawatts: enough electricity to serve 1.3 million residential customers. The integration of hydropower and other resources provides an efficient and flexible operation of this region's electrical resources. Releases of water from Glen Canyon Dam are adjusted in part to follow customer loads.

DFC Background and Legislation

Glen Canyon Dam is an important component of the Colorado River Storage Project (CRSP) which stores water, the West's most vital resource, during wet years for use in times of drought, much like a bank account. As part of the nation's critical infrastructure, the water stored by Glen Canyon Dam is vital to the growing water needs of the Western United States. Over 30 million people depend on the water stored behind the dam for drinking, irrigation, and other municipal and industrial uses.

Revenues from the sale of Glen Canyon hydropower generation and other CRSP facilities are used to repay the reimbursable costs, and interest on the interest-bearing costs of the Federal investment in the CRSP, and are also used to repay over 85 percent of the irrigation costs of the CRSP Federal irrigation projects. These revenues are also used, instead of annual Federal appropriations, to pay for the yearly operation, maintenance and replacement costs of Glen Canyon Dam and other CRSP facilities.

The Reclamation Project Act of 1939 provides that hydropower produced by Glen Canyon Dam and other CRSP facilities be offered for sale first to municipalities and other public corporation and cooperatives and other nonprofit organizations financed in whole or in part by loans made pursuant to the Rural Electrification Act of 1936. Customers include rural electric associations, Federal facilities, state agencies, universities, and 57 Native American entities.

Why the Power DFC is Important

- Hydropower is an authorized purpose of Glen Canyon Dam.
- Hydropower produced by Glen Canyon Dam is under long-term contract to not-for-profit entities and 57 tribal entities.
- Power revenues are a significant funding source (est. \$20 million/year) for the AMP, Upper Colorado River and San Juan River Endangered Fish Recovery Programs, and the Colorado River Salinity Control Program.
- Hydropower is a renewable resource that is an important component in the Western Electricity Coordinating Council (WECC). Hydropower production is a national objective to help meet the Nation's needs for reliable, affordable, and environmentally sustainable electricity.
- Glen Canyon generation has the ability to "ramp up" to meet system reliability obligations that are important when regional power shortages or power/transmission system disruptions occur.

DFC GOALS AND OBJECTIVES

- Glen Canyon Dam capacity and energy generation is maintained and increased, so as to produce the greatest practicable amount of power and energy, consistent with the other DFCs.
- Ensure continued delivery of Glen Canyon Dam hydropower to the existing customers who have entered into long-term firm power contracts with WAPA.
- Ensure sufficient and efficient production of Glen Canyon Dam hydropower in order to provide the revenues to support the CRSP facilities and purposes.
- Maintain the operational flexibility (including but not limited to load following capability, ramp rates, and emergency operations allowances) that enable Reclamation and WAPA to meet the system operating and other regulatory requirements of WECC, North American Electric Reliability Corporation and the Federal Energy Regulatory Commission, as well as emergency operating criteria for safety and human health situations.
- Maximize the environmental benefits of hydropower generation at Glen Canyon Dam.
- Minimize carbon emissions through hydropower generation at Glen Canyon Dam.

POWER DFC ADDITIONAL INFORMATION

Linkages

- Operational changes, including experimentation and management actions, which include changes to volumes, release limitations (minimum and maximum), ramp rates, hourly, daily, monthly and seasonal variability, all potentially impact this resource.
- The above-identified parameters could have impacts to the CRE resources as well as recreational and cultural resources, depending on the operational design.

Metrics

- Valuation (measurement characterization for an average year)
 - Electric generating capacity (MW)
 - Electric generating energy (MWH)
 - Load following capability MW/hr)
 - Ramp rate capability (MW/hr)
 - CO₂, SO₂ and NO_X emissions (tons)
 - Power plant water consumption (acre-feet)
 - Costs (\$ millions)

CULTURAL RESOURCES DESIRED FUTURE CONDITIONS

DFC DESCRIPTION

Cultural Resources Definition

Preservation and appropriate management of cultural resources are vital at many levels. At the most basic level, cultural resources are our history; they define and reaffirm us, and provide a tangible record of who we are and where we have been. Their importance may be to the nation as a whole, to a local community, or to a group traditionally associated with the area. This includes resources within the Grand Canyon region, including resources along the river corridor in Glen and Grand Canyons.

DFC Background and Legislation

Recognition of the importance of cultural resources is codified through numerous statutes and executive orders that mandate protection, consideration, and preservation of cultural resources. Because of the structure of federal law, particularly the National Historic Preservation Act of 1966 (NHPA), cultural resources will be considered below in two broad groupings: 1) those that fall within the purview of the NHPA (National Register Eligible historic properties); and 2) all other resources of traditional cultural importance. This is done for purely pragmatic reasons; there are specific legal requirements for cultural resources that fall under the NHPA umbrella that do not apply to the second class of cultural resources. The Cultural Resources DFCs apply the requirements of the Grand Canyon Projection Act to “protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park (GCNP) and Grand Canyon National Recreation Area (GCNRA) were established,” including cultural resources, and are the goals that AMWG members will consider when making recommendations to the Secretary.

Why the Cultural Resources DFCs are Important

The cultural resources of the Grand Canyon provide a record of human history in the area. They also encompass the traditional cultural use and significance of the Grand Canyon. Maintaining these resources is important to the nation as a whole so we can better understand the long history of the people who came before us and to the traditional groups that consider this area to have traditional significance to them. A number of Native American groups believe the Grand Canyon is their place of origin. These DFCs will help: maintain compliance with relevant cultural resource laws; maintain traditional cultural linkage with the Grand Canyon; and maintain traditional cultural access to and use of resources in the Grand Canyon in accordance with applicable law.

DFC NHPA ELIGIBLE (OR POTENTIALLY ELIGIBLE) HISTORIC PROPERTIES

Description

These resources are historic properties that are eligible or potentially eligible for inclusion in the National Register of Historic Places. The criteria for inclusion are defined in the NHPA, and are described in more detail in National Register Bulletins 15 and 38. Resources in the Grand Canyon include:

- Prehistoric archaeological sites (including trails, petroglyphs and pictographs)
- Historic sites (boats, mining, European exploration, river running)
- Traditional Cultural Properties - for the Grand Canyon, these include:
 - Archaeological sites

- Traditional resource use areas
- Sacred sites
- Landmarks/geographic features
- Springs
- The Colorado River
- Ethnoecological resources
- Significant event locations
- The Grand Canyon itself

Prehistoric Archaeological Sites and Historic Sites:

- To the extent feasible, maintain significance and integrity through preservation in place.
 - If preservation in place is not feasible or reasonable, then implementation of appropriate preservation treatments will be implemented to ensure reduction or elimination of threats consistent with NPS management policies, tribal traditional values and historic preservation law.
 - Public access to historic properties on tribal lands is managed by the respective tribes. On lands administered by the NPS, access to some sites for users of the river corridor is maintained as long as integrity of the sites is not compromised.

Traditional Cultural Properties (TCPs):

- Attributes are maintained such as National Register eligibility is not compromised. These attributes will be specific to the traditionally associated peoples and will need to be identified by the federal agencies in consultation with those groups. Attributes may include aspects of location or physical integrity, as well as be intangible elements that link the resource to ongoing traditional cultural practices.
- The ability of traditionally associated people to maintain access to and use of the resources is preserved, in accordance with applicable law.
- Culturally appropriate conditions of resources are maintained based on traditional ecological knowledge; integration of the desired condition is included in relevant monitoring and management programs.
- Maintain ongoing consultation with the groups for whom the resource has traditional value. Because the desired condition of a TCP needs to be determined by the group for whom it has the traditional value, ongoing consultation is necessary to assess the condition of the resource.
- Mitigate impacts that affect the integrity of the TCPs. How and if effects can be mitigated will need to be developed in conjunction with the traditionally associated peoples for whom the resource holds value.

Linkages

The goals for the following all have the potential to directly or indirectly affect the condition of the National Register eligible properties (including some examples of effects):

- Flow
 - Direct inundation
 - Levels of sediment deposition
 - Fluctuation frequency and range
- Sediment

- Distribution (laterally and vertically)
- Vegetation
 - Species composition
 - Density
- Recreation
 - Camping locations
 - Recreational visitation
 - Trailing

Additionally, management and research actions have the potential to directly or indirectly impact these resources.

Metrics

- Erosion (or deposition) rates of substrates in which the sites are contained
- Impacts at sites that will affect eligibility

RESOURCES OF TRADITIONAL CULTURAL SIGNIFICANCE BUT NOT NRHP ELIGIBLE

Description

These are resources of cultural significance to traditional peoples, often Native American Tribes which do not meet some aspect for eligibility for inclusion in the National Register of Historic Places. A common reason that a resource does not meet National Register eligibility is that the resource lacks a clearly defined boundary or does not remain in a fixed location.

Resources that have the potential to be considered of traditional cultural significance in the Grand Canyon include:

- Animal resources
- Geologic materials
- Landscapes
- Plant resources
- Soundscapes
- Viewscapes
- Water

Objectives

- Maintain the ability of traditionally associated peoples to access and use the resource in accordance with applicable law.
- Maintain culturally appropriate resource conditions based on traditional ecological knowledge, and integrate this desired condition into monitoring and management programs.
- Maintain effective consultation with the groups for whom the resource has traditional cultural significance.

Linkages

The goals for the following resources all directly or indirectly affect the condition of resources with traditional cultural significance:

- Flow

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- Sediment
- Vegetation
- Recreation

Also, management and research actions have the potential to directly impact these resources.

Metrics

Because culture defines the roles that resources play in that culture, only members of that culture can assess the status or health of the resources. Therefore, measures for resource status or health and appropriate management will need to be determined individually by the federal agencies in consultation with the traditionally associated peoples.

RECREATION DESIRED FUTURE CONDITIONS

DFC DESCRIPTION

Definition

The Recreation DFCs are meant to describe goals and objectives for human use of the Colorado River Ecosystem (CRE) through GCNRA and the GCNP. They are intended to include not only traditional recreational activities such as whitewater rafting, camping, and fishing, but also such things as educational activities, spiritual engagement, and other appropriate activities and values. Grand Canyon and Glen Canyon offer many ways for people to experience, appreciate, and learn from them, even to those who never visit in person.

DFC Background and Legislation

Recreational use began before there were any dams on the Colorado River, though the exact beginnings are unknown. Recreational and other activities and values in the Grand Canyon and Glen Canyon have increased greatly since the time of the construction of Glen Canyon Dam. The Recreation DFC applies the requirements of the Grand Canyon Protection Act to “protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park (GCNP) and Grand Canyon National Recreation Area (GCNRA) were established,” including visitor use/recreation, and the goals that AMWG members will consider when making recommendations to the Secretary.

Why the Recreation DFC is Important

Grand Canyon National Park: The Grand Canyon is a unique place in this world. Its natural beauty, challenging environment, fascinating history, wilderness character, biodiversity and sheer size offer a rare and valuable experience. The river corridor is at the heart of the Grand Canyon. The river corridor and the canyon are worthy of the greatest possible respect, treatment, and protection that we can afford them. They must be kept vital and intact for future generations.

Glen Canyon National Recreation Area: The river corridor through the GCNRA provides opportunity to enjoy outdoor beauty with relatively easy access. It supports a valuable and high quality trout fishery and offers excellent outdoor opportunities that are more accessible and less demanding than those of the Grand Canyon. It is deserving of our respect and protection, while also providing the recreational opportunities for which it was established.

DFC GOALS AND OBJECTIVES

DFC Objectives

The Recreation DFCs have been divided in to four subcategories, each corresponding to a different section of the overall ecosystem or type of use:

River Recreation in Grand Canyon National Park

- Stewardship worthy of the Grand Canyon so that it can be passed from generation to generation in as natural condition as possible.
- Provide maximum opportunity to experience the wilderness character of the canyon.
- Wilderness experiences and benefits available in the canyon include solitude, connection to nature, personal contemplation, joy, excitement, the natural sounds and quiet of the desert

and river, and extended time periods in a unique environment outside the trappings of civilization.

- A river corridor landscape that matches natural conditions as closely as possible, including extensive beaches and abundant driftwood.
- A river corridor ecosystem that matches the natural conditions as closely as possible, including a biotic community dominated in most instances by native species.
- A dynamic river ecosystem characterized by ecological patterns and processes within their range of natural variability.
- Numerous campable sand bars distributed throughout the canyon.
- Recreational and wilderness experiences minimally affected by research and management activities.
- River flows that continue to be within a range that is reasonably safe, given the inherent risks involved in river recreation.

River Recreation in Glen Canyon National Recreation Area

- A quality recreation experience in Glen Canyon.
- Camping beaches suitable for recreational use.
- A setting and ecosystem that is as close to natural conditions as possible.
- Quality river running and angling recreation opportunities.

Blue Ribbon Trout Fishery in Glen Canyon National Recreation Area

- A high-quality sustainable recreational trout fishery in the river corridor in GCNRA, while minimizing emigration of non-native fishes.
- Operate Glen Canyon Dam to achieve the greatest benefit to the trout fishery in GCNRA without causing excessive detriment to other resources.

River Corridor Stewardship

- Management of Glen Canyon Dam that is significantly driven by concern for the cultural values and ecological integrity of the river corridor through the Grand Canyon, with preservation and protection considered over the long term (multiple generations).
- A well-informed public, confident that high quality scientific information is being used for best stewardship practices in the CRE.

DFC ADDITIONAL INFORMATION

Linkages

- A natural, healthy, and protected ecosystem is a fundamentally key element to the recreation experience and wilderness character of the river corridor.
- Cultural resources within and near the river corridor:
- The history of human habitation and use is an important part of the recreation experience. Individual sites are valuable whether they are open for visitation or designated off-limits.
- Outfitters and guiding opportunities
- Local businesses

Metrics

- Socio-economic value of river recreation in GCNP.

- Socio-economic value of the river corridor visitation and the Grand Canyon itself, as a whole.
- Economic effects of Grand Canyon tourism.
- Factors that make up the "wilderness character" of the river corridor.
- Number and size of campable beaches, safe flows for an optimal recreation experience
- Socio-economic value of river recreation in GCNRA.
- Socio-economic value of the river corridor itself in GCNRA.
- Socio-economic value of the fishery in GCNRA.
- Effect of the trout on the ecosystem in GCNP and the social and economic costs of mitigation.
- Characteristics most valued for the fishery; for example, the number, condition, and size of fish, and the ease or challenge of catching them.
- River running visitation metrics
- Water quality variables that influence river recreation
- Other river running safety issues

ATTACHMENT A: DFC BACKGROUND

GENERAL COMMENTS REGARDING PHASE 1 PROCESS

Dam Operations, Limitations, and Constraints

The process to complete the DFCs generated a number of comments and discussion that may clarify or augment the DFCs, and are here documented as background information.

Almost every means or fundamental DFC resource or process in the Colorado River ecosystem (CRE) in Glen and Grand Canyons has some nexus to the operations of Glen Canyon Dam, and the existence of the dam is a given. The Grand Canyon Protection Act (GCPA) and the Adaptive Management Work Group (AMWG) Charter frame the discussion of system limitations and constraints accepting the existence of Glen Canyon Dam as a given. Pursuant to your direction, our DFCs Phase 1 discussions focused on the definition of reasonableness and achievability of the DFCs proposed; however, many uncertainties exist over the nature and extent of dam operations and their impacts. Some resources, such as power, are clearly affected by Glen Canyon Dam operations, while the impacts of dam operations on other resources (e.g., water quality) are less clear.

The DAHC engaged in a rigorous discussion over what could be managed with dam operations and which resources and processes were not affected, or were only partially affected, by dam operations. Teasing apart the ecosystem impacts of dam existence versus dam operations remains a challenge, both in terms of science and agency policy dynamics. For example, dam construction greatly reduced annual flow variability, and the potential ecological benefits and policy implications of Modified Low Fluctuating Flows (MLFF) flows with relatively small (45,000 cfs) high flow experiments are still being evaluated. It was agreed that additional direction and science are needed to help improve understanding of these relationships, limitations, and operational constraints, and that those topics should be key components of Phase 2 DFCs discussions.

The GCPA provides for management actions other than dam operations, and therefore may expand river ecosystem management tools. The AMWG charter states, “the AMWG may recommend research and monitoring proposals outside the Act, which complement the Glen Canyon Dam Adaptive Management (AMP) process, but such proposals will be funded separately, and do not deter from the focus of the Act.” Phase 2 DFCs discussions will need to distinguish between dam operations and non-flow management responsibilities and actions. The DAHC will forward to the AMWG for considerations recommendations to the Secretary for appropriate long-term flow and non-flow management actions for implementation, addressing the funding for non-flow actions.

Science and Monitoring

A rigorous, credible science program is essential for all aspects of DFCs monitoring, research, and reporting, for development of AMP advice to the Secretary (Schmidt et al. 1998). At present, science services are provided to the AMP primarily by the U.S. Geological Survey through the Grand Canyon Monitoring and Research Center (GCMRC). While a DFC specifically for science integrity was considered by the DAHC, we view the need for AMP science and

monitoring as programmatic, extending to all elements of the AMP. Therefore, achieving DFCs as well as AMP goals requires the following from its science program(s).

1) Scientific information used for the AMP process must be reliable, of high quality, and rigorously reviewed. At present, the AMP relies on dialogue between stakeholders and the GCMRC to establish research and monitoring tasks and priorities. Continued and even more rigorous review of scientific research plans and projects should be performed by the independent Science Advisors, and their recommendations should be seriously considered and implemented where appropriate.

2) Peer-reviewed publication of scientific findings in major scientific journals is the gold standard for scientific credibility, and peer-reviewed publication amplifies the credibility of the overall AMP to the scientific community and to the public. Peer-reviewed publication is the norm for all scientific organizations; and we strongly recommend that all major AMP projects undertaken by the USGS be prepared and submitted for peer-review publication, rather than being left in report form.

3) AMP data, reports, hard copy field notes and maps, meeting documentation, and other information should continue to be compiled and archived in a fashion that makes it easy to access and easy to relate to contemporary and emerging issues. AMP information management, through both GCMRC and Reclamation, occasionally should be reviewed by the Science Advisors or by external information management experts, and recommendations from those reviews should be followed. A summary of findings and conclusions to date should be developed, maintained, and modified as appropriate to further guide the AMP process (e.g., Gloss and Kennedy 2005 is an excellent example). An annotated, searchable administrative history of the AMP would be useful and improve information availability, project completion, AMP progress, and education of new AMWG members, and should help prevent duplication of effort over time.

4) Uncertainties, unrecognized linkages, unanticipated ecosystem events and processes, changing policies, and biases are abundant and affect our understanding of the CRE and its dynamic character. Consequently, much uncertainty exists over CRE management appropriateness and effectiveness, particularly involving direct and indirect impacts of dam operations on biota, processes, and interactions. The implications of uncertainty often are not clearly acknowledged or embraced in science planning. The extent, impacts, and risks of scientific uncertainty on monitoring, research, and management program success should be more clearly identified, assessed, and communicated to the AMWG.

DFC REVISION AUGUST 2011 TO JANUARY 2012

Process

The Department of the Interior reviewed the DFCs submitted by AMWG on 8 November 2010, with a transmittal memo from George Caan and Larry Stevens. The 8 November 2010 DFCs memo noted: "We expect that the DFC document presented here will be carefully reviewed and considered by DOI for consistency with existing laws and policies. However, the advice provided is the Secretary's to do with as he sees fit, and may or may not be incorporated into DOI management. Consequently...we consider the DAHG presentation of this final DFC

document to be an appropriate use of Secretarial engagement of his Federal Advisory Committee."

AMWG 24 August 2011 Charge

The Secretary's Designee coordinated the expected review of the DFC document, and graciously returned the reviewed draft to AMWG for consideration. The DFC Review Ad Hoc Committee was charged on 24 August 2011: "To reconstitute the DFCs Ad Hoc Group, with Larry Stevens and Perri Benemelis as co-chairs, with participation from federal agencies, with members who volunteer in the spirit of full participation, to provide a final review of the DFCs, focusing on changes made to the DFCs by the federal agencies, and submit the final draft DFC document for consideration by the AMWG."

The scope of the DFC Ad Hoc review process focused on changes to the DFC's by DOI but was not strictly limited to reconciling the DOI document with the final recommendation from the Ad Hoc. , In those instances where substantive changes to the AMWG recommendation were made, discussion focused upon existing information, laws and policies that led to modification of the AMWG recommendation.

The Review Process

Before discussing non-consensus issues that arose at these meetings, the DFCAHC recommends that the AMWG examine the process used to develop its Phase I narrative (qualitative) DFCs document. The AMP program employs adaptive ecosystem management to pursue improvement of the science-based aspects of the program. The DFCAHC believes that it is also worthwhile to review the process utilized to develop DFCs so that it can learn from, and improve its process in the future to benefit the Program and the valued resources of the Colorado River Ecosystem.

- In August, 2010, the AMWG recommended the narrative DFCs to the Secretary for consideration, revision, and approval, subsequent to comments received by the DFC Ad Hoc group. This recommendation initiated a process in which individual Ad Hoc members and others suggested additional changes to the document. While the development of the August 2010 document was largely accomplished with in-person meetings, the subsequent comment process was handled in a less direct manner. The co-chairs were responsible for reconciling comments (provided to the Ad Hoc via mail, e-mail or by phone communication) and appropriately modifying the document. The resulting document was issued in November 2010.
- The two-step process (described above) to develop the November 2010 DFC recommendation led to confusion. The first part of the process was accomplished mostly through in-person meetings. The second part of the process was accomplished mostly via e-mail. The November 2010 recommendation inadvertently omitted provisions of the August recommendation. Omissions from the November 2010 document were not identified until the reconstituted DFC Ad Hoc 2 process began.
- The Interior agencies subsequently initiated a review of the November 2010 document for consistency with existing law and policy. The resulting document was reformatted, reorganized and rewritten. The undated DOI document and table of changes was included with the AMWG materials for the August 2011 meeting. We note some confusion over interpretation of the formatting of the November 2010 document, which resulted in additional confusion in the August 2011 document.

- The shift from the in-person process to the e-mail communication process may have resulted in unintended changes to the AMWG recommendations. These omissions were not identified until much later. The Interior agencies changes resulted in additional confusion.
- The Ad Hoc was under significant time pressure to complete its work by the identified deadline.

The DFCAHC Review members and co-chairs devoted considerable time and effort to this process, and intend that their efforts result in a positive outcome for the program. Future Ad Hoc efforts could benefit from recognition of the role of the public deliberation part of the process. Both the Ad Hoc group and the greater advisory council benefit from open, frank and respectful communication between the stakeholder representatives. Although the stakeholders represent varied and sometimes competing interests, all have a responsibility to clearly communicate issues and concerns and to openly deliberate with the goal to reach a reasonably balanced and workable solution or recommendation.

Non-Consensus DFC Issues

At the November 22 2011 meeting, these non-consensus issues were identified. This list follows the order of presentation in the DFC Reviewed document, and does not imply priority or importance.

1. Resolution of Kanab ambersnail taxonomy
2. Additional CRE information text to add
3. Funding responsibility for extirpated species
4. Use of the term “balance” with respect to hydropower and environmental management
5. The scope of cultural concerns is broader than just archeology
6. The use of the term ‘unimpaired’
7. Use of the phrase “blue ribbon trout fishery”
8. Additional CRE issues in GLCA
9. A Recreation DFC for a well-informed visiting public

All topics except 2 and 3 (above) were resolved with further discussion during the 10 January 2012 meeting. Following is a summary of the non-consensus issues discussion. Text associated with the two remaining non-consensus issues is highlighted in red. The following non-consensus issues summaries are provided for informational purposes.

1. P. 6: Resolution of Kanab ambersnail (KAS) taxonomy involves peer-reviewed publication of genetics findings, which indicate that KAS as *Oxyloma haydeni kanabensis* should be subsumed into the taxon known as the Niobrara ambersnail (*O h. haydeni*), thus eliminating KAS as a taxonomic entity. Failure of AMWG to continue funding this process after more than a decade of research means that KAS will continue to impact flow management options in the CRE.

In the December 23, 2011 Biological Opinion entitled *High Flow Experimental Releases, Non-native Fish Control Downstream, and the Modified Low Fluctuating Flow from Glen Canyon Dam for 10 years through 2020*, the Service addressed the Kanab ambersnail (KAS)

taxonomy discrepancy. Due to the pending taxonomic evaluation the conservation measure for KAS was revised to study the effect of the HFE Protocol on the population of Kanab ambersnail at Vasey's Paradise through continued monitoring but not continue removal and replacement of habitat for HFEs. FWS has analyzed the effect of the potential loss of habitat over the life of the proposed action and concluded that the conservation measure is not necessary to maintain a healthy population of Kanab ambersnail at Vasey's Paradise because the amount of habitat and snails that will be unaffected by the proposed action is sufficient to maintain the population. FWS recommended that Reclamation should consider supporting the recommendations in the Kanab ambersnail 5-year review including convening a team of snail, taxonomy, and genetics experts to conduct a Structured Decision Making exercise focused on reviewing or revising the current taxonomic status of the *Oxyloma* genus.

2. P. 7: Modification of the text of the CRE Additional Information Linkages section was suggested by the State of Colorado, but was not resolved and requires more discussion. The suggested additional text reads:

“In addition to physical and biological interactions, the CRE is linked to Native American cultural resources such as archeological and cultural properties. Recreation benefits have resulted from both dam operations and healthy ecosystem conditions. **It is critical to recognize the linkage between the body of law known as the “Law of the River,” the 1992 GCPA, laws pertaining to the NPS, and these DFC’s. The “Law of the River” defines how the Secretary of Interior must operate Glen Canyon Dam for water storage, water management, river regulation and hydropower. The ability to achieve the DFC’s identified herein depends in large part on the ability of the Secretary of Interior to find an appropriate balance given the competing legal mandates within the operational flexibility those laws provide.”**

3. P. 7: Disagreement among stakeholders exists over responsibility for funding the restoration of extirpated native fish and non-fish species (Colorado, Arizona, Western; contested by GCT, GCWC). The following text on this subject was originally agreed to by AMWG and included in the AMP Strategic Plan was inadvertently omitted and did not appear in the final November 2010 DFCs passed along to the Secretary:

“Achieve the balance of resource benefits envisioned by the Grand Canyon Protection Act, GCD EIS Preferred Alternative, and NPS 2006 Management Policies; maintaining, enhancing and where practical, restoring native species, natural habitats, and natural ecosystem processes. Native and non-native species are to be managed in accord with federal regulations, policies, and guidelines. Goal 3 in the AMP Strategic Plan (“Restoring populations of extirpated species as feasible and advisable”) is to be achieved in accord with the direction in RIN 3.1.1, which states:

‘RIN 2.1.1 What information (including technical, legal, economic, and policy issues) should be considered in determining the feasibility and advisability of restoring pikeminnow, bonytail, roundtail chub, river otter, or other extirpated species? (Category C)’

A Category C Information Need is defined in the Strategic Plan as: ‘Information Needs that are funded and accomplished under authority of an entity other than GCMRC.’

Restoration of extirpated species should be guided by Goal 3 of the GCD AMP Strategic Plan and AMWG agreements from its August 2003 meeting, and such activities are not to be funded by the Adaptive Management Program. While AMP funding may not be used for such activities, AMWG may still advise the Secretary about the feasibility of reintroduction activities, and may request monitoring and information integration about such reintroduction activities.”

The above text was requested for inclusion in the CRE Extirpated Species DFC by some stakeholders but it was agreed to identify and move the issue here in Appendix for discussion by AMWG at a more appropriate time in the future. This issue pertains primarily to cases in which the construction or operations of Glen Canyon Dam have been clearly identified as contributing to the extirpation or precipitous decline of a native species in the CRE. The issue of actions outside the scope of the AMP and the funding of those actions was initially addressed in a January 2000 informal opinion by Scott Loveless, legal counsel for Interior and Reclamation. The argument of whether or not the reintroduction of extirpated species was within or outside the AMP lead to the above language.

AMP assumption of funding responsibility for extirpated species may affect the funding available for other AMP activities as well as having impacts on power marketing both from costs accrued from the conduct of restoration activities as well as potential limitation of flows to accommodate restored populations. However, NPS and FWS missions oblige Interior to engage in restoration, and some AMWG stakeholders are committed to the restoration of native extirpated and declining species. The DFC AHC noted that positive benefits may accrue from AMWG advice on such actions and resolution of conservation issues that limit flow management (e.g., humpback chub management, Kanab ambersnail taxonomic status). The consequences of an AMWG recommendation to the Secretary at this time that does not address responsibility for extirpated species management simply means extirpated species management continues under existing federal laws. Nothing prohibits AMWG offering advice to Secretary at a later date through the Adaptive Management Program.

4. P. 9 (top): There has been significant discussion regarding achieving a balance among GCDAMP resources. Language reflecting the relationship of the hydropower DFC to the other DFCs was proposed and included.
5. Pp. 10, 12: At least one and likely other Tribes contend that the DFC treatment of cultural issues fails to recognize Grand Canyon as a vital, living landscape, one whose care is central to the cultural well-being of several Tribes. Also of central concern are aquatic and wetland species, which hold special significance to several Tribes. The cultural DFC focuses principally on archeological and historical resources and fails to take into full account both fine-scale and Canyon-wide distribution of cultural sites.

6. The term “unimpaired” is used several times in the CRE DFC. Management of the CRE for a DFC of an unimpaired condition is philosophically misleading, unrealistic, and may limit management options (State of Colorado; Zuni Tribe).
7. P. 15: The phrase “blue-ribbon trout fishery” is retained as a header for the trout fishery section of the CRE, and has economic implications for the angling community. Should the phrase be used more frequently in the text?

Wikipedia (http://en.wikipedia.org/wiki/Blue_Ribbon_fishery) defines a blue ribbon trout fishery as:

“... a designation made in the United States by government and other authorities to identify recreational fisheries of extremely high quality. Official *Blue Ribbon* status is generally based on a set of established criteria which typically addresses the following elements:

- *Water quality and quantity*: A body of water, warm or cold, flowing or flat, will be considered for Blue Ribbon status if it has sufficient water quality and quantity to sustain a viable fishery.
- *Water accessibility*: The water must be accessible to the public.
- *Natural reproduction capacity*: The body of water should possess a natural capacity to produce and maintain a sustainable recreational fishery. There must be management strategies that will consistently produce fish of significant size and/or numbers to provide a quality angling experience.
- *Angling pressure*: The water must be able to withstand angling pressure.
- *Specific species*: Selection may be based on a specific species.

...Many quality recreational fisheries are informally referred to as *Blue Ribbon* by government agencies, tourist, media, environmental, sportsman organizations and writers, but are not officially designated as such by established criteria.”

8. P. 15: Recreation issues within Glen Canyon National Recreation Area not recognized in the DFCs include: a) the economic significance of river running and trout fishing (recreation); b) limiting the undesired impacts of recreation on the viewshed (CRE); and c) the loss of driftwood as a natural resource, primarily as habitat in the CRE DFC. Text on these topics were added to the Recreation DFCs for Glen Canyon.
9. P. 15: A Recreation DFC issue not included in the document involves outreach of scientific information to the visiting public in GLCA and GRCA. A primary resource for enhancing visitor experience is information on the high quality of scientific information available for Grand Canyon, and public trust that such information is being used to support best management practices. Such a Recreation DFC for both NPS units might read:

“A well-informed public, confident that high quality scientific information is being used for best stewardship practices in the CRE.”

This DFC was added to the Recreation DFCs in the River Corridor Stewardship section.

23 January 2012

The 10 January 2012 Meeting, Conference Call, and Final Wrap-up

A conference call held on 10 January 2012 clarified many points of disagreement in the December 2011 draft documents. The 13 January draft DFC review, cover letter to AMWG, and table of comments were circulated to the DFCAHC for a final review. That meeting and further discussion during the following week resolved the non-consensus issues, except for points 2 and 3 (above). The non-consensus issues are described in the final DFC AHC Background and the two unresolved issues are highlighted in red (above) for discussion and development of recommendations to the Secretary by AMWG. The documents were forwarded to Reclamation on 23 January 2012 for inclusion in the February 22-23 AMWG meeting package.

DFC PHASE 2 RECOMMENDATIONS: HOW TO MOVE FORWARD

DFC Phase 2 Challenges

Phase 1 DFCs clarify the DAHC vision for the Colorado River socio-ecosystem. Further DOI review of these DFCs helps focus the AMP. Several conflicts and assumptions over AMP direction challenged the development of Phase 1 DFCs and remained unresolved.

General programmatic conflicts are listed in the 2009 Policy Issues Ad Hoc Committee report and primarily involve conflicts among mandates and establishment of clear priorities. It would be advantageous for the DOI to resolve intra-departmental conflicts, and to identify a resolution strategy for inter-departmental conflicts that would help the AMP find a balance among competing laws and mandates.

An assumption that perpetuates conflicts in development of the DFCs appears to be the direction and magnitude of the AMP: if environmental impacts stemming from dam operations can be successfully addressed, and other problems can be solved or mitigated outside the AMP, will the size and cost of the AMP program decrease?

Phase 2 DFCs quantification will require clarification of the scope of the AMP. Previous efforts have attempted to identify which elements lie within or outside the scope of AMP, but all issues have not been resolved or agreed to and they perpetuate controversy within the AMP. For example, how can the AMP be limited to dam operations if a fisheries recovery program addresses non-flow management activities? To what extent should AMWG consider restoration of missing species? The scope of AMP activities needs to be addressed through further discussion between the AMWG and the DOI.

Phase 2 should be structured to prioritize “fundamental resource” over “means” DFCs or to identify obstacles (including uncertainties) to that prioritization where possible. A prioritized approach will help define and clarify the supporting ecological and sociological linkages needed to achieve DFCs, and move towards those goals through appropriate scientific endeavors.

The relationship among federal and state responsibilities and the AMP should be clarified. It can be argued that the NPS has full jurisdiction over all DFCs, except those for hydropower and the Tribal and joint-use lands in the river corridor. For example, there is shared responsibility for some cultural and natural resources in the river corridor (e.g., Tribal responsibilities for cultural resources, Arizona’s responsibilities for fish and wildlife). Reclamation, in full cooperation with the Colorado River Basin States and other stakeholders, has responsibility for water storage, delivery, and dam operations. NPS has responsibility for GCNRA and GLNRA. (need correct acronyms). Clarification and balancing of jurisdictional responsibilities will help improve the overall adaptive management process.

In relation to the above, discussion on establishing a reference condition for management of the CRE has been a persistently divisive and controversial issue within AMWG.

Should the reference point be the pre-dam condition, or is it one or more post-dam reference years (e.g., 1984 or the initiation of the AMP in 1997), varying among resources? Resolution of this issue is needed for DFCs quantification in Phase 2.

Many of these issues are controversial. Therefore, we recommend that the Phase 2 DFC discussion be facilitated to identify, define, and resolve or clarify these and other conflicts prior to, and during, the Phase 2 DFCs quantification process.

PHASE 2 DFCs PROCESS RECOMMENDATIONS

We believe a number of steps should be taken as part of the Phase 2 process. The following is a list of some steps that might be considered.

- Design and conduct a facilitated AMP policy issues discussion process—perhaps as a workshop—to clearly identify, define, discuss, and, where possible, promote resolution of key issues of conflict among agencies. This process should focus initially on contentious issues among DOI agencies, such as NPS management for the natural (predam) condition of the CRE and Reclamation’s dam management policies and consequences. Progress on DFCs quantification in Phase 2 also will require determining whether and how inter-agency conflicts may limit achievement of DFCs and how to resolve those conflicts.
- Establish priorities among fundamental and means DFC elements by considering ranking and weighting by: perceived importance, certainty of beneficial impact, agreement on methods and metrics to be used (standardized metrics may be most useful), legal requirements, compliance/acceptability, cost, time frame, and linkage to other prioritized actions (i.e., implications for quantification of some DFC variables that affect quantification of other variables). Towards this end, completion and utilization of the comprehensive, long-term planning process would likely prove beneficial.
- Determine how Phase 2 DFCs priorities relate to AMP and GCMRC strategic plans and readjust monitoring priorities if necessary.

After the development of the quantified Phase 2 DFCs, Interior should propose or develop a draft Phase 2 DFCs implementation plan and funding strategy for review by all stakeholders, GCMRC and the Science Advisors. A final Phase 2 DFCs implementation plan should be provided to the AMWG by the Secretary for guidance.

COMPLIANCE RESPONSIBILITIES, LAWS, AND REGULATIONS

Each DFC has associated laws, regulations, and compliance responsibilities. A section was included in the DFC template to identify specific legal and compliance issues in each DFC. Many of these regulations are common to all DFCs but may be interpreted and applied differently, creating challenges in understanding linkages. We have provided a list of these laws and regulations below in order to facilitate the discussions that will occur during later phases of the project.

Partial List of Authorities (chronological if noted)

- Reclamation Act (1902)
- Grand Canyon National Monument (1908)
- National Park Service Organic Act (1916)
- Migratory Bird Treaty Act and Bald Eagle (1918)
- Grand Canyon National Park (1919)
- The Colorado River Compact- Law of the River (1922 and ongoing)
- Fish and Wildlife Coordination Act (1934)
- Bald and Golden Eagle Protection Act (1940)
- Upper Colorado River Basin Compact (1948)
- Colorado River Storage Project Act of (1956)
- Wilderness Act (1964)
- National Historic Preservation Act (1966) Sections 106 and 110
- Colorado River Basin Project Act (1968)
- National Environmental Policy Act (1969)
- Endangered Species Act (1973)
- Grand Canyon Enlargement Act (1975)
- DOE Organization Act (1977)
- Redwoods Act (1978)
- Archeological Resource Protection Act (1979)
- Native American Graves Protection and Repatriation Act (1990)
- Grand Canyon Protection Act (1992)
- Religious Freedom Restoration Act (1993)
- GCNP General Management Plan (1995)
- Record of Decision, Operation of Glen Canyon Dam Final Environmental Impact Statement (1997)
- Grand Canyon National Park Resource Management Plan (1997)
- Energy Policy Act (2005)
- Colorado River Management Plan (2006)
- NPS Management Policies (2006)
- Natural Environment Research Council NERC/WECC Standards (2007)
- NPS management statutory authorities for Glen Canyon National Recreation Area and Grand Canyon National Park
- Executive Order 11593-Protection and Enhancement of the Cultural Environment
- Executive Order 13007-Indian Sacred Sites
- Executive Order 13175-Consultation and Coordination with Indian Tribal Governments
- Secretary Order 3206-American Indian Tribal Rights, Federal-Tribal Responsibilities and the Endangered Species Act
- Arizona Revised Statutes Title 49
- Arizona Revised Statutes Title 17

CRE Relationship to Dam Operations

There are many direct and indirect, short-term and long-term ecosystem responses to dam existence and operations. Many of these are discussed in the SCORE Report (Gloss et al. 2005;

Fig. 1). This and the other three proposed DFCs are directly or indirectly linked on short and long-term bases through dam-related flows, sediment retention and distribution, hydropower production, fish and wildlife populations, recreation, and visitor experience. Figure 1 illustrates the complicated linkage among the dam operations and natural as well as socio-cultural resources in the CRE, and the extent of coverage of the proposed DFCs described in this document.

REFERENCES CITED

Gloss, S.P., and T.A. Kennedy, editors. 2005. The State of the Colorado River Ecosystem in Grand Canyon (SCORE). U.S. Geological Survey Circular 1282:87-98.

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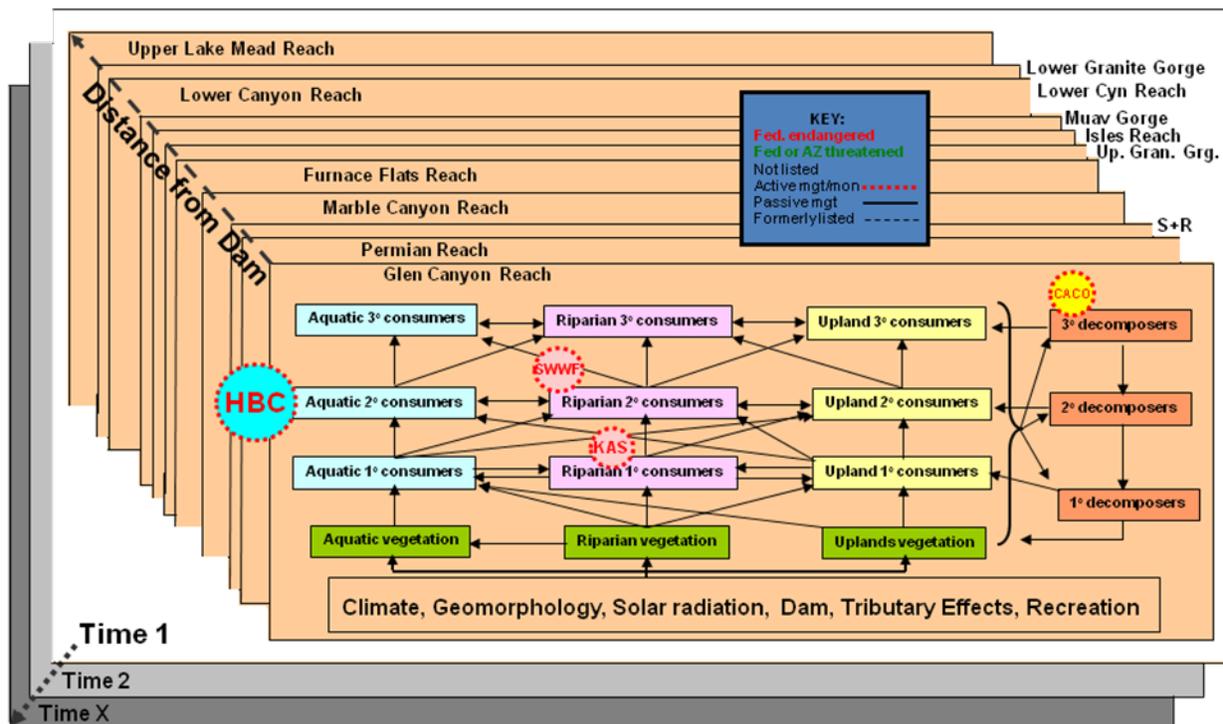


Figure 1: A schematic of the Colorado River ecosystem in relation to Glen Canyon Dam. The trophic position of species of management concern about which the AMP has devoted significant attention are indicated in circles: CACO – California Condor, HBC – Humpback Chub, KAS – Kanab ambersnail, SWWF – Southwestern Willow Flycatcher. Figure courtesy of Grand Canyon Wildlands Council, Inc., Flagstaff, AZ.

RECOMMENDED INFORMATION NEEDS AND PROGRAM ELEMENTS FOR A PROPOSED AMP SOCIOECONOMIC PROGRAM

AS APPROVED BY AMWG ON FEBRUARY 23, 2012

AMWG Charge to TWG (August 2010)

The AMWG supports implementation of studies to further our understanding of the socioeconomics of adaptive management decisions within the GCDAMP; this includes and is not limited to market, non-market, and non-use studies. Thus, the AMWG directs TWG to further develop an economics implementation plan to be provided to AMWG at its next meeting for possible implementation starting in FY 2012. That implementation plan will include the following components:

- a) Information needs associated with each study or analysis and the prioritization of those needs,
- b) Scope and costs associated with each project and potential funding sources,
- c) A description of how the information would be useful to the program, and
- d) A more thorough review of the economics panel report.

RECOMMENDATION

The following Tables 1 and 2 contain the information needs and associated program elements developed by the SEAHG for consideration by the Technical Work Group which are responsive to the AMWG motion (above). The proposal does not incorporate any prioritization or specific application to managers or policymaker's needs regarding how this information would be used to make recommendations. These recommendations could be addressed by GCMRC and the SEAHG during the next phase if the AMP and the Secretary would like to proceed with developing either part or all of this proposed program. Although this program would add considerable value to the AMP it would also come at a substantial cost and has implications to the needs of the LTEMP EIS being developed. There are numerous policy level issues which need to be addressed before the SEAHG can work with GCMRC to develop a socioeconomics program from this plan.

A description of comments on the economics panel report and a crosswalk between the panel recommendations and direction taken in this implementation plan will be provided in a separate document in order to fulfill part (d) in the AMWG motion.

BACKGROUND

Economic values related to hydropower production under differing flow regimes have been developed by the Western Area Power Administration on a continued basis since development of the Adaptive Management Program (AMP). However, economic values related to other resources, although addressed in the 1995 GCD EIS process have since received minimal program attention. Although a broader socioeconomic science and management program emphasis has been discussed by the AMP and its operating entities (AMWG, GCMRC, TWG, Science Advisors), a formal program has not been developed and approved by the AMWG to date.

In spring 2009, GCMRC proposed in their annual work plan to host a workshop to clarify socioeconomic interests of the GCDAMP. This effort involved prospectus development by the GCMRC, stakeholders, and SAs during the summer of 2009 and resulted in a two-day workshop in December, 2009 that reviewed previous socioeconomic studies and their results and identified a suite of stakeholder questions: subsequently, a report was developed by a group of independent economists that included a list of recommendations to address the interests and issues identified by stakeholders during the December 2009 workshop (Hamilton and others, 2010). In August 2010, AMWG heard an oral report from the independent panel of economists and then charged the TWG to review the written report and develop their own socioeconomic program proposal that could be reviewed and evaluated by AMWG at their next meeting. This task was accomplished by forming a Socioeconomic Ad Hoc Group (SEAHG). An outline of elements of a Proposed Socioeconomic Plan, including draft information needs and program activities was developed by the SEAHG in January, 2011 as a “Table 3”. Information needs in that “Table 3” also drew upon earlier work of the Science Planning Group (SPG 2006) as well as development efforts by the GCMRC and TWG on the Core Monitoring Plan (GCMRC 2009).

At the February, 2011 AMWG meeting, AMWG members received a briefing from Shane Capron, the TWG chair about “Table 3”. At the same time, it was pointed out to AMWG that NPS was initiating a comprehensive study on the economic value of recreation on the Colorado River that would address several of the components identified in “Table 3”, potentially rendering some elements of the SEAHG’s plan redundant. Therefore, a new Survey Instrument Ad Hoc Group (SIAHG) was formed and charged to review the two survey instruments proposed for use by the National Park Service to evaluate economic values for recreation in the CRE. It was felt that the NPS ongoing recreation science and management surveys and assessments represented similar efforts, at least in part, to those being proposed in the AMP, and both programs might benefit from the interaction. The SIAHG provided recommendations to the NPS on several economic values being developed in the two surveys, including market, non-market and non-use values. The recommendations were proposed for consideration by the NPS and were also considered as potential information needs for the AMP.

At the August, 2011 AMWG meeting, the TWG was charged by AMWG to continue refining “Table 3” (see below as Table 2). The SEAHG approached this task by reviewing the existing socioeconomic information needs and determined if additional needs should be proposed in this area. The review did identify potential additional information needs to be considered by the AMP.

In the fall of 2011 the SEAHG continued to review its past efforts and worked on developing a revised set of information needs and program elements for consideration by the TWG at its January, 2012 meeting.

The first task of the SEAHG was specification of a revised set of succinct socioeconomic information needs. This revised set of information then became the primary basis for establishing a required set of science and management activities, i.e. program elements to respond to these needs. The effort involved development of a progression of revised and improved Information Needs (INs) and program element revisions captured in power points from meetings on 11/2/11, 11/14/11 and 12/8/11.

DEVELOPING RECOMMENDED SOCIOECONOMIC INS AND PROGRAM ELEMENTS

A SEAHG review of developed socioeconomic information needs by the SEAHG and SIAHG determined that significant duplication existed, and many information needs lacked clarity. In addition, there was a need to winnow extraneous information that addressed questions, protocol, process, methods, costs etc. The SEAHG proposes that this information is more adequately addressed once the TWG agrees to a set of information needs to pursue and specifies the program elements for addressing these needs.

As noted above, the December 2009 workshop first identified information needs in the form of a series of questions. The SEAHG subsequently translated those questions into a set of information needs. Significant duplication was reduced in earlier work on information needs. Without succinct statements on information needs, development of program elements to accomplish the individual needs becomes problematic.

In general, this effort of the SEAHG has resulted in a significant expansion of socioeconomic information needs recommended for consideration by the TWG. Several general areas of socioeconomic information needs were considered important to the stakeholder group, i.e. recreation, cultural, water, and power resources. In addition, a general information need category was also identified. For each area, three or more types of socioeconomic values are specified for development, including market, non-market and non-use values. The effort also became more focused on delineating clear distinctions among differing social and economic values being proposed for evaluation, a direction encouraged in the October TWG meeting.

The area of information needs that received greatest attention by the SEAHG was recreation. The area was the focus of an earlier effort by the SIAHG and was expanded by this SEAHG effort. Market, non-market, non-use, etc. evaluations of alternative management actions on recreation are now proposed for development. The diversity of recreation resources in both Glen Canyon and the Grand Canyon are proposed for evaluation, i.e. angling, boating, camping, hiking, wilderness values, etc.

Intra-regional market efficiency impacts of alternative dam operations have traditionally been the AMP focus in hydropower. This direction is modified in the SEAHG proposal with the new direction incorporating inter-regional impacts and assessments of total economic implications that incorporate market, non-market, non-use etc. values.

Evaluating implications of alternative GCD operation scenarios on associated values of water resources has not been an element of the AMP. The SEAHG is proposing that assessments be developed related to market, non-market, non-use and other values.

Determination of alternative dam operation impacts on various values of cultural resources is recommended by the SEAHG. Because cultural resources per se often do not enter the arena of market exchange, much of the need lies in determination of non-market, non-use, existence value etc. of impacts associated with operations changes.

The SEAHG also determined that a category of general information needs was important to capture both needs and program elements that are important to effective implementation of the proposed socioeconomic program. The general area could expand but currently incorporates an IN that addresses valuation needs in resource areas currently not defined by SEAHG. It also addresses the need of the AMP

to continue to educate members on the meanings, benefits and costs, and utility of information from market, non-market, non-use, etc. evaluations being proposed for the program. It addresses as well the need for a workshop for specification of how information proposed for development might best be utilized by the AMP, in core monitoring and other areas.

MORE COMPLETE EVALUATIONS OF RESOURCE ECONOMIC VALUES

In its deliberations, the SEAHG decided to propose that more complete economic values be evaluated for the identified resources of concern. This relates primarily to the fact that both market and non-market resource values of the CRE that may be impacted by alternative dam operations are not being completely accounted for in current AMP evaluations. Therefore, more comprehensive market and non-market economic resource values of concern to the AMP, including cultural values and sites, recreation, water quantity and quality, and hydropower are proposed for development in the socioeconomic program. The following brief overview highlights general characteristics of more complete economic evaluations. More specific definition of needed valuations to be pursued in individual resource areas would be developed in a general science and management plan proposed for 2012.

Market exchanges of goods and services of economic value has persisted for thousands of years as has societal methods and requirements for creating uniform economic basis for these exchanges. This has resulted in monetary systems and theories of the economy of these exchanges being applied globally in the last century. The most common existing theories of market exchange relates to scarcity and the free or quasi-free interaction of supply of goods and services by producers and demand for these supplies by consumers. The agreed upon price for the exchanges is determined to reflect the market value of the good or service. The theoretical and practical performance of this system in existing societies uses different forms of money as the uniform basis to define the actual market value.

Market values of exchange of goods and services, although they reflect individual consumption measures, may not reflect the total economic value of the good or service to society. Goods and services not normally exchanged in the market and even those which are exchanged and do have established market values may also have non-market values. Included are many natural resources that society values and provides to the public. Examples include goods and services provided by governments as public goods. These are desired, accessed and benefited by the public, and often with minimal or no market exchanges. They are generally provided through taxation or minimal fee structures established exogenous to the market system. Examples in the CRE are rafting and recreational fishing, camping and hiking, tours of archeological sites.

Although market exchanges (fees) occur for some public goods and services, the prices paid are not established by the free market mechanism and often are assumed to be less than the true economic value of the resource. That is, even though some market exchange occurs, additional non-market value in the form of consumer surplus would normally exist at higher prices consumers would be willing to pay. Even exchange fees established for water and power resources in the CRE may not express the true economic value of these resources. Additional non-market value may also exist in the form of consumer surplus.

Current proposed assessments of varied flow and non-flow management alternatives for Glen Canyon Dam and the CRE and the resulting marginal changes to market and non-market values of

recreation, cultural, hydropower, water and other resource values, presents a classic example of the need for complete economic valuation of this large social investment. In many assessments of this type evaluation of impacts utilize cost/benefit or other economic analyses which attempt to express change in total economic value of goods and services in monetary terms.

Several different forms of economic non-market values have been defined for assessment purposes as are methodologies for deriving these values. Generally in science, management and legal applications two general types of non-market values have had significant application, revealed preference and stated preference approaches.

The first approach, revealed preference, studies actual revealed behavior on closely related markets to define the non-market value of a good or service. Two widely used methods for determining revealed preference are the hedonic pricing and travel cost methods. The revealed preference approach has a strong attribute in that it utilizes actual choices and market transactions to derive non-market values. A weakness is its use of only current and past levels of the non-market values. It also cannot be used to evaluate passive or non-use values such as existence values.

A second approach, stated preference, has received greater use in the past thirty years because it can be used to develop willingness to pay values over a range of conditions, including expected or proposed future conditions. It also can be used to develop non-use values including existence, altruistic and bequest values. The approach utilizes surveys to define individuals stated behavior under hypothetical conditions and settings. Development of actual willingness to pay values has involved several methodologies including conjoint analysis, contingent valuation, and choice experiments. Contingent valuation methods have had greatest application.

Greater specification of where and how market, non-market, non-use evaluations may be applied in the socioeconomic program will depend upon what information needs and program elements proposed by SEAHG are recommended by the TWG for further assessment. Once proposed information needs and program elements are recommended for evaluation, a Socioeconomic Program Plan can be developed.

Important to all proposed market and non-market economic assessments is the context in which these assessments will be eventually applied. The direction of the AMP in pursuit of goals outlined in the GCPA is to evaluate impacts of alternative dam operations and other management actions proposed on resources of the CRE (e.g., water, recreation, cultural, power). Before one can effectively ascertain the impacts of these alternative actions on the economic value of the resources, it may be necessary (depending on the methods of economic evaluation that are eventually employed) to first determine with some measure of certainty the biological, social or physical impact of the actions. The AMP is expending resources to improve the certainty of these impacts to varied resources, but significant uncertainty still exists. Without knowing these impacts with reasonable certainty, the additional step of defining marginal economic impacts is difficult.

DEFINING PROPOSED SOCIOECONOMIC INFORMATION NEEDS AND PROGRAM ELEMENTS

The following Table 1 contains the information needs and associated program elements developed by the SEAHG for consideration by the Technical Work Group.

Table 1: Proposed Information Needs and Program Elements

PROPOSED SEAHG INS	PROPOSED PROGRAM ELEMENTS
<p>Recreation Information Needs</p> <p>RIN 1. What are the total market, non-market, and non-use values for the following recreational uses of the Colorado River Ecosystem downstream from Glen Canyon Dam, including pre-rod and post-rod demand and economic assessments</p> <ul style="list-style-type: none"> • Glen Canyon boating and walk-in trout fishery and related components • Glen Canyon recreational boating industry • CRE day hiking and overnight camping • Grand Canyon Private and commercial rafting operations including Native American enterprises 	<p>Conduct recreation expenditure analysis of Lees Ferry anglers and boaters, and Grand Canyon boaters. (Note: Some of this may be covered by the NPS economic study being carried out by University of Montana in 2012)</p> <p>Initiate and conduct recreation non-market and non-use assessments (Note: Some aspects of this program element may be covered by the NPS economic study.)</p>
<p>RIN2. Define and value key attributes and key benefits that affect the Grand Canyon wilderness and Glen Canyon recreation experiences</p> <ul style="list-style-type: none"> • How do they affect market values for these different CRE recreation activities? • How do they affect non-market for these different CRE recreation activities? • How do they differ under alternative flow regimes and events such as HFEs, low steady flows and other experiments? • How do they differ under alternative management actions? 	<p>Conduct focus groups and pilot non-market surveys</p> <p>Conduct full non-market value surveys</p>
<p>Tribal Information Needs</p> <p>CRIN1. What are the market, non-market and non-use values for CRE resources valued by tribes as affected by dam operations?</p>	<p>Scoping; identify tribes for specific surveys. Determine if separate tribal studies are needed.</p> <p>Conduct tribal market, non market, non-use scoping and value assessments</p>

impacts from dam operations and deemed important to the AMP	differing flow and non-flow alternatives. Develop general program capability to evaluate market, non-market and non-use values for resource impacts not yet defined by the AMP
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PROPOSED SOCIOECONOMIC IMPLEMENTATION PLAN

The following Table 2 contains the implementation plan requested by AMWG. It is a further refinement of the previous “Table 3” which has been presented to TWG and AMWG at numerous meetings.

Table 2. Proposed Socioeconomic Plan by year of implementation.

ROW #	Proposed Study/Activity	Information Needs	Description of Activity
Year 1			
1	<p>Conduct workshop to inform TWG/AMWG of various socioeconomic information types and their utility.</p> <p>Make a recommendation on appropriate socioeconomic research information use within the AMP.</p> <p>Cost: \$15,000</p>	<p>GIN 1. What are merits of market non-market, non-use and existence. values being proposed for development, i.e., reliability of information gained, costs, area of proposed use in program..</p> <p>GIN 2. Define how socioeconomic research information should be used by AMP</p>	<p>The socioeconomics panel recommended that GCMRC host a Non-Use Values 101 workshop to help TWG & AMWG understand the relevance and value of this type of study for informing future decision making. In 2011, TWG and GCMRC held a basic introduction to the concepts and rationales underlying socioeconomic studies in general, to clarify terminology, and to provide an overview of how various types of analyses (market, non-market, non-use studies) are conducted and how the resulting data could be interpreted. This proposed workshop would tier off that effort and delve more deeply into how data collected could be applied to AMP decisions. One result of the workshop should be a recommendation on how the AMWG, DOI, and DOE/WAPA should use the recommended socioeconomic data in the different decision making processes such as NEPA analysis, adaptive management, and in any benefit-cost analysis.</p>
2	<p>Define GCD operational base cases and change cases.</p> <p>Base cases proposed: MLFF and pre-ROD</p> <p>Cost: Policy decision</p>	<p>HIN 1. What are the impacts to federal hydropower customers from implementation of Record of Decision (ROD) dam operations and various other flow regimes and segregate those effects from other causes such as changes in the power market.</p>	<p>This task addresses the fundamental need to define a base case (i.e., a “standard”) against which proposed changes in GCD operations can be evaluated in the future. The panel recommended that TWG select an operational scenario that reflects current (MLFF) operations. The base case needs to define monthly volumes, hourly (or even within hourly) outputs, amount of peak and off-peak power production, etc. There is disagreement of what the base case should reflect; pre-rod conditions or MLFF. We recommend developing two base case scenarios that captures current MLFF operations and pre-ROD.</p>
3	<p>Power modeling: conduct the base case analysis and initial</p>	<p>HIN 1. What are the impacts to federal hydropower customers from</p>	<p>Implement the report recommendation to complete the base case study for hydroelectric operations. The detailed description of the base case</p>

ROW #	Proposed Study/Activity	Information Needs	Description of Activity
	<p>power modeling using currently available models and test “spill over” effects with the WECC.</p> <p>Cost: GCMRC \$30,000, Western \$107,000</p> <p>WECC = Western Electrical Coordinating Council (i.e., western grid).</p>	<p>implementation of Record of Decision dam operations and various other flow regimes and segregate those effects from other causes such as changes in the power market.</p> <p>HIN 2. What would be the market impacts on marketable capacity and energy of:</p> <ul style="list-style-type: none"> • Increasing the daily fluctuation limit Increasing up-ramp and down-ramp limits • Raising maximum power plant flow limit above 25,000 cfs • Lowering the minimum flow limit below 5,000 cfs 	<p>study will be prepared by GCMRC, with input from WAPA , and any additional specifications by the TWG/AMWG. This base case study will also include an analysis of "spill over" with the WECC. The base case and spill over analysis will be completed by WAPA and a report prepared at no cost to the AMP. The report will be submitted by WAPA to GCMRC for peer review. GCMRC will oversee the peer review process and use the Science Advisors as needed. WAPA will incorporate changes into the report based on comments received from the peer review process.</p> <p>If WAPA’s power flow models demonstrate changes in flows at the border of WAPA’s system, or at interconnection points with other systems, then a more extensive modeling effort may be required, to check for changes in four indicators throughout the WECC (generation, transmission, reliability, and hub prices).</p>
Year 2			
4	<p>Non-use values workshop to incorporate review of the 1994 Non-Use Value Survey and update the questionnaire.</p> <p>Cost: \$30,000</p>	<p>HIN 3. What are the total market, non-market and non-use impacts on upper and lower basin water users from proposed alternative dam operations?</p> <p>HIN 4. What are the socioeconomic impacts of Glen Canyon Dam operations and experiments to tribal communities, including market, non-market and non-use?</p> <p>HIN 5. What are the market, non-market and non-use values associated with Glen Canyon electrical power, and determine these values.</p>	<p>A new non-use value study is needed to properly assess resource values associated with Grand Canyon, and potential impacts to those values from dam operations. The focus would be on values that are important to tribes and the broader American public that are not dependent on human use or consumption for their value. Data on tribal values may be gathered as part of this study depending on the outcome of preliminary investigations. Preparing for this study will take considerable time; therefore the panel recommended that GCMRC and TWG start planning early for a future non-use value study, taking into account changes that have occurred in the canyon and to dam operations since 1995. Initiating Step #1 – discussion and review of old questionnaire – could be done at no additional cost to the AMP. However, TWG is recommending that this be accomplished in a workshop format to include a more detailed review of non-use economics.</p>

ROW #	Proposed Study/Activity	Information Needs	Description of Activity
		<p>HIN 6. What are the market, non-market and non-use values associated with water released through Glen Canyon Dam, and determine these values.</p> <p>RIN 1. What are the total market, non-market, and non-use values for the following recreational uses of the Colorado River Ecosystem downstream from Glen Canyon Dam, including pre-ROD and post-ROD demand and economic assessments:</p> <ul style="list-style-type: none"> • Glen Canyon boating and walk-in trout fishery and related components • Glen Canyon recreational boating industry • CRE day hiking and overnight camping • Grand Canyon private and commercial rafting operations including Native American enterprises <p>RIN 2. Define and value key attributes and key benefits that affect the Grand Canyon wilderness and Glen Canyon recreation experiences:</p> <ul style="list-style-type: none"> • How do they affect market values for these different CRE recreation activities • How do they affect non-market and non-use values for these different CRE recreation activities • How do they differ under 	

ROW #	Proposed Study/Activity	Information Needs	Description of Activity
		<p>alternative flow regimes and events such as HFEs, low steady flows and other experiments</p> <ul style="list-style-type: none"> • How do they differ under alternative management actions 	
5	<p>Scoping activity: identify tribes for specific surveys of preferences and attitudes and determine if separate tribal studies are needed.</p> <p>Cost: \$5,000</p>	<p>CRIN 1. What are the market, non-market and non-use values for CRE resources valued by tribes as affected by dam operations?</p>	<p>There is a need to better integrate tribal values in AMP decision making. This task is intended as a scoping activity to determine how tribal values should be assessed and then integrated into AMP decision making. Future activities per the panel’s recommendations are provided below but they are placeholders if scoping finds that a separate process is needed to specifically address tribal preferences and values. This scoping process should fully include the tribes and any similar processes they may be involved in (such as the surveys currently being conducted by the Hopi Tribe as part of their monitoring project).</p>
6	<p>Recreation Use Analysis:</p> <p>Part A (Market): initiate recreation expenditure analysis of Glen Canyon anglers, day-use rafters, and Grand Canyon and Marble Canyon white water users including Diamond Creek to Mead rafters.</p> <p>Part B (Non-Market): initiate development of survey instrument for recreation non-market use analysis and obtain OMB clearances.</p> <p>Cost: \$150,000 - \$200,000</p>	<p>RIN 1. What are the total market, non-market, and non-use values for the following recreational uses of the Colorado River Ecosystem downstream from Glen Canyon Dam, including pre-ROD and post-ROD demand and economic assessments:</p> <ul style="list-style-type: none"> • Glen Canyon boating and walk-in trout fishery and related components • Glen Canyon recreational boating industry • CRE day hiking and overnight camping • Grand Canyon private and commercial rafting operations including Native American enterprises 	<p>The panel proposed that GCMRC undertake socioeconomic studies focused on recreational values that include both market and non-market use values for specific river reaches. While the panel suggested that economics of scale could be had by gathering recreational data on both market and non market aspects at the same time, this is really a program decision. Market data are easier to gather and can be analyzed easily. Data on recreational consumer surplus (preferences) will require a proper survey design and additional input from stakeholder groups. The expenditure data could be gathered and analyzed while the nonmarket survey instrument is being developed. The regional economic effects of GCD experiments and other DOI actions will be analyzed. This analysis would be devoted to the impact on the regional economy as a result of changes in expenditures resulting from these actions.</p> <p>The groups of interest for this study would be Glen Canyon day use rafters and anglers and Grand Canyon Whitewater rafters (commercial and private boaters) from Lees Ferry to Diamond Creek or Lake Mead and the Hualapai white water recreational enterprise that services Diamond Creek to Lake Mead. This expenditure data can be used in the IMPLAN regional input-output model to estimate the positive economic impacts to the surrounding counties and Indian Reservations in terms of direct and indirect personal income and employment generated. Indirect effects would capture the multiplier effects from subsequent rounds of</p>

ROW #	Proposed Study/Activity	Information Needs	Description of Activity
			<p>spending in the surrounding region. Separate interviews with the guides and the tribes will be needed to obtain their expenditures associated with the guiding, access fees, food, and other costs. We recommend that the economic impact analysis use two impact areas. For consistency with past research, it would be appropriate to use the counties surrounding the Grand Canyon. However, since many outfitters have their base of operation in Nevada or Salt Lake City, it would be appropriate to show results using a broader multi-state economic impact area (Report page 16)</p> <p>(Note: Some aspects of this program element may be covered by the NPS economic study.)</p>
7	<p>Power modeling: conduct change case analyses, and power flow studies that show the financial and economic consequences of GCD management alternatives on WAPA and WAPA customers.</p> <p>Cost: \$100-200,000</p>	<p>HIN 1. What are the impacts to federal hydropower customers from implementation of Record of Decision dam operations and various other flow regimes and segregate those effects from other causes such as changes in the power market.</p> <p>HIN 2. What would be the market impacts on marketable capacity and energy of:</p> <ul style="list-style-type: none"> • Increasing the daily fluctuation limit Increasing up-ramp and down-ramp limits • Raising maximum power plant flow limit above 25,000 cfs • Lowering the minimum flow limit below 5,000 cfs 	<p>This task would evaluate economic outcomes from alternative GCD operations in relation to the base case. TWG/AMWG/or DOI first need to define what “change cases” they want to analyze before this can be initiated (see task above). Determine if this will be done as part of the LTEMP process or external to that process.</p>
8	<p><i>[Contingent upon power modeling in Year 1]</i></p> <p>WECC power analysis: GCMRC to solicit firms for</p>	<p>HIN 1. What are the impacts to federal hydropower customers from implementation of Record of Decision dam operations and various other flow regimes and segregate those effects from other</p>	<p>This project will be informed by power modeling done by WAPA in Year 1 to determine “spill over” effects to the WECC.</p> <p>The panel believed there was a need to more fully analyze how proposed changes in GCD operations may affect the larger western electrical grid,</p>

ROW #	Proposed Study/Activity	Information Needs	Description of Activity
	<p>future WECC analysis and work with WAPA to establish framework for future economic and financial analyses if deemed necessary by power modeling completed in Year 1.</p> <p>Cost: 250,000 to 500,000 or more if new models are required</p> <p>WECC = Western Electrical Coordinating Council (i.e., western grid).</p>	<p>causes such as changes in the power market.</p> <p>HIN 2. What would be the market impacts on marketable capacity and energy of:</p> <ul style="list-style-type: none"> • Increasing the daily fluctuation limit Increasing up-ramp and down-ramp limits • Raising maximum power plant flow limit above 25,000 cfs • Lowering the minimum flow limit below 5,000 cfs 	<p>thus influencing power market values. The need to evaluate the impacts on the WECC would be assessed in step 1 under power modeling in Years 1 and 2. During Year 1, information generated by the WAPA modeling effort would be used to develop budgets for Year 2 and beyond, once a determination is made about the potential geographical scope of economic effects and whether the expanded WECC-level analysis is deemed necessary to influence GCDAMP decision-making.</p> <p>If determined that WAPA’s models are not sufficient to capture “spill over” effects, GCMRC should solicit outside consultants to perform the WECC analyses using models that are appropriate for this purpose. If these tasks are needed, GCMRC should enlist additional expertise to develop the RFQs for the power modeling work (see staffing).</p>
Year 3			
9	<p>Recreation Use Analysis Continues:</p> <p>Part B (Non-Market): initiate recreation surveys of Glen Canyon anglers, day-use rafters, and Grand Canyon and Marble Canyon white water users including Diamond Creek to Mead rafters.</p> <p>Cost: =\$150,000 - \$200,000</p>	<p>RIN 1. What are the total market, non-market, and non-use values for the following recreational uses of the Colorado River Ecosystem downstream from Glen Canyon Dam, including pre-ROD and post-ROD demand and economic assessments:</p> <ul style="list-style-type: none"> • Glen Canyon boating and walk-in trout fishery and related components • Glen Canyon recreational boating industry • CRE day hiking and overnight camping • Grand Canyon private and commercial rafting operations including Native American enterprises 	<p>GCMRC should undertake socioeconomic studies focused on recreational values that include both market and non-market <i>use</i> values for specific river reaches. In Year 2, work would focus on the second phase of this project implementing the non-market use values surveys. This recommendation combines areas from Glen Canyon down to Mead in order to maximize efficiency in developing surveys. The intent of the non-market use work is to determine the broader value of the resource to recreation users beyond the simple expenditure analysis under the market use analysis (above). This broader analysis of “willingness to pay” for changes in resource conditions would help the AMP in determining economic consequences of actions by including overall changes in benefits. For example, changes in operations might increase the value of power but might have a negative consequence on the overall benefits to recreational visitors or other user groups. This analysis would put dollar amounts on those changes in benefits and allow an economic analysis to be performed on GCDAMP decisions.</p> <p>(Note: Some aspects of this program element may be covered by the NPS economic study.)</p>

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		<p>RIN 2. Define and value key attributes and key benefits that affect the Grand Canyon wilderness and Glen Canyon recreation experiences:</p> <ul style="list-style-type: none"> • How do they affect market values for these different CRE recreation activities? • How do they affect non-market and non-use values for these different CRE recreation activities? • How do they differ under differing flow regimes and events such as HFEs, Low Steady Flows and other experiments? • How do they differ under differing management actions? 	
10	<p><i>[Contingent on scoping results Year 2]</i> Prepare surveys of tribal preferences and social values. The analysis could include consideration of both use and non-use values and include sociology and socioeconomics.</p> <p>Cost: \$40,000</p>	<p>CRIN 1. What are the market, non-market and non-use values for CRE resources valued by tribes as affected by dam operations?</p>	<p>This activity is dependent on the outcome of the scoping exercise in Year 2. Although it is important to consider tribal values in AMP decision making it is unclear whether these values require separate analyses or whether these values could be adequately considered during the use and non-use tasks described elsewhere in this plan. It is important that this research program incorporates tribal values so that decisions can incorporate those values in a meaningful way. A socioeconomic research program needs to recognize not only the economic impacts but also the social impacts on the tribes that result from changes in dam operations. Socioeconomic impacts to Tribes may suggest both opportunities and constraints that should be considered as changes in river operations are contemplated. Information to be covered in this survey could include attitudinal questions about preferences and impacts of flow regimes. Tribal representatives would be invited to participate in the development</p>

ROW #	Proposed Study/Activity	Information Needs	Description of Activity
			and testing of the survey.
11	<p>Initiate OMB clearance to conduct surveys with focus groups in Year 3 in order to develop a non-use values survey in Year 4.</p> <p>Cost: \$20,00</p>	<p>RIN 1. What are the total market, non-market, and non-use values for the following recreational uses of the Colorado River Ecosystem downstream from Glen Canyon Dam, including pre-ROD and post-ROD demand and economic assessments:</p> <ul style="list-style-type: none"> • Glen Canyon boating and walk-in trout fishery and related components • Glen Canyon recreational boating industry • CRE day hiking and overnight camping • Grand Canyon private and commercial rafting operations including Native American enterprises <p>HIN 3. What are the total market, non-market and non-use impacts on upper and lower basin water users from proposed alternative dam operations?</p> <p>HIN 4. What are the socioeconomic impacts of Glen Canyon Dam operations and experiments to tribal communities, including market, non-market and non-use?</p> <p>HIN 5. What are the market, non-market and non-use values associated with Glen Canyon electrical power, and determine</p>	

ROW #	Proposed Study/Activity	Information Needs	Description of Activity
		<p>these values.</p> <p>HIN 6. What is the market, non-market and non-use values associated with water released through Glen Canyon Dam, and determine these values.</p> <p>RIN 2. Define and value key attributes and key benefits that affect the Grand Canyon wilderness and Glen Canyon recreation experiences:</p> <ul style="list-style-type: none"> • How do they affect market values for these different CRE recreation activities • How do they affect non-market and non-use values for these different CRE recreation activities • How do they differ under differing flow regimes and events such as HFEs, low steady flows and other experiments • How do they differ under differing management actions 	
Year 4			
12	<p><i>[Contingent on scoping results in Year 3]</i></p> <p>Conduct tribal market, non-market, non-use scoping and value assessments. Cost: \$100,000</p>	CRIN 1. What are the market, non-market and non-use values for CRE resources valued by tribes as affected by dam operations?	A socioeconomic research program for GCMRC needs to recognize not only the socioeconomic impacts but also the social impacts on the Tribes that result from changes in dam operations. Conduct tribal surveys for preferences and social values potentially affected by GCD operations.
13	Conduct focus groups and piloting of Non-Use Value survey, and initiate OMB	HIN 3. What are the total market, non-market and non-use impacts on upper and lower basin water users from proposed	The panel recommended that GCMRC start to plan for a future non-use value study to be ready for actual implementation. These Year 4 tasks are part of the preparatory phase preceding implementation of the actual

ROW #	Proposed Study/Activity	Information Needs	Description of Activity
	<p>clearance for full survey implementation.</p> <p>Cost: \$200,000</p>	<p>alternative dam operations?</p> <p>HIN 4. What are the socioeconomic impacts of Glen Canyon Dam operations and experiments to tribal communities, including market, non-market and non-use?</p> <p>HIN 5. What are the market, non-market and non-use values associated with Glen Canyon electrical power, and determine these values.</p> <p>HIN 6. What is the market, non-market and non-use values associated with water released through Glen Canyon Dam, and determine these values.</p> <p>RIN 2. Define and value key attributes and key benefits that affect the Grand Canyon wilderness and Glen Canyon recreation experiences:</p> <ul style="list-style-type: none"> • How do they affect market values for these different CRE recreation activities? • How do they affect non-market and non-use values for these different CRE recreation activities? • How do they differ under differing flow regimes and events such as HFEs, Low Steady Flows and other experiments? • How do they differ under 	<p>survey.</p>

ROW #	Proposed Study/Activity	Information Needs	Description of Activity
		differing management actions?	
14	<p>Develop "real-time decision-making spreadsheet" for power impacts and benefits.</p> <p>Cost: \$50,000 - \$100,000</p>	<p>GIN 3. Determine methods to assist more real time assessments of resource impacts of alternative management activities.</p> <p>GIN 4. Evaluate, as needed, market, non-market, and non-use values for other resources also found to have impacts from dam operations and deemed important to the AMP</p>	<p>To the extent that repeated analyses of power market impacts are required as part of the future decision-making it may well be possible to ease the calculations by developing a simplified response-surface model, embodied in a spreadsheet, linking changes within the CRSP service area to impacts on prices and capacity requirements within WECC. The GTMax Lite model may be applicable to develop this, but only after adequate testing is done in tasks above.</p> <p>Develop general program capability to evaluate market, non-market and non-use values for resource impacts not yet defined by the AMP</p>
Year 5			
15	<p>Conduct full non-use value survey.</p> <p>Cost: \$500,000</p>	<p>HIN 3. What are the total market, non-market and non-use impacts on upper and lower basin water users from proposed alternative dam operations?</p> <p>HIN 4. What are the socioeconomic impacts of Glen Canyon Dam operations and experiments to tribal communities, including market, non-market and non-use?</p> <p>HIN 5. What are the market, non-market and non-use values associated with Glen Canyon electrical power, and determine these values.</p> <p>HIN 6. What is the market, non-market and non-use values associated with water released through Glen Canyon Dam, and determine these values.</p>	<p>By Year 4, it will have been 20 years since the Welsh et al. (1995) study was conducted. Much has changed including the management scenarios in the Grand Canyon and the demographics of the U.S. population, especially in the Four Corners Region. As recommended by the National Research Council in its report "Downstream", these nonuse values are quite important to understanding the public benefits of alternative management strategies in the Grand Canyon. By tying flow-related changes to the environment to the non-use value survey, the incremental or marginal nonuse values can be estimated that are most useful for evaluating potential management actions in the Grand Canyon.</p>

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		<p>RIN 2. Define and value key attributes and key benefits that affect the Grand Canyon wilderness and Glen Canyon recreation experiences:</p> <ul style="list-style-type: none"> • How do they affect market values for these different CRE recreation activities? • How do they affect non-market and non-use values for these different CRE recreation activities? • How do they differ under differing flow regimes and events such as HFEs, Low Steady Flows and other experiments? • How do they differ under differing management actions? 	
16	<p>Implement Core Monitoring Plan for Socioeconomics.</p> <p>Cost: \$20,000</p>	<p>Develop Core Monitoring Information Needs (CMINs)</p>	<p>The panel recommends that socioeconomic surveys be repeated every 2-3 years as a monitoring tool to assess how changes in GCD operations affect recreational values. This should be integrated into the Core Monitoring Plan. A placeholder for socioeconomics should be kept in the initial General Core Monitoring Plan.</p>