SUMMARY OF
PUBLIC SCOPING COMMENTS ON THE GLEN CANYON DAM LONG-TERM EXPERIMENTAL AND MANAGEMENT PLAN ENVIRONMENTAL IMPACT STATEMENT

Prepared by

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For

Bureau of Reclamation
Upper Colorado Region
Salt Lake City, Utah

and

National Park Service
Intermountain Region
Denver, Colorado

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NOTATION

AMWG	Adaptive Management Working Group
AMP	Adaptive Management Program
AGFD	Arizona Game and Fish Department
Argonne	Argonne National Laboratory
°C	degrees Celsius
cfs	cubic feet per second
CRSP	Colorado River Storage Project
DFC	desired future conditions
DOI	U.S. Department of the Interior
EIS	Environmental Impact Statement
ESA	Endangered Species Act
°F	degrees Fahrenheit
ft	foot/feet
FWCA	Fish and Wildlife Coordination Act
GCDAMP	Glen Canyon Dam Adaptive Management Program
GCMRC	Grand Canyon Monitoring and Research Center
GCPA	Grand Canyon Protection Act
GCRG	Grand Canyon River Guides
HFE	High-Flow Experiment
in.	inch(es)
LCR	Little Colorado River
LTEMP	Long-Term Experimental and Management Plan
LTEP	Long-Term Experimental Plan
MLFF	Modified Low Fluctuating Flow
mm	millimeter(s)
MSCP	Lower Colorado River Multi-Species Conservation Plan
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPS	National Park Service

NOTATION (cont.)

Reclamation	Bureau of Reclamation
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
TCD	Temperature Control Device
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
Western	Western Area Power Administration

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1 INTRODUCTION

On December 10, 2009, Secretary of the Interior Ken Salazar announced the need to develop a Long-Term Experimental and Management Plan (LTEMP) for Glen Canyon Dam. The Secretary emphasized the inclusion of stakeholders, particularly those in the Glen Canyon Dam Adaptive Management Program (GCDAMP), in the development of the LTEMP.

The decision of the U.S. Department of the Interior (DOI) to develop the LTEMP is a component of its efforts to continue to comply with the ongoing requirements and obligations established by the Grand Canyon Protection Act of 1992 (GCPA). The LTEMP will ensure continued compliance with federal law and will recognize the importance of protecting, mitigating adverse impacts, and improving the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established; at the same time, recognizing the water delivery obligations regarding allocation, appropriation, development, and exportation of the waters of the Colorado River basin under federal law. Other actions that are related to the ongoing work of the GCDAMP, such as efforts to protect cultural resources and to conserve endangered and threatened species, are anticipated to be part of the LTEMP.

DOI, through the Bureau of Reclamation (Reclamation) and the National Park Service (NPS) will prepare an Environmental Impact Statement (EIS) to evaluate the impacts of adoption of the LTEMP. The proposed action being considered in the LTEMP EIS is the development and implementation of a structured, long-term experimental and management plan, to determine the need for potential future modifications to Glen Canyon Dam operations, and to determine whether to establish an Endangered Species Act (ESA) Recovery Implementation Program for endangered fish species below Glen Canyon Dam.

In 1995, the first EIS on operations of Glen Canyon Dam was published (Reclamation 1995). The LTEMP EIS will be the first EIS completed on the operations of Glen Canyon Dam since the 1995 EIS, which was intended to allow the Secretary to "balance and meet statutory responsibilities for protecting downstream resources for future generations and producing hydropower, and to protect affected Native American interests." Given that it has been over 15 years since completion of the 1996 Record of Decision (ROD) on the operation of Glen Canyon Dam, DOI will study new information developed through the GCDAMP, including information on climate change, to more fully inform future decisions regarding the operation of Glen Canyon Dam and other management and experimental actions.

A previous planning process called the Long Term Experimental Plan (LTEP) for the operation of Glen Canyon Dam started in late 2006. In February 2008, the LTEP EIS was put on hold until the completion of environmental compliance on a five-year plan of experimental flows (2008–2012), including a high-flow test completed in March 2008, and yearly fall steady flows to be conducted in September and October of each year from 2008 to 2012. As stated in the Notice of Intent (NOI) in the *Federal Register* on July 6, 2011 (DOI 2011a), the LTEMP EIS supersedes the LTEP EIS. The LTEMP EIS will draw on the environmental documentation and updated information developed for the LTEP EIS. Accordingly, to the extent applicable, the scoping comments received for the LTEP EIS will be considered when the agencies determine the scope of the LTEMP EIS. The LTEP scoping report, which summarizes those comments, is publicly available at the following Web address: http://www.usbr.gov/uc/rm/gcdltep/scoping/FinalScopingReport.pdf.

Public scoping is a phase of the National Environmental Policy Act (NEPA) analysis process, and is intended to give the public the chance to comment on the LTEMP, recommend alternatives, and identify and prioritize the resources and issues to be considered in the EIS analyses. The public scoping phase of the EIS process gives interested parties the opportunity to comment and provide early ideas about:

- The resources or issues to be evaluated in the LTEMP EIS,
- The alternatives to be included in the LTEMP EIS, and
- Concerns or observations regarding Glen Canyon Dam operations and downstream resources.

This report presents a summary of the issues raised during the scoping process and discusses which issues will be addressed in the EIS. The report also includes summary statistics of participants in the process. Specific comments and their context are not provided; instead, the relevant issues raised in the comments as they apply to the preparation of the EIS are presented. All comments — regardless of how they were submitted — received equal consideration.

2 SCOPING PROCESS

2.1 Approach

The primary objective of scoping is to conduct an open and thorough process, to hear and understand the opinions of all interested parties, and to afford the public opportunities to provide input. Scoping for the LTEMP EIS provided the public with an opportunity to comment on the proposed action, recommend alternatives, and identify and prioritize the resources and issues to be considered in the LTEMP EIS analyses. The public was invited to submit comments via the project web-site and by standard mail. The scoping period started with the publication of the NOI in the *Federal Register* on July 6, 2011 (DOI 2011a), and ended January 31, 2012.

Six open-house-style public meetings and one Web-based meeting were held to inform the public about the LTEMP EIS. At the public meetings, the public could view exhibits about the project, discuss issues informally, and ask questions of technical experts and managers. A brief overview of the project was also presented at the start of each meeting by Reclamation and NPS. Computer stations were available for meeting participants to browse the project Web site and submit electronic comments. Hard-copy comment forms were also available for attendees to submit comments at the meeting or to take with them for later use. There were 221 people who attended these meetings, which were held in the following locations:

- Phoenix, Arizona — November 7, 2011
- Flagstaff, Arizona — November 8, 2011
- Page, Arizona — November 9, 2011
- Salt Lake City, Utah — November 15, 2011
- Las Vegas, Nevada — November 16, 2011
- Lakewood, Colorado — November 17, 2011

The Web-based meeting was held on November 15, 2011. For this meeting, the public was able to watch, via the Internet, a live overview presentation of the LTEMP EIS, and to ask questions of technical experts and managers. Twelve people participated in this meeting.

Prior to the public scoping meetings, Argonne National Laboratory (Argonne) established a Web site for the LTEMP EIS (http://ltempeis.anl.gov) that provides background information about the project, information on public involvement, and answers to frequently asked questions. The Web site also provides an opportunity to join a mailing list to receive project updates and announcements via e-mail, and a link to the project's online comment form that was made available on NPS's Planning, Environment, and Public Comment (PEPC) Web site.

The project Web site was used to disseminate information about the public scoping meetings, including locations, times, meeting format, pre-registration, and presentation materials. The public also was notified of the meetings by a *Federal Register* Notice published on October 17, 2011 (DOI 2011b), a press release and media advisory distributed to local media outlets, and an op-ed article for publication in local and regional newspapers.

2.2 Scoping Statistics

A total of 447 individuals, recreational groups, environmental groups, power customers or organizations, federal and state government agencies, and other organizations provided scoping comments on the LTEMP EIS. Ninety-six percent of the comments were submitted using the Web comment form. Comments were received from individuals or organizations from 41 states and 3 foreign countries. Sixty percent of the comments were from three states near the

project area (Arizona, Utah, and Colorado); followed by California and New Mexico (Table 1). All of the remaining states and countries contributed fewer than 3 percent of the comments (Table 1). Table 2 lists the names of organizations that provided official comments. Table 3 provides summary information on commenter affiliations.

TABLE 1. Comments Received from the Public According to State and Country of Residence

State/Country	Number	Percent
Arizona	153	34.2
Utah	64	14.3
Colorado	53	11.9
California	45	10.1
New Mexico	15	3.4
Washington	13	2.9
Oregon	9	2.0
Tennessee	7	1.6
Nevada	6	1.3
Idaho	6	1.3
Texas	6	1.3
All other states	70	15.7
Foreign countries	3	0.7

Although no formal campaigns letters were received, some commenters chose to submit entire letters or portions of letters from various other commenting organizations. The following multiple submittals were received:

- Submittals that endorsed the comments of the Grand Canyon River Guides (GCRG) by either posting the GCRG submittal in its entirety or by submitting a subset of the GCRG letter (number of commenters = 13).

- Submittals that endorsed a "Grand Canyon First!" alternative that would "achieve the requirements of the Grand Canyon Protection Act." This submittal recommended that the EIS develop a high-flow/steady-flow alternative; involve staff of the Grand Canyon Monitoring and Research Center (GCMRC) in the science development; and look at a long-term (e.g., 15-year) operations change (number of commenters = 18).

TABLE 2. Organizations that Provided Scoping Comments

Organization
American White Water
Arizona Department of Water Resources
Arizona Power Authority
Arizona Raft Adventures
Arizona Game and Fish Department
Arizona State Council of Trout Unlimited
Colorado River Basin State Representatives of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming
Colorado River Energy Distributors Association
Environmental Defense Fund
Farmington River Club
Federation of Fly Fishers
Glen Canyon Institute
Grand Canyon Private Boaters Association
Grand Canyon River Guides, Inc.
Grand Canyon River Outfitters Association
Grand Canyon River Runners Association
Grand Canyon Trust
Grand Canyon Whitewater
Grand Canyon Wildlands Council, Inc.
Irrigation and Electrical Districts Association of Arizona
Living Rivers
Marble Canyon Business Interests
Salt River Project Agricultural Improvement & Power District (SRP)
San Pedro Flycasters
Sierra Club[a]
Sun City Grand Fly Fishing Club
U.S. Fish and Wildlife Service
Utah Associated Municipal Power Systems
Western Area Power Administration
Western Resource Advocates
White Mountain Fly Fishing Club

a The scoping letter submitted by the Sierra Club inadvertently was not included in an earlier version of this report. The Sierra Club's letter was received prior to the close of the scoping period, and issues raised in the letter were fully considered in developing the scope of the LTEMP EIS.

TABLE 3. Commenter Affiliations

Organization	Number	Percent
Grand Canyon River Guides	42	9.4
Fly Caster Clubs (Various)	18	4.0
Whitewater Associations (Various)	15	3.4
Grand Canyon Private Boaters Association	14	3.1
Glen Canyon Institute	8	1.8
Other Fishing Clubs (Various)	8	1.8
Other Boating/Rafting Associations (Various)	4	0.9
Grand Canyon Trust	3	0.7

- Submittals that included the same 14 points that focused on improving recreational experiences on the Colorado River; protecting and improving downstream resources; maximizing sediment retention on beaches and backwater areas; and ensuring a role for the GCRMC (number of commenters =7).

- Submittals that included six points focusing on protecting natural and cultural resources. These commenters also called for the EIS to comply with the Grand Canyon Protection Act and include the GCMRC as an integral part of the EIS process. (number of commenters = 23).

- Submittals that called for the EIS to meet the requirements of the Grand Canyon Protection Act; address climate change; include a full assessment of the impacts of "equalization" water releases; analyze a "Run-of-the-River" alternative that includes consideration of the "fill Lake Mead first proposal"; include an alternative that augments the sediment supply to Grand Canyon by mechanically bypassing the dam;; and ensure no bias toward hydropower (number of commenters = 14).

- Submittals that included the points mentioned above and wanted the EIS to consider the Colorado River from Cataract Canyon to Hoover Dam as a single ecosystem; include clearly defined "desired future conditions"; ensure an integral role for GCMRC; include a Seasonally Adjusted Steady-Flow alternative; include an alternative that uses a temperature control device; and consider restructuring the Glen Canyon Adaptive Management Work Group (number of commenters = 23).

3 SUMMARY OF SCOPING COMMENTS

Comments received during public scoping covered a wide range of topics and issues and represented a variety of points of view. Comments addressed various aspects of the proposed action, including environmental and socioeconomic impacts, dam operations and flows, geographic scope, and potential alternatives.

A summary of issues raised in comments are presented in the following sections under the main topics of purpose and need; environmental issues; dam operations and hydropower; geographic and temporal scope; policy and regulatory concerns; LTEMP approach and considerations; alternatives; other issues; and stakeholder involvement. All of the major scoping comments are represented in Sections 3.1 through 3.9. The actual correspondence received from the public on the scope of the LTEMP EIS is presented in the appendix to this report.

3.1 Purpose and Need

Comments expressed concerns over the purpose and need for the LTEMP EIS as stated in the July 6, 2011, NOI (DOI 2011a). Many comments said the language of this statement did not sufficiently reflect the purpose and intent of the GCPA. They noted that the primary purpose of the Glen Canyon Dam should be water delivery to the lower basin, followed by the preservation and recovery of downstream (i.e., the Colorado River corridor through Grand Canyon National Park and Glen Canyon National Recreation Area) natural resources and values; hydropower is secondary and should only be generated after the priority goals were addressed and managed.

In contrast, other comments said that any EIS that addresses the Glen Canyon Dam must address hydropower as a primary purpose, as required by the 1956 Colorado River Storage Project (CRSP) Act, which authorized this federal project. They specifically cited the 1996 ROD, which stated that the existing operational alternative would "balance competing interests and to meet statutory responsibilities for protecting downstream resources and producing hydropower," and Section 1802(b) of the GCPA, which states, "It is imperative that the proposed action clearly be one that preserves the purposes for which Glen Canyon Dam was constructed, while meeting environmental and science objectives to the extent practicable."

3.2 Environmental Issues

Comments and concerns frequently raised by the public in their comments on the LTEMP EIS scope included restoration of the downstream Colorado River Ecosystem; reestablishment of ecosystem patterns and processes to their pre-dam range of natural variability; elimination or minimization of further beach erosion; facilitation of sediment re-deposition; in situ maintenance and preservation of the integrity of cultural and archeological resources; elimination of adverse impact on and assisting the recovery of native species; nonnative fish management; and assistance in repropagation of the native riparian plant communities.

Many comments emphasized the importance of preparing the LTEMP EIS pursuant to and in compliance with relevant acts, policies, and legislation, including the GCPA, the ESA, the Fish and Wildlife Coordination Act (FWCA), the NPS Organic Act of 1916, 2006 NPS Management Policies, the 1978 Redwood Amendment to the NPS General Authorities Act of 1970, and the numerous compacts, federal laws, court decisions, contracts, and regulatory guidelines that address the management and operation of the Colorado River, collectively known

as the Law of the River. In addition, the EIS process should be coordinated with (and not allowed to disturb or contradict) the existing programs currently operating in the Colorado River Basin.

The following text describes the main categories that encompass environmental concerns identified in submitted comments. The text summarizes comments from the public and represents a variety of views and interpretations. There has not been an attempt to correct any of the statements or assertions.

3.2.1 Water Resources

Water Flows. Commenters indicated that steady flows are likely optimal for all sediment-related resources and recovering the overall environment below Glen Canyon Dam because they conserve sediment, minimize damage, and provide warm water (especially near the shoreline). Steady flows would improve the productivity of the aquatic food base at higher trophic levels and create the habitat and opportunity necessary for the reestablishment of native fish populations. One comment noted the need to conduct a true steady-flow experiment to monitor the benefits to native fish over at least a six-month period in the summer, when day length and sunlight angle can stimulate productivity. In addition, it was noted that these flow regimes will not change or affect water allocations among the states.

Some commenters specifically suggested what they considered optimal flow levels. In relation to balancing environmental protection, recreational access, and overall safety, multiple commenters supported a base flow in the 8,000–11,000 cubic feet per second (cfs) range, with appropriately timed moderate fluctuations. Another comment requested consideration of a flow lower than 8,000 cfs for both safety and convenience of private boaters, as opposed to commercial operators. Another comment suggested a steady flow of about 9,000 cfs would be optimal for beach preservation and rebuilding. This commenter specifically noted the importance of differentiating between steady and average flows. For example, an average flow of 9,000 cfs, which results from flows of 5,000 cfs and 13,000 cfs for equal periods of time or a flow of 8,000 cfs for 23 hours and 32,000 cfs for one hour, could have different effects. A steady flow of about 9,000 cfs was seen as meeting a goal of no further damage to beaches and habitat.

A few comments discussed concerns regarding steady flows and the presence of green algae lining the riverbank, particularly at camps and heavy day-use areas. The commenters believe that these spots are the direct result of non-fluctuating flows, combined with human activities (e.g., bathing, urination, dishwater disposal, boat loading, and unloading). Without slight fluctuations of river level, which act to "wash" the beaches, the spots and resulting impacts build up over the course of just a few weeks. Thus, if a steady-flow regime was adopted, the comments requested that there be a study conducted to determine the best way to mitigate this issue.

Commenters suggested the LTEMP EIS should include a detailed analysis of experimentally modifying the releases, or even possibly re-engineering the Glen Canyon Dam, to restore natural water and sediment flows to emulate pre-dam patterns when the appropriate

conditions prevail. This operating regime would also ensure that the basic elements of the ecosystem and natural habitat that existed prior to Glen Canyon Dam's construction could reestablish and ultimately thrive. The seasonally adjusted steady-flow regime is based on the natural rhythms of the pre-dam river. This type of flow regime is also referred to by commenters as natural, pre-dam, or regular high flows. It was asserted by commenters that this flow regime would act to redistribute sediment, under enriched conditions, which could, in turn, stimulate native fish spawning; restore habitats; rebuild beaches; stabilize and protect near-river cultural sites and archeological resources; enhance the recreational experience; and improve other sediment-related resources. It was further stated that initiating seasonally adjusted steady flow immediately would provide the downstream ecosystem with the best baseline from which to work in the near future should delays or suspensions in the EIS process occur.

The seasonally adjusted steady-flow regime calls for a combination of steady flows with precisely timed high flows corresponding to historic high-flow periods. Comments generally suggested that these high-flow releases should be conducted in spring (snow melt/spring run-off), summer (monsoon season), and winter (flood season). Alternatively, flows might involve a gradually increasing flood flow beginning in the late spring, followed by a gradual decrease in this flood flow in the early summer (April to July). It was also proposed that a seasonally adjusted steady-flow regime could possibly consist of steady flows for the summer, followed by a gradual down-ramping over several weeks in the fall, but making note that this should be done only if data exist showing this regime can help restore sediment-related resources. It was further added that there should be the option of no spike flow if there is not enough sediment inflow in a season. Still another comment suggested that flows be altered up or down in approximately 10-day intervals, with no daily fluctuations. A different comment, however, stated that even though these flows seem to have a beneficial impact on the overall ecosystem, high-flow experiments (HFEs) are expensive in terms of water bypassing turbines and the manpower needed to study the impacts. In addition, some commenters advocated minimum flows that are no less than the long-term average base flow of the river, and that parallel the seasons when those historic base flows occurred.

Some comments said that further study should be done on the effects of modified low fluctuating flow (MLFF) (the flow regime selected in the 1996 ROD). Other comments stated that these flows still jeopardize the continued existence of the native fish species (e.g., humpback chub and razorback sucker) and threaten to destroy or adversely modify designated critical habitat. Different comments stated that this operating regime, which resulted in the constraint of hydropower generation levels (e.g., maximum and minimum generation/flow and limits on up and down ramps) in favor of downstream concerns, has not produced the intended results. Specifically noted were statements made by Secretary Norton in her 2002 report to Congress that, "dam operations during the last 10 years under the preferred alternative of the MLFF have not restored fine-sediment resources or native fish populations in Grand Canyon, both of which are resources of significant importance to the program" and that, "This trend leads to questions about whether daily, monthly, or even annual patterns of dam operation alone are relevant to native fish recruitment or whether changes in the sediment and thermal regimes of the river imposed by regulation have had the greatest influence on native fishes."

In addition, comments noted that future study should include evaluation of the effects of releasing water at full power plant capacity on a constant basis, as well as using maximum power plant capacity in a fluctuating release regime beyond that of the MLFF regime.

Water Temperatures. Numerous comments expressed concerns about the water temperature of the Colorado River. It was noted that before Glen Canyon Dam was constructed, the natural flow cycle of the Colorado River included an annual temperature gradient from near freezing in winter months to above 80°F (27°C) in the late summer. After the dam was constructed, the temperature of the river has reached a relatively steady temperature of 45–50°F (7–10°C) as a result of the temperature of the released water, which is drawn from intakes positioned deep in the reservoir pool. Even though the colder released water eventually warms as it moves downstream, the seasonal warming trend has been essentially eliminated. Consequently, the aquatic ecology of the Colorado River has been effectively altered to the point where it is detrimental to the native fish populations. For example, the water temperature does not normally reach the level necessary, at least 60–63°F (15–17°C), to enable native endangered warm water fish (e.g., humpback chub, *Gila cypha*) to reproduce in the mainstem of the Colorado River, thus allowing nonnative species to displace native species.

As a result, some comments requested that Glen Canyon Dam be reconfigured to help restore pre-dam downstream conditions by releasing warmer water to the river. Possible suggestions included the use of a temperature-control device, selective withdrawal system, or multi-level water intake structure, which would allow water to be drawn from the shallower and warmer regions of the reservoir. In addition, it was noted that these strategies could be implemented to more closely simulate the annual temperature cycles of the river in its natural pre-dam state (or, at the least, temperature cycles that would allow endangered and other native species to successfully reproduce), offering more flexibility in the ability to respond to changing ecosystem concerns in the future.

On the other hand, a few commenters believed that the original ecosystem has been altered forever and efforts should not be made to recreate it. Instead, the created cold-water environment, which has reduced levels of particulates, sediment, and organics, should be maintained and its benefits enhanced. For example, the altered environment has allowed for the establishment of economically and recreationally beneficial trout fisheries. In addition, it was noted that increasing the temperature of the river would change the dynamics of the food web and increase the rates of colonization by invasive nonnative species (e.g., New Zealand mudsnail, *Potamopyrgus antipodarum*). Warmer river water temperatures would also allow warmwater species (e.g., striped bass, *Morone saxatilis*; channel catfish, *Ictalurus punctatus*; common carp, *Cyprinus carpio*; and perhaps largemouth bass, *Micropterus salmoides*) to move upstream from Lake Mead and become even more established, resulting in more competition for forage, breeding sites, and direct predation of endangered and native species.

Lake Powell Reservoir Water Levels and Quality. Comments recommended that the EIS evaluate the impacts of the reduced and continually dropping water levels in Lake Powell, due to factors such as drought and over-appropriation. This evaluation should assess the low water levels as the norm, rather than the exception, and the probability of the reservoir pool being completely exhausted during the timeframe of the proposed action. Also taken into

consideration should be the anaerobic bacteria, hydrogen sulfide, and super-saline and metal-rich sediments resulting from the lower water levels, which may find their way through the dam's bypass tubes, and how these factors might be mitigated. In addition, as the elevation of the reservoir continues to drop nearer to the penstocks, new pathogens, parasites, and other invasive or exotic species are more likely to invade the downstream ecosystem in Grand Canyon and complicate the conservation of endangered native species. One commenter requested that Lake Powell not be drained.

One commenter stated that a partially empty Lake Powell is a benefit for long-term dam and sediment management and Grand Canyon resource protection. Another commenter specifically requested that the Lake Powell reservoir should be kept below the 3,650-ft elevation and not be allowed to rise and fall continuously above and below this level. This would reduce the significant water loss due to evaporation and allow the Escalante River and side canyons of Glen Canyon above this water level (e.g., Willow and Davis Gulches, 40 Mile and 50 Mile Gulches, and Cathedral in the Desert) a chance to recover ecologically. In addition, keeping the reservoir at or below 3,650 ft would enhance the natural values of Rainbow Bridge National Monument. Another commenter requested that dam operations maintain water levels between 3,612 ft and 3,700 ft.

3.2.2 Sediment Resources

Loss of Sediment. In general, comments noted that the EIS needs to address sediment below Glen Canyon Dam because most of the resources of concern in Grand Canyon are reliant upon sediment in one way or another. The ongoing loss of sediments and organic nutrients, which is a direct consequence of Glen Canyon Dam operations and the presence of the dam, was of particular concern to commenters. It was noted that this loss had resulted in destruction of important wildlife habitats; reduction in nutrients needed to maintain native fish species (i.e., not allowing young fish to mature to reproductive age); loss of protection for near-river cultural sites and archeological resources; erosion of natural beaches and sandbars; and fewer and smaller areas for recreational users to camp or otherwise congregate.

Comments recommended that the EIS examine options for mechanically introducing additional sediment below the dam, to augment that which is periodically available from tributaries (e.g., Paria River, Little Colorado River, and other side streams), but seemingly below the threshold of effectiveness. Multiple comments suggested dredging the sediment directly from Lake Powell near Glen Canyon Dam and injecting it into the water that is released. A related comment indicated the importance of testing this sediment before it is released to ensure it is not contaminated. Different comments suggested augmenting the sediment supply by mechanically bypassing the dam altogether.

On the other hand, a few comments requested that the EIS address the operational and safety impacts of coarse sediments and increased turbidity in the water flowing through Glen Canyon Dam. One comment specifically noted that sediment augmentation would create muddy waters that would have negative consequences on the algae (e.g., diatoms and *Cladophora*) that serve as a critical part of the food base for fish.

One group of comments specifically stated that the LTEMP EIS should go beyond a focus on mass sediment balance and fish, for this metric is not sufficient to represent the issue. Instead, the EIS needs to focus on whether the sediment adequately benefits, protects, and/or improves the individual resources along the Colorado River. It was further noted that a positive mass sediment balance is not very meaningful if that sediment is not located where it is most needed.

Beaches and Sandbars. The importance of beaches to Grand Canyon ecological resources and the recreational experience was explicitly mentioned in multiple comments. These commenters requested that the remaining beaches be preserved, and that research needs to be conducted on how to best restore and maintain beaches and sandbars over the long term. For example, investigations should be done on the built-up beaches to see if they are truly stable or actually more prone to erosion from rain and wind. Several comments requested that the optimal operational plan for rebuilding and maintaining sandbars (year-round steady flows), identified by Wright et al. (2008) of the U.S. Geological Survey (USGS), be tested in an effort to determine what the best-case scenario is for not only eliminating or minimizing further beach erosion and facilitating redeposition of sediment, but also maintaining the integrity of cultural resources in situ, eliminating adverse impacts on native species, forcing the retreat of encroaching vegetation, and assisting in re-propagation of native riparian plant communities.

In addition, it was requested that the recommendations from the GCMRC for optimizing the results of future HFEs should be incorporated; specifically mentioned was the design of controlled floods for optimal sandbar deposition to be based not only on threshold levels of sand enrichment, but also on reach-averaged bed-sand median grain size.

3.2.3 Aquatic Resources

Overall, commenters recommended that the LTEMP EIS provide the predicted outcome for native species, as well as nonnative and invasive aquatic species, and their habitat.

Native Aquatic Species. The reasons offered for the decline of native fish were cited to include dramatic changes in the thermal, sediment, and hydrologic regimes of the river that are a direct result of the construction and operation of numerous dams (including Glen Canyon Dam) in the basin, introduction of nonnative predatory and competitive fish species, and introduction of diseases and parasites. It was noted that there were originally eight native fish species found only in the Colorado River Basin and that occurred in Grand Canyon National Park. Of these species, three — the Colorado pikeminnow (*Ptychocheilus lucius*), roundtail chub (*Gila robusta*), and bonytail chub (*Gila elegans*) — have been extirpated from Glen and Grand Canyons. Another, the razorback sucker (*Xyrauchen texanus*), is listed as endangered and has not been observed in the Grand Canyon since 1991. The humpback chub is listed as endangered and the flannelmouth sucker (*Catostomus latipinnis*) is a candidate for listing; both species persist in the Grand Canyon. The remaining two, bluehead sucker (*Catostomus discobolus*) and speckled dace (*Rhinichthys osculus*), appear to be doing reasonably well in the Grand Canyon, although much remains to be learned about their ecology and population dynamics.

Commenters asked that the EIS identify specific baseline objectives for sediment and nutrient concentration, temperature gradients, flow characteristics, and nonnative fish suppression that are believed to stimulate recovery of critical habitat for the aforementioned Grand Canyon native fish. It should then evaluate how each alternative will achieve these objectives. Comments specifically noted the need to address the recovery and reestablishment of native fish habitat, the humpback chub population in the Little Colorado River, establishment of a second humpback chub population downstream of Glen Canyon Dam, lack of progress on a management plan to reinstate the razorback sucker, and reintroduction of other native fish stocks that are actively subject to management, population enhancement, and study in the Lower Colorado River Multi-Species Conservation Plan (MSCP). Also mentioned was the wealth of new scientific information that was not available or known when the 1995 EIS was completed.

Continued studies were requested to address to native fish species, notably in the lower River, as to their numbers, condition, spawning habits, and adaptability to the colder water in the mainstem of the Colorado River, versus their normal spawning area in the Little Colorado River that has warmer water. Some comments suggested simply allowing native fish to naturally thrive 10 to 50 miles downriver where warmer conditions prevail.

Commenters specifically requested that the LTEMP EIS focus on improving the inventory, monitoring, and restoration of rare taxa and endangered species. These activities would involve continued inventory, with particular focus on rare and declining species; reintroduction and restoration of missing and declining species; restoration of missing and altered habitats in the Colorado River ecosystem; and restoration of the range of native fish species to the entire flowing portion of the Colorado River ecosystem.

Humpback Chub. Multiple comments specifically discussed the documented decline in and low absolute number of the humpback chub since the last EIS was completed in 1995. Commenters cited a 2005 USGS publication, based on research by the GCMRC, that theorized the downward trend in the humpback chub population may have coincided with initiation of interim operating criteria and ROD flows. However, other comments went on to state that since publication of that USGS report, significant new science and information has been developed indicating that the humpback chub population is actually a persistent and increasing reproducing population in the Grand Canyon, and that the current adult population substantially exceeds the recovery goal.

Overall, and regardless of whether the comments cited a downward or upwards population trend, many commenters stated that the LTEMP EIS needs to conduct a major reassessment of this species. It was stated that this evaluation must include further study with monitoring of production and recruitment trends, including translocation. Analysis of the condition factors responsible for the survival of these fish and health of their critical habitat, as recommended by the U.S. Fish and Wildlife Service (USFWS), should also be conducted. Moreover, factors relevant to habitat, such as feeding habits, water quality, age class, genetics, and migration patterns for all periods of the humpback chub's life span need to be documented. In addition, the LTEMP EIS should determine the population level and changes in biological parameters that would trigger a cessation of handling humpback chub, so as to avoid incidental take of the remaining population.

One commenter explicitly noted that, according to the USFWS's Reasonable and Prudent Alternative (RPA) identified in its Biological Opinion of Glen Canyon Dam operations, if sufficient progress had not been not made to remove humpback chub and razorback sucker jeopardy by 1998, then seasonally adjusted steady flows were to begin at Glen Canyon Dam. In addition, the RPA stated that in low-water (drought) years, dam releases should be regulated using the seasonally adjusted steady-flow alternative.

Many comments suggested that the EIS address the steps necessary for full humpback chub population recovery. Comments requested that the EIS explore increasing the range of the critical habitat designation in the Little Colorado River, to further promote translocation programs for the humpback chub up this tributary. Different comments discussed improvement and management of the food base, especially in the upstream regions of the river below Glen Canyon Dam. Other comments expressed concern over the lack of progress or protocols developed for locating an appropriate site in the mainstem Colorado River below Glen Canyon Dam or in one of Grand Canyon's tributaries for a second population of humpback chub, as mandated by the 1996 ROD. Neither has a management plan for the Little Colorado River been implemented to protect the critical habitat of the humpback chub from pollution, reduction of instream flows, or habitat fragmentation due to unforeseen geologic events such as debris flows or landslides. Additional issues that commenters felt needed to be addressed include the required habitat conditions needed and/or how modifications to the habitat will be implemented to achieve suitable habitat conditions. One commenter suggested relocation of the chub to other rivers where they can thrive.

Commenters stated that the EIS should examine and report on the adverse consequences of water warming and sediment augmentation, specifically, as to how it affects the food base (i.e., algae), potential influx of additional nonnative species (e.g., catfish and bass) from Lake Mead, and proliferation of parasitic invasive species, which could increase the potential of disease for the chub. On the other hand, some comments mentioned that, although the Colorado River itself is now too cold for young humpback chub, it not too cold for adult chub; thus, the cold water released from Glen Canyon Dam has actually saved the Grand Canyon population of humpback chub from the fate endured by the Upper Colorado River populations of humpback chub, which are being consumed and outcompeted by warm-water nonnative fish species.

Trout. Many comments emphasized the fact that the dam has changed the environment and ecology of the river. It is now a cold-water environment to which the native species are not adapted. Numerous comments discussed this fact and its connection to the unresolved relationship between the abundance of trout in the Colorado River and the threat to the humpback chub population.

One group of comments reported that the trout are the primary reason for the humpback chub's decline as a result of competition for forage, competition for spawning sites, and predation of the humpback chub by the trout. Some of these comments directly attribute the HFEs as a reason for the enhanced trout population, because these events result in reductions in humpback chub habitat and food supply, as well as promote the conditions in which trout thrive. In general, this group of commenters believes the EIS should recommend that dam operations

not be modified in any way to intentionally benefit nonnative fish habitat. In addition, comments seemed to agree that the EIS should evaluate any and all reasonable mechanisms for nonnative fish suppression as necessary to improve habitat conditions for native fish. Specifically referred to was the practice of mechanical harvesting (e.g., electrofishing), which is a proven technique that has been successful at controlling nonnative fish below Glen Canyon Dam. Some comments also related to the range covered by these suppression methods, suggesting that all nonnative fish species be removed beginning at the base of the dam all the way down to the mouth of Lake Mead.

A second group of comments noted that this altered and now cold-water environment is perfect for trout (e.g., rainbow trout, *Oncorhynchus mykiss*, and brown trout, *Salmo trutta*); and, short of removing the dam, these commenters believed that this fact will not likely change. Thus, the LTEMP EIS should include research that specifically addresses the beneficial effects of trout to the overall river ecology and Grand Canyon user experience. These comments specified that any management actions or experiments that purposely cause damage to the resident rainbow and brown trout populations should not be undertaken simply on the assumption that there are too many trout downstream of Glen Canyon Dam, or because trout are "not native." Thus, programs for capturing and killing trout should be ceased, particularly above Lees Ferry. Some comments mentioned an alternative solution that would allow for electrofishing to be conducted just below the Lees Ferry fishery (and down about 17 miles to an area near Soap Creek, where Tribal concerns take over). Doing this maintains a management barrier to trout going down river and adversely impacting the chub, but allows the trout to be captured and brought up river to Lees Ferry (e.g., on motorized boats that can navigate the rapid between Lees Ferry and Soap Creek). Others suggested reducing the number of smaller trout (e.g., allowing unlimited fishing of trout smaller than 14 inches), which not only reduce the size of the fish in the Lees Ferry fishery but also migrate downstream into the Grand Canyon where they interfere with the native fish in the lower river. Still others suggested that if the trout must be removed from the river, specifically downstream from Lees Ferry, they should be restocked elsewhere or utilized for human food. Another possible solution that was suggested was the introduction of triploid brown trout, which are reproductively sterile but grow larger and much faster than wild trout, as a supplement to the wild trout in Lees Ferry. This method could also act as way of reducing the excessive spawning that created a large amount of small wild trout.

Some commenters noted that the impact of rainbow trout, specifically on chub, is questionable at best; instead, the main culprit in humpback chub predation is the channel catfish (*Ictalurus punctatus*), followed by the brown trout. This group of commenters does not generally support mechanical removal of the rainbow trout and feel the suppression programs should be reconsidered. It was mentioned that based on current science, there was no guarantee that the native fish would benefit from or even survive regardless of whether or not the trout are killed. Some of these commenters requested that stomach content surveys should be part of any trout removal program, for it is suspected by certain commenters that trout seem to actually feed off the myriad of insects, and not the native fish. In addition, it seemed to some that the practice of removing nonnative trout in one reach of the river, while concurrently protecting and maintaining a healthy population in another reach, is contrary to resource protection within the National Park system. It was also noted in the comments that some of the other suppression

actions, such as returning to peak-power flows in an attempt to reduce rainbow trout spawning success, will likely only accelerate the rate of sediment loss.

One commenter noted the importance of trout as a part of the overall food web, specifically with respect to common mergansers (*Mergus merganser*), bald eagles (*Haliaeetus leucocephalus*), and river otters (*Lontra canadensis*) that feed on trout. Still other comments simply stated that all killing and stocking of nonnative trout below Glen Canyon Dam should cease, citing that this practice is a disrespect of life and waste of taxpayer money and manpower. Another commenter asked that time, effort, and money would be better spent finding a way to restore water flow along the Little Colorado River, rather than trying to manage or eliminate trout in the mainstem Colorado, so that it can behave more like a natural river for the native fish. Still other comments suggested the money wasted on the flows from power generation to protect endangered fish could be spent building a fish hatchery and releasing them into some of the tributaries not threatened by other fish species.

Other Nonnative and Invasive Aquatic Species. Besides the aforementioned trout, bass, and catfish, comments noted a few nonnative invasive species that should be addressed in the LTEMP EIS. This list includes: New Zealand mudsnails, quagga mussels (*Dreissena bugensis*), and the Asian tapeworm (*Bothriocephalus acheilognathi*). These species have shown increases in number and rates of colonization as a result of the temperature changes in the river and changing dynamics of the food web. It was also noted that the Asian tapeworm, in particular, was discovered in the ecosystem after the issuance of the 1996 ROD, and thus, constitutes new information to be addressed in the EIS.

3.2.4 Terrestrial Resources.

Comments on terrestrial resources focused on wildlife and vegetation of riparian habitats along the Colorado River in Grand Canyon National Park.

Birds. Comments requested that the LTEMP EIS provide resource planning information for neotropical migratory bird management, explicitly noting the endangered southwestern willow flycatcher (*Empidonax traillii extimus*). In addition, a focus should be placed on beach restoration that conserves habitats for numerous birds, including migratory species, nesting songbirds, waterfowl, and other wetland species. Finally, a few comments noted the LTEMP EIS should address important food web maintenance needs, such as conservation of species that support nesting peregrine falcon (*Falco peregrinus*) and bald eagles in the project area.

Native Plant Species. The basic comment related to native riparian plant communities was that redeposition of sediment would result in repropagation of these areas. However, some commenters do not feel this result is desirable or beneficial. Some native species, such as arrow weed (*Pluchea sericea*) and coyote willow (*Salix exigua*), have proliferated and dominated some beaches to the extent that they are no longer usable by campers. Thus, some beaches lose more campable area to vegetation encroachment than to sediment erosion.

Nonnative Plant Species. Comments stated that, since 1963, dam operations have encouraged the encroachment of nonnative vegetation, including such tree species as tamarisk (*Tamarix* spp.) and camel thorn (*Alhagi maurorum*), along the shoreline.

Specifically with respect to tamarisk, some comments stated that these nonnative species are invasive, have developed a hold on the river ecosystem, pushed out native vegetation and habitats, and draw much-needed water from the Colorado River. Other comments discussed the tamarisk beetle (*Diorhabda carinulata*) that has recently entered the Grand Canyon; an occurrence that these commenters feel will elicit a watershed-scale change for the river corridor ecosystem in the Grand Canyon. In anticipation of further tamarisk defoliation and death by the these leaf-eating beetles, some commenters felt that the LTEMP EIS should investigate measures that can enhance restoration of native riparian shade trees, which also act as anchors stabilizing the silt and sand substrates on beaches, sandbars, wash fans, or other similar locations along the mainstem of the Colorado River. In addition, research will need to be performed on the tamarisk leaf beetle as it relates to dam releases and future adaptive management efforts.

3.2.5 Tribal and Cultural Resources

Overall, comments requested that the LTEMP EIS focus on improving the inventory, monitoring, and restoration of cultural, historical, and archeological resources. Enhanced sediment supplies and facilitation of transport downstream were specifically mentioned as necessary in order to protect the fragile and nonrenewable archaeological sites along the river corridor.

There were numerous general statements regarding the overall decline and destruction of cultural resources and tribal heritage as a result of Glen Canyon Dam. It was noted that the magnitude and timing of river fluctuations have a significant impact on the cultural record and traditional cultural properties of the 11 associated tribes that live in and around Grand Canyon.

Commenters expressed overall concern about the unique historic and archeological resources and character of the Colorado River. It was noted that, in general, there are fewer of these resources since the 1996 ROD and resulting Glen Canyon Dam operations. Commenters primarily attribute this loss to reduced sediment loads in the river and increased erosion of beaches that expose these resources.

3.2.6 Recreation

Fishing. Multiple comments noted that the Colorado River system and its tributaries provide a home for many endangered, threatened, and sensitive fish species, as well as other native nongame and game fish. Game fish, in particular, have important recreational and economic value to the area.

In general, comments stated strongly that it was essential that a comprehensive fishery management plan, covering the Colorado River between Glen Canyon Dam and Lake Mead, be an integral part of the LTEMP EIS. This plan would include the restoration, recovery, and

maintenance of native fish along with the recovery, sustainability, and enhancement of the fishing in the once blue-ribbon Lees Ferry trout fishery and the Colorado River area through the Grand Canyon (including Bright Angel Creek). Comments noted that the LTEMP should also address the maintenance and management of the associated aquatic food base and threat from invasive nonnative species (e.g., warmwater fish and vegetation). It also should include experimental management actions based on comprehensive, measurable, and defined objectives. It was strongly suggested that there should be a single plan covering the river and its tributaries that is collectively developed by the relevant federal, state, and tribal agencies, along with the participation of affected public organizations and private parties. In addition, the administrative geographic divisions within the area of the plan should be managed by the entities responsible for those divisions as determined by federal, state, and tribal laws, regulations, and treaties.

Comments stated that scientific information and recent studies have allowed for a better understanding of the relationship between dam operations and rainbow trout response. Specifically cited was the Arizona Game and Fish Department (AGFD), which believes that management of Glen Canyon Dam is possible without loss of angling opportunities or detriment to the quality of the fishery (as defined in the fish management plan). Numerous commenters admitted there is a fine balance between maintaining a quality trout fishery in Lees Ferry and protecting or enhancing native fish downstream. Commenters seem to be confident that this balance can be achieved through adequate coordination among resource managers, and LTEMP EIS alternative(s) should be identified that best address this balance.

With respect to the Lees Ferry trout fishery specifically, comments noted that it is located in a clear and cold water section of the river no longer suitable for native fish, but is ideally suited for trout. Comments noted the desire for maintaining larger size fish in Lees Ferry. It was suggested that this could be done by changing the fishing regulations in the Lees Ferry section, to allow unlimited or a possession take of smaller fish (under 14 in.), while maintaining catch-and-release rules for all fish over 14 in. (e.g., by barbless flies). Similarly, other comments suggested allowing outfitter-led rafting trips to include dedicated fishing excursions, with unlimited take-and-keep, through the Grand Canyon below the Lees Ferry reach. These would likely help remove the smaller fish that are detrimental to the native species, thereby benefiting both the fishery and the native fish. Alternatively, the management plan could include information for different methods of controlling trout numbers by reducing reproduction and/or survival of young-of-the-year and juveniles.

Numerous commenters voiced strong concerns over the fact that trout are being removed and killed, and requested this practice be stopped. Commenters noted that one of the primary reasons people come to the Glen Canyon area of the Colorado River is to fish in trophy trout waters. They believe that the practice of mechanical trout removal is not supported by science and results only in a serious loss to the state of time, money, revenue, and effort. Section 3.2.3, Aquatic Resources, discusses the humpback chub–trout issue in more detail.

Finally, some commenters noted that the high and inconsistent daily water flows has made the walk-in area unfishable and sometimes, dangerous. Thus, fishing enthusiasts request consideration of a more consistent river flow (i.e., between 9,000–16,000 cfs to improve the quality and experience of fishing in this area.

Boating and Rafting. Comments stated that rafting and boating on the Colorado River through Grand Canyon is a unique and special experience that should not be diminished. The LTEMP EIS should consider flows that preserve this natural experience.

Comments also identified Lake Powell as a vital boating recreation area. The lowered water levels diminish the users' experience, thus reducing visitation rates to the detriment of the local economy. However, another commenter asked that the LTEMP EIS address the water quality of Lake Powell and consider monitoring the recreational use on the lake, including boaters and shoreline activity. The comment noted significant amounts of sewage and refuse along the shoreline. Education and attention must be paid to this area to preserve the water in the river.

Also mentioned was the Castle Rock Cut, which allows the NPS, concessionaires, and recreational boaters departing from Wahweap Bay (location of the lake's largest marina) access to the greater Lake Powell at a reduced boat travel distance of more than 10 miles. Minimum safe water elevation for passage through the Castle Rock Cut is 3,612 ft. When lake levels are allowed to recede below this elevation, considerable additional costs are incurred by all boaters who need to find an alternate route. The associated costs include fuel expenses, equipment maintenance, and time; travel by alternate routes also results in significant increases in water and air pollution, greater facilities and equipment maintenance costs, and increased emergency response times.

Camping. Comments stated that it was imperative that beach habitat be protected and maintained to preserve the river ecosystem; provide a landscape that is restored to natural pre-dam conditions as closely as possible; and ensure the presence of numerous campable sandbars throughout the river corridor. It was also stated that the erosion of natural sandbars and camping beaches has progressed under all previous Glen Canyon Dam flow regimes. This erosion is a major concern, because as beaches recede and disappear, camping options for river-runners and hikers (who reach the river and decide to camp) are reduced. This, in turn, exacerbates crowding and congestion and negatively affects the quality of the recreational wilderness experience. In addition, comments noted that the availability and carrying capacity of the beaches in the river corridor are directly related to the number of launches (both private and commercial), so this also needs to be taken into consideration.

Thus, comments requested that the LTEMP EIS assess water levels and flows in a way that balances the needs of both river and shoreline users. That is, the proposed flows and flow experiments should be designed to ensure a year-round navigable river, as well as to build up sediment and ensure a sufficient number, size, and distribution of camping beaches to accommodate the level of use delineated by the Colorado River Management Plan and minimize crowding and congestion.

Comments mentioned the fact that camping space was being lost due to plant growth in the riparian zone. It was stated that some beaches lose more campable area to vegetation encroachment than to sediment erosion. Building sandbars could force the retreat of encroaching vegetation. In addition, comments raised concern over the impacts of reduced campable area on

sensitive resources in the Old High Water Zone and the capacity of the ecosystem to absorb visitor impacts.

Safety and Navigability. Comments requested that more and improved information be reported regarding river corridor visitation, visitor safety, and accidents (including types and frequency). Commenters also felt that water quality and disease issues are poorly understood and underreported.

In general, comments stated that the wide range of water releases, which result in high and inconsistent daily water flows, can make both wade fishing and boat fishing very challenging, and oftentimes, dangerous or impossible. Fishing enthusiasts request consideration of a more consistent river flow (i.e., between 9,000–16,000 cfs) to improve the quality and experience of fishing in this area. Some boaters and rafters indicated that they consider a minimum flow of no less than 8,000 cfs necessary to ensure navigability and safety. Thus, any and all flow regimes should acknowledge the potential for adverse operational and boating safety implications.

To the extent practicable, comments also requested that the release regime structure be known in advance. This would allow recreational users to discern that a rise in the river could occur within a certain number of hours after a major sediment increase becomes evident. This would also enable users to take precautions against a rapid rise in water level. The LTEMP EIS should also address the operational and safety impacts of coarse sediments flowing through Glen Canyon Dam, specifically during low reservoir levels.

Wilderness Values. Commenters stated that the Grand Canyon and its neighboring canyons on the Colorado River are some of the most majestic places on earth. Park areas that were specifically noted: Grand Canyon National Park, Glen Canyon National Recreation Area, and Marble Canyon. The fundamental purpose of all parks is to provide for the enjoyment and preservation of park resources and values, including visitor use. The wilderness experiences and benefits specifically noted by commenters 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. Thus, the LTEMP EIS needs to clearly define the resources and values of the Colorado River Basin, assess the impacts of different alternatives against them, and propose ways to protect and preserve this environment as much as possible.

3.2.7 Climate Change

The Colorado River watershed is likely to become warmer and drier in coming years, which will have a wide range of effects. Thus, commenters stated that potential climate change impacts should be integrated into all aspects of the LTEMP EIS, including, but not limited to, water resources, wildlife habitats and communities, recreational use, and cultural sites. Also included should be a basin-wide discussion on how to address these impacts through water management adaptation and mitigation. It was suggested that the DOI partner with National Oceanic and Atmospheric Administration (NOAA) to ensure the most up-to-date climate modeling is applied in evaluating each alternative's flexibility in relation to climate variability.

Comments noted that particular attention should be given to evaluating alternatives against scenarios in which Lake Powell reservoir has not only dropped to dead pool and the dead pool filled with sediment, but remains at dead pool over multiple years.

Comments cited Reclamation's recent publications (DOI 2011c; Reclamation 2011) that project climate change impacts in the Colorado River basin and suggest that in the quest to develop a long-term plan for Glen Canyon releases, it would be prudent for the agencies to consider the extremes of hydrologic variability. Extreme and long-term droughts may significantly change Colorado River flows by midcentury, and commenters urge the agencies to anticipate these circumstances in their plans. Thus, the EIS should proactively address the potential for drought, similar to that experienced in the past several years (prior to 2011), while also taking into consideration forecasted water needs and sources. For example, plans exist to draw water from the system at or above Flaming Gorge and/or the White River for diversion to the East Slope of Colorado. One commenter felt it noteworthy to add that the water managers, who developed the agreement that serves as the cornerstone for the "Law of the River," most likely had water surpluses rather than water deficits in mind.

In addition, commenters noted that the LTEMP EIS should heed the two Secretarial Orders that address climate change in federal planning and to also utilize rigorous science (Secretarial Order 3289, *Addressing the Impacts of Climate Change on America's Water, Land, and Other Natural and Cultural Resources*, and Secretarial Order 3305, *Ensuring Scientific Integrity within the Department of the Interior*).

3.2.8 Air Quality

Comments were received regarding concern over the air quality impacts associated with adjustments to hydropower operations. Comments requested that the LTEMP EIS quantify the impacts from any changes in hydroelectric output, including impacts from replacement power resources. Depending on the source of this replacement energy, it could have negative impacts with respect to increased level of nitrous oxides, sulfur oxides, and greenhouse gas emissions.

3.2.9 Socioeconomics

Colorado River resource stakeholders would likely be affected in different ways and to different degrees by various Glen Canyon Dam management decisions. Commenters generally asked if the LTEMP EIS will look to the affected stakeholders to measure or determine economic feasibility. If this was not to be the case, commenters inquired about how the federal government plans to determine economic feasibility on behalf of nonfederal stakeholders, and if the costs of federal impact mitigation would be considered within determinations of economic feasibility.

Recreational Economics. Commenters asked that the LTEMP EIS take a hard look at the socioeconomic impacts of dam operations on recreational resources, such as fishing, boating, rafting, camping, and other tourism. A full valuation of the socioeconomic impacts on recreational resources affected by dam operations is an essential part of the EIS process, when

the economic implications of alternatives are examined. Commenters noted that, particularly in a time when our economy is doing poorly, the recreational assets of this area should be protected and improved. Self-sustaining recreational activities utilizing these assets, such as the blue-ribbon trout fishery, have a considerable positive impact on the economic viability and livelihood of the local communities. These benefits include: support and patronage for local businesses (e.g., restaurants, sporting equipment stores, lodging, etc.); income and employment for the local area population, including many Native Americans who make up a substantial part of the work force; and even revenue for the state (i.e., license fees). Thus, if there were not the potential for award-winning fishing or exceptional Grand Canyon River-running opportunities, there would be little to support the local economy and the area would suffer financially.

In addition, a few commenters requested that economic values be assigned to sediment in the system. In other words, beaches, camping space, cultural resources protection, archaeological site cover, and species habitat would be included in a cost-benefit study. Replacement cost or offset value of these resources (e.g., beaches) for recreationists could be determined.

Non-Use Values. Comments recommended that the LTEMP EIS provide a thorough non-use value analysis. Non-use values should be incorporated by managers into decision making. One commenter stated that non-use values as measured by contingent valuation analysis, if considered at all, must have the lowest priority afforded to those assessments by the decision-maker. This commenter stated that they believed contingent valuation is a deeply flawed methodology for measuring non-use values, one that does not estimate what its proponents claim to be estimating. Thus, this commenter felt that current contingent valuation methods should not be used in assessment of non-use values or benefit–cost analysis.

Tribal Socioeconomics. Comments noted that since 2004, 57 tribal entities began receiving the benefit of the CRSP resource through long-term firm contracts with the Western Area Power Administration (Western). Many of these tribal communities are in some of the most economically stressed areas of the country. The LTEMP EIS should evaluate the impacts on these communities as well as other CRSP firm electric service customers from operational changes or alternatives that may seek to further restrict Glen Canyon Dam hydropower generation. In addition, mitigation measures should be recommended and evaluated.

3.3 Dam Operations and Hydropower

3.3.1 Dam Operations

Comments generally stated that the current operating plan for Glen Canyon Dam is inadequate — studies and experiments have led to fewer and smaller beaches, continued impacts on native fish communities, and continued impacts on the cultural and archeological resources in the Grand Canyon. The dam must be operated in a manner that is not detrimental to natural, cultural, or recreational resources in the river corridor, but still satisfies power demands from Glen Canyon Dam. One commenter stated that the LTEMP EIS must also address Glen Canyon Dam's operations and impacts in the full spectrum of its lifespan. Intelligent and informed dam operations and flow management can help moderate those impacts. One commenter mentioned a

pivotal part of the LTEMP EIS would be defining a mutually acceptable approach to studying, assessing, and managing a balance among resources and reducing uncertainties surrounding impacts of dam operations. Dam operations must be carefully considered in the context of an ecosystem approach and the respective tradeoffs they may elicit.

Commenters stated that water conservation and efficiency should be taken into account as a part of dam operations, especially considering how operations can change in light of the declining water volume in the Colorado River due to drought, seepage, evaporation, and increased demand and usage. One commenter stated that all reasonably supported hydrologic and catastrophic scenarios over a century time-window should be explored in conjunction with evaluating alternatives. Similarly, the adequacy and capability of dam operation under the event of probable maximum floods, the opposite extreme to a severe and sustained drought, should be evaluated. Multiple commenters stated that the LTEMP EIS should study and evaluate the full use of power resources at Glen Canyon Dam, as was required during the summer of 2010. Commenters added that it is also important for future operational plans to permit adaptation as new scientific findings emerge and as other variables in the system change materially. One comment urged an assessment of senior-perfected water rights and an evaluation of current water use to avert major basin-wide complications.

Comments stated that the LTEMP EIS needs to provide a better integration with the one- and five-year operating plans that were required to be developed according to guidelines published in the Glen Canyon Operating Criteria (DOI 1997). It was also stated in many comments that the LTEMP EIS should result in a long-term (greater than 15 years) operations change, and not just short-term experiments. In addition, comments called for dam operations to achieve compliance with numerous federal environmental and resource management laws and statutes associated with Glen Canyon Dam operations, including the GCPA. Other comments asked that the integrity and standard operating procedures of Glen Canyon Dam, as they were originally planned and executed upon completion of the dam, be maintained and preserved.

Comments discussed how historically, flood control storage had not been a high priority for managers of the Colorado River system, requiring just 5.35 million acre feet annually to be available system-wide at the beginning of each year. It was this low requirement that led to a problem at Glen Canyon Dam in 1983, when high spring runoff was released over the spillway. A faulty design in the spillway caused hydraulic pressure to excavate bedrock. Dam managers were forced to abandon the spillway's full use, and overtopping was narrowly avoided when inflows subsided. Reclamation forecasted that if Glen Canyon Dam had failed when full, it would have had a catastrophic effect on communities downstream, overtopping and perhaps overcoming the Hoover Dam.

Comments indicated that the LTEMP EIS needs to include a full assessment of the impacts, emphasized as severe and adverse, of equalization water releases as established in the *Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lakes Powell and Mead EIS* (Reclamation 2007) on the downstream resources in the Grand Canyon and the entire Colorado River system. Comments specified the desire for proactive, rather than the current reactive, management of the dam, which would anticipate the future need for equalization flows, predict changes in average yearly releases, and account for the possibility

of planned release events, such that the goals of both the LTEMP and GCDAMP are achieved. They also requested that these plans not confound the results of regular HFE events. In addition, this analysis should ensure that any equalization flows be implemented in a way that is consistent with the mandates of the GCPA, the ESA, and other laws and regulations. Larger flows can and should be released over a two- or three-year period instead of a single year as currently planned. This longer term of releases would still satisfy the criteria for moving water from Lake Powell to Lake Mead, but would do it in a manner that better protects Grand Canyon's resources. Commenters specifically mentioned the adverse effects of high equalization releases observed in 2011 on sediment resources.

3.3.2 Hydropower Production

Comments recognized that hydropower provides a clean, low-cost source of energy that can be relied upon for long-term, stable production of domestic energy. Comments recommended that the LTEMP EIS provide the predicted outcome for hydropower (e.g., capacity, generation, and revenue) and assess the costs and benefits from management policies and dam operations to water and power users and to natural, recreational, and cultural resources. In addition, a comment specified that the LTEMP EIS analysis should take into consideration impacts on the hydropower resource since operations changed in 1991 due to interim flows. However, it was also stated that the LTEMP EIS should not have a bias toward hydropower, which would be in violation of the mandate of the GCPA.

On one hand, some comments indicated that the Glen Canyon Dam generation capacity is currently constrained by maximum and minimum flow and ramp rate releases; thus, flexibility and resource diversity is reduced. Reduced generation capability also requires that other, less environmentally desirable resources be used as sources of energy, to replace the hydropower resource that is unavailable. Thus, the dam should be operated in such a manner as to provide for the best production of electricity. Other comments state that Glen Canyon Dam should stop altering its flows to accommodate the power demand, especially for the large cities in the area. These commenters think that protecting the resources of one of our best National Parks should be a top priority. Another comment suggested determining the cost to consumers of hydropower production at steady flows and then developing and conducting a survey to assess the willingness of those consumers to pay more for their electric power in order to preserve Grand Canyon.

Comments noted that large and frequent fluctuating flows designed to maximize hydropower erode sediment, adversely affect the canyon ecosystem, diminish beaches, and expose centuries-old cultural and archeological sites along the Colorado River. Some comments acknowledged that some moderate fluctuation of river levels is acceptable, but should be adapted to climate conditions, such as drought or high precipitation and storage levels in the reservoirs. Moreover, it was mentioned that daytime flows should be kept at a level that allows wading and fishing on beaches and sandbars upstream from Lees Ferry, but not so low that they negatively affect the aquatic food base available to both native and nonnative fish.

In general, it was noted that the magnitude and timing of river fluctuations will have a significant impact on the ecology, cultural and archeological resources, and recreational value along the river corridor. Comments requested that these factors be considered in determining

flow. In addition, comments requested that, to the extent practicable, the release regime should be known in advance and public input considered.

In contrast, one commenter mentioned that aquatic plants, such as *Cladophora* and diatoms, are actually evolved to benefit from daily fluctuating flows, and indeed, do worse under steadier flows. Thus, some modest relaxations of restrictions on daily flow fluctuations could be good for the ecosystem and should be considered.

Comments discussed the fact that steady flows do not change the amount of hydropower production at Glen Canyon Dam; however, they may reduce power revenues by shifting production away from higher-revenue peaking power rates. Thus, it was suggested that the LTEMP EIS explore means of replacing this peaking power and its revenue stream, particularly with another sustainable sources such as utility-scale photovoltaic facilities. Alternately, if water customers are encouraged to further reduce consumption, there would be more flexibility in release schedules, and consequently, reduced demand and downstream impacts.

Comments identified that the overall goal of the LTEMP EIS needs to be the design of a downstream mitigation plan that addresses the resources downstream of Glen Canyon Dam, while still maintaining the dam's capabilities as a hydropower facility. If studies are conducted with this goal of maximizing all resources, the result will be hydropower coexisting with endangered fish recovery, habitat protection, and recreational resource enrichment.

One commenter requested that resources from the dam's operations should be used to specifically mitigate the loss of river and canyon resources. The mitigation measures suggested may include creating access points for ingress and egress to the Green, San Juan, and other rivers in the area, which would be used to provide offsite river use opportunities in the surrounding rivers.

3.4 Geographic and Temporal Scope of the LTEMP EIS

Many comments supported limiting the scope of the LTEMP EIS to the Glen and Grand Canyon areas. It was noted that extending the geographic scope beyond this area raises significant additional issues that may not be directly associated with the operation of Glen Canyon Dam, and may affect the operation of Hoover Dam. In addition, the water and fish species in Lake Mead are already subject to a federally approved and active conservation plan, the MSCP. Thus, one commenter stated that to include Lake Mead National Recreation Area within the scope of the LTEMP EIS would be beyond the scope of the GCPA and applicable law, and duplicative of an existing conservation program.

One commenter explicitly asked that upstream effects of the Glen Canyon Dam also be considered, including the effects of lower reservoir elevations on the ability to enter the lake from tributaries.

Other commenters recommended the geographic scope of the LTEMP EIS include the entire Colorado and Green rivers system, both upstream to Cataract Canyon and downstream to

include Grand Canyon, Lake Mead, and Hoover Dam. These comments consider this area to be a single ecosystem, whose components are inextricably linked and must be managed in concert. Failing to include Lake Powell and its major tributaries, particularly Cataract Canyon, would translate into less attention being paid to the sources of water and nutrients, as well as important scientific controls for understanding and predicting changes in Grand Canyon, such as anoxic waters, systemwide nutrient flux, food-base delivery, invasive species (e.g., quagga mussel) threats, recreation use (boating, fishing, etc.), and economics.

Other comments indicated that the Glen Canyon Dam was the "linchpin" of the Colorado River; thus, the geographic area covered in the LTEMP EIS should include the entire basin. In addition, the entire Colorado River system can be considered an integrated "ecoregion," so it is important to consider and include impacts throughout the system in planning for the future of Glen Canyon Dam.

A common theme among the comments was that Grand Canyon National Park is a national treasure and a natural resource to be held in trust for the world's generations to come. Some comments addressed the proposed 10- to 15-year management plan as being too narrowly drawn, pointing out that the current drought could last at least another decade; a 100-or-more-year plan would not be inappropriate, allowing for a broader look at such influencing factors as climate change, aridity, and catastrophic, maximum flood events. A comment addressed the finite lifespan of Glen Canyon Dam and the need to develop a plan for when it might no longer be able to provide uninterrupted water delivery.

3.5 Policy and Regulatory Concerns

Comments urged the use of scientifically justifiable and credible management decisions, without the influence of special interest groups; there is previous and ongoing scientific research from other dams; the GCMRC, NPS, Reclamation, and other research organizations; and individuals that can be used to inform decisions on Glen Canyon Dam and monitor progress toward goals. Comments also requested the testing of hypotheses with robust scientific experiments.

Comments stated that a successful approach to the LTEMP EIS includes: (1) taking a comprehensive look at the challenges and opportunities facing the region, including documenting the affected environment; (2) exploring the full range of potential solutions and their environmental impacts; (3) fully considering public issues and concerns; and (4) choosing a preferred alternative that will restore the environmental, recreational, and cultural resources of the Colorado River Basin. Also, operational implementation of recommendations should be practical. The LTEMP EIS would be a living document, responding actively to new information.

Comments strongly suggested that all alternatives must comply with the numerous laws, regulations, mandates, the Law of the River, and policies that affect the operation and management of Glen Canyon Dam, Grand Canyon National Park, and Glen Canyon National Recreation Area; the ecology and wildlife of the area (considering, in particular, endangered species, habitats, and the ESA); and the tribal, cultural, environmental, and recreational downstream resources of the Colorado River ecosystem.

3.5.1 NEPA Compliance

Comments were concerned with the timeframe for providing scoping statements, requesting an extension of 45 to 90 days to allow interested parties additional time to respond, citing the complexity of the issues and the insufficient time to research the available materials.[1] Another factor in the request for an extension was the number of holidays in the response period, overlapping both the Thanksgiving and winter holidays. A comment also addressed the need to complete the LTEMP EIS and to issue the ROD. Given the scope, duration, and importance of the LTEMP EIS, there should be sufficient time given for stakeholders to review the relevant development documents and implementation plans.

One comment addressed other ongoing federal activities that could inform or even replace the LTEMP EIS, such as the HFE Environmental Assessment and the Non-Native Fish Control Environmental Assessment; this comment also suggested that the GCDAMP should be able to make management decisions concerning Glen Canyon Dam. A comment said that GCMRC's work in restoring riparian ecology and meeting the NEPA's conditions should be given priority in management decisions.

3.5.2 GCPA Compliance

Comments discussed the National Park Service Organic Act of 1916 and its requirement that national parks remain unimpaired for the enjoyment of future generations, and that the LTEMP EIS should have, as its first priority, the restoration, protection, and improvement of Grand Canyon; any other considerations are secondary. Comments noted that the NPS manages Grand Canyon National Park to conserve its scenery, wildlife, and cultural and historic resources, and the LTEMP EIS should benefit the park and its resources. Comments expressed the goal that no further harm should be done to the Grand Canyon ecosystem.

Many comments urged compliance with the GCPA and quoted it with regard to the operation of the Glen Canyon Dam, that it should be operated "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." Some comments addressed protecting and fostering native vegetation and native fish; the elimination of non-native fish; beaches and sediments; and the health of the river ecology as consequential outgrowths of GCPA compliance. This raised the question of funding the restoration of flora and fauna and whether this should be the responsibility of the GCDAMP.

Comments stated concern that the dam is operating today essentially as it was prior to the passage of the GCPA and that fish recovery goals have not been met. A portion of a 2002 Report to Congress by Former Secretary Norton was quoted in a comment: "The first population estimate of humpback chub in the Grand Canyon suggests that in 1982 there were 7,000 to 8,000

[1] The comment period subsequently was extended from December 31, 2011, to January 31, 2012.

humpback chub larger than 200 mm. Approximately ten years later, in 1992, it was estimated that there were approximately 4,000 to 5,000 humpback chub larger than 150 mm. In 2001, there were approximately 2,000 to 3,000 humpback chub larger than 150 mm. While there is some question over the accuracy of the absolute numbers, there is little question that the population of humpback chub in the Grand Canyon has declined over time. The decline in the abundance of fish larger than 150 mm appears to be the result of a sustained decline in recruitment beginning in 1992."

Comments addressed the deterioration of downstream resources even after the passage of the GCPA. Other comments stated that the obligation placed on the operation of Glen Canyon Dam was to cause the least possible damage to these downstream resources. Comments said that restoration of the pre-dam shoreline should be a paramount management goal.

Other comments urged compliance with the intent of the GCPA, interpreted in those comments as hydropower's taking a secondary role to the tribal, natural, cultural, and recreational environment of Grand Canyon. Comments mentioned that the underlying purpose of Glen Canyon Dam, authorized by the Colorado River Storage Project Act of 1956, was to regulate the flow of the Colorado River for water and supply, with hydropower listed as an incident to these purposes. Comments also stated that there has been a longstanding debate as to where hydroelectric power generation falls in relation to the environmental and societal objectives of the GCPA.

On the other hand, comments said that power production is a primary purpose of the Glen Canyon Dam and that it must be balanced with other purposes, water delivery and allocation obligations, exportation, statutory requirements, and economic development in the area. One comment pointed out that the Secretary of the Interior is limited in his ability to change elements of the dam's operations by the priorities the GCPA places on water storage, allocation, delivery, and the required compliance with the Law of the River; annual and monthly releases are constrained by water supply considerations, water delivery requirements, and the avoidance of anticipated spills. Some comments suggested that the Colorado River Compact be revisited to reflect the current limitations of the river and changing societal demands.

3.5.3 ESA Compliance

Comments noted that four of Grand Canyon's eight native fish species have become extirpated from the Grand Canyon since Glen Canyon Dam began operating, that a fifth is heading toward extirpation, and that a sixth is considered a species of special concern. Native birds, mammals, reptiles, and amphibians have also been affected. Comments said that in a report to Congress, the Secretary stated that recovery goals to bring the dam into compliance with the ESA had not yet been met.

A comment discussed the development of a recovery maintenance program for the humpback chub, an endangered species, which would parallel the LTEMP EIS process. One comment said that the elements contained in the GCDAMP's Humpback Chub Comprehensive Report should be used as a starting point for discussions regarding a Recovery Implementation Program to include the Adaptive Management Working Group (AMWG) and collaboration with

the Upper Colorado and San Juan Endangered Fish Recovery Implementation Plan and the Lower Colorado River MSCP to avoid duplication of effort.

3.6 LTEMP Approach and Considerations

3.6.1 Adaptive Management

Many comments noted that the overall LTEMP should take an adaptive management approach, which is based on continually adapting practices based on ever-changing information, and operated in concert with the rest of the Colorado River Basin. The aim of this approach should be to preserve, protect, and improve the natural, cultural, and visitor-use values of the Grand Canyon National Park and Glen Canyon National Recreation Area, which has been drastically altered by the presence and operation of Glen Canyon Dam. One group of comments specifically stated that the LTEMP EIS must mandate the completion and implementation of a conceptual ecosystem modeling plan. The same group called for a management plan that explicitly addresses the protection of humpback chub against toxic contamination or chemical spills. In contrast, one commenter voiced the opinion that humans should not attempt to "manage" the environment or its resources.

3.6.2 Ecosystem Management

Some commenters wanted the LTEMP to take an ecosystem management approach, as mandated by agency policies, management plans, and strategic plans. This approach is appropriate for protecting archaeological resources because the priority is to protect them in place. An ecosystem management approach would link several models together, such as a flow–sediment model; a nutrient dynamics model for carbon, nitrogen, and phosphate; a water-quality model (including temperature, inorganic constituents, and microbes); an aquatic food-base model; a coupled river continuum and landscape-based river corridor habitat model; a wetland and riparian vegetation development model; population models of trophically significant biota; a trophic-relations model; a human goods-and-services model (including cultural concerns, hydroelectric and recreational economics, and non-use values); and an administrative model that tracks stewardship goals, objectives, projects, and costs in relation to the overall ecosystem model.

3.6.3 Experimentation

The majority of commenters stated that scientific studies and monitoring of conditions in the river corridor, particularly with regard to sediment and river flows (e.g., range and variability), should continue until more data are compiled to adequately analyze the impacts of different flow regimes on the resources analyzed in the EIS. In other words, the experiments should be given adequate time to be properly tested and adjusted. In addition, the LTEMP EIS needs to clearly distinguish between what is considered proposed experimental versus management actions related to Glen Canyon Dam operations.

Some commenters strongly suggested the experimental flows be determined by the information derived from and the needs of science and be based on comprehensive, measurable, and defined objectives, with a specific focus on preserving, protecting, and restoring the resources of Grand Canyon. The process for developing management and experimental programs under the LTEMP EIS should also be considered. It should be sufficiently flexible to assure quality and non-biased reporting and avoid rushing to completion. In addition, comments noted that evaluations should be based on how well the flows mimic the natural hydrograph (which is also noted as the principle behind the recommendations from the USFWS in its 1994 Biological Opinion) and consider endangered species, cultural interests, and commercial/private viability. Conversely, one comment stated that the experimental flows, in general, have produced little solid scientific information and have not only wasted a lot of generation power and water, but also destroyed a blue-ribbon trout fishery.

Some commenters voiced concern that there are currently no control sites for the experiments; thus, the EIS should consider establishing such controls as a top priority in further experimentation. One comment suggested including Cataract Canyon as a scientific control study area. In addition, scientific knowledge, data, lessons learned, and other relevant information from other regulated rivers (e.g., the Green River below Flaming Gorge Dam) should be used in the LTEMP EIS process.

Multiple comments supported the continuation of HFEs. They specifically remarked that HFEs should be carried out in a way that helps determine if the sediment would be moved up to a high-enough elevation to be of assistance in protecting and recovering the shoreline environment below the Glen Canyon Dam, as opposed to simply rearranging or changing the shape of the shoreline and beaches. One commenter asked that computer modeling of power plant capacity HFEs be performed to see if sand would be moved up to a high-enough elevation for beach/ecosystem/dune benefits, and, if this modeling showed a benefit, Reclamation should conduct power plant capacity HFEs. Another commenter specifically requested that trout response be monitored and accounted for in the experimental design. In contrast, other comments indicated that HFEs have failed to produce any long-term discernible benefit to the beaches and sandbars, since any deposition created by these artificial floods largely disappears within six months.

With respect to timing of these events, comments in support of these experiments mentioned that HFEs should be done on a regular basis when sufficient sediment is in the river system and the Lake Powell water supply permits. One comment indicated the belief that the more frequent the high flows, the greater the benefit, because finer sediments that are important in binding together high-flow deposits (making them more persistent) wash through the system quickly. Other comments suggested that HFEs should be conducted in a pattern that would closely mimic pre-dam river behavior/flows (which is basically the same as the seasonally adjusted steady-flow regime described below). Another commenter requested that HFEs not occur in the fall, as they scour the algae and other plant life, which are a critical part of the food base for fish, from the bottom of the river at the time of year when the sun is not reaching the bottom of the canyon (as it does in spring) and there is little opportunity for recovery.

Comments indicated the magnitude of HFEs should be increased, when the Lake Powell water supply permits, because current HFEs are not sufficiently large. Experimental high flows are needed to better understand the effect of flows of about 60,000 cfs for the development and refinement of sediment, geomorphological, and vegetation models, and for ecosystem stewardship. Such flows are still far lower than those that occurred nearly every year in pre-dam times. Direct observations, by the Grand Canyon Wildlands Council, Inc., of high flows of those magnitudes in the early 1980s suggested thresholds in riparian vegetation scouring, sandbar rejuvenation, ponding of tributary mouths, mobilization of debris boulders, and many other factors; thresholds that have yet to be recognized by the existing HFE program. Multiple comments requested the testing of experimental flows at least above the 41,000-to-45,000 cfs range, if hydrologic events/conditions allow.

In addition, several comments specifically mentioned that efforts to restore sediment to the river system should not be limited to "experiments," but need to be a part of the dam management plan. Other comments requested that a protocol be established for expedited approval of higher-volume dam releases when the Paria, Little Colorado, or other major sediment sources are injecting large amounts of sediment into the main river. Increased flows during these times would take maximum advantage of natural sediment augmentation opportunities and be more effective at moving sediment than simply trying to get high flows to pick sand up off the river bottom. Finally, one comment requested that the LTEMP EIS include a proactive plan to occasionally get the lake level to spillway elevation, so that short-duration HFEs that utilize some spillway water can be made.

Commenters felt that it was important for the LTEMP to establish and implement long-term monitoring programs and activities, including any necessary research and studies on conditions in the river corridor, to track the progress and determine the effect of actions on the natural, recreational, and cultural resources. This will also ensure the dam is operated in a manner consistent with relevant acts, policies, and legislation.

3.6.4 Baseline Conditions

Comments requested that the current state of management and all proposed management actions be evaluated against the baseline of the pre-dam state of the Colorado River. This is the only way to evaluate the complete impact of MLFF, since comparing other alternatives to MLFF would not provide a complete assessment. Some comments are strongly opposed to MLFF, pointing out that this regime has hurt the downstream riparian environment, threatened the existence of cultural sites and native fish species, and failed to achieve the goals of the GCPA.

3.6.5 Desired Future Conditions

Commenters indicated that the LTEMP and EIS should clearly state the desired future conditions (DFCs) for all river-related factors under consideration, and utilize those DFCs for evaluation of alternatives. DFCs, framed qualitatively and quantitatively, should consider water flow; hydroelectric generation; water and air quality; climate change impacts; sediment; vegetation; noxious weeds; terrestrial and aquatic wildlife; birds; missing, declining, and

endangered species (including a timeline for restoration); cultural resources; recreation; Indian Trust assets; societal processes; Native American concerns; environmental justice; and the National Wild and Scenic Rivers System.

Comments recognized that the DFCs need to be consistent with the letter and intent of the GCPA and other laws, regulations, and plans, such as the NPS Organic Act, NPS management policies, and the General Management Plans for Grand Canyon National Park and Glen Canyon National Recreation Area. This will require balancing the differing goals and competing interests.

According to the comments, DOI, in conjunction with the GCDAMP, is developing qualitative DFCs for key downstream resources to guide recommendations for the operation of Glen Canyon Dam; the final recommendations and goals might be adopted by DOI and could provide a useful framework for developing the LTEMP EIS. Some commenters wanted the DFCs to be adaptable to material changes, unacceptable impacts, new knowledge, new scientific findings, and whether a DFC is achievable.

3.7 Alternatives

It was noted that a clear delineation between what is considered management versus experimentation must be determined prior to beginning the LTEMP EIS and incorporated into the alternatives. Comments expressed some general concerns regarding alternatives. Various comments pointed out that alternatives must be consistent with the many laws, regulations, and policies that govern water delivery, quality, and releases; natural and cultural downstream resource preservation; recreational use at Grand Canyon National Park and Glen Canyon National Recreation Area; protecting endangered species; environmental considerations; and hydropower generation. Comments recognized that there may be competing goals among the laws and regulations, policy conflicts in need of resolution, and management responsibilities that must be prioritized.

Alternatives must also consider climate change. Many comments also said that alternatives should look at the entire Colorado River ecosystem to consider such matters as flora; fauna; sediment conservation; habitat restoration that would conserve migratory and nesting songbirds, waterfowl, and other wetland species; beaches and sandbars; climate change; reduced inflow; cultural sites; boating safety; river navigability; recreation; and water delivery obligations in developing LTEMP alternatives.

Selected alternatives must be economically feasible and should include thorough and rigorous socioeconomic analysis to enable managers to understand the value of system components. For example, in evaluating sediment removal, decision makers should know the estimated cost of analyzing, permitting, building, and operating a sediment replacement system under various flow regimes and be able to compare it to values for operating the hydropower plant at peaking flows.

For each alternative being considered, commenters wanted the environmental impacts and predicted outcomes on park and other resources and values (i.e., nonnative species; hydropower capacity, generation, and revenue; non-use values) described and analyzed. This would enable comparison to NPS targets for ecosystem patterns and process and facilitate decision making. Some commenters specifically stated that DFCs should be used as the benchmark against which alternative performance should be compared. Comments called for all alternatives to be scientifically defensible and credible with well-defined hypotheses. The possible negative or positive effects of uncertainty in scientific analyses or statements that are unsupported by data should be discounted, since they may introduce bias. Alternatives could build on prior research, such as that performed by the GCMRC.

Comments expressed concern that GCDAMP might be locked into a single flow regime for the next 10 to 15 years. Also, comments pointed out that there have been major changes in the riparian and riverine ecosystems since Glen Canyon Dam was constructed, and there will need to be changes in dam operations and management activities to restore Grand Canyon National Park resources and values.

One commenter suggested that GCDAMP stakeholders be integrated into the development of alternatives for the LTEMP EIS using structured decision making to develop some or all of the alternatives for the LTEMP EIS. The use of this approach would help fully integrate the AMWG/Technical Work Group stakeholders in the development of alternatives and the initial assessment of the performance of those alternatives.

3.7.1 Proposed Alternatives

While many commenters provided suggestions for what the LTEMP should achieve in terms of resource goals, several also put forward specific suggested alternatives to be considered in the EIS. One comment pointed out that the range of alternatives considered is generally at the agency's discretion and is reviewed under a rule of reason that requires an agency to set forth only those alternatives necessary to permit a reasoned choice. Reclamation may diverge from the directive to generate the most power possible only to the extent that peer-reviewed science demonstrates that downstream resources will be improved. Another commenter asked for a distinct and clear definition of the term "reasonable" as it relates to alternatives, and how it would be measured.

Grand Canyon First! Adopting a "Grand Canyon First!" strategy was advocated in many comments. In this alternative, consideration of the ecology and wildlife of Grand Canyon would be the paramount consideration, restoring Grand Canyon to as close to its historical state as possible. This alternative would recognize the GCPA as the primary source to inform the LTEMP EIS and that the operations of Glen Canyon Dam should help to preserve the natural and cultural resources of Grand Canyon. The alternative describes objectives but not an operational regime to achieve those objectives.

Fill Lake Mead First. In this proposed alternative, primary water storage would shift from Lake Powell to Lake Mead, using Lake Powell as a backup for seasonal and flood control purposes. According to the commenters, there would likely be less water lost to evaporation and

seepage, and there would be greater flexibility for implementing Grand Canyon restoration strategies. Comments pointed out that both lakes are at half-capacity, and that filling Lake Mead would expose more of Glen Canyon and open a new section of the river for recreational use.

Run-of-the-River. Commenters suggested that the dam could be re-engineered to a modified run-of-the-river design. This would restore natural water and sediment flows to the greatest extent possible. In this proposed alternative, considered but rejected in the 1995 EIS process, the old river bypass tunnels could be reconnected or new tunnels could be opened to bypass Glen Canyon Dam. This alternative would utilize elements of the "Fill Lake Mead First" alternative above. Some comments said this may be the only alternative that ensures the long-term restoration of the Colorado River ecosystem.

Decommission Glen Canyon Dam. An extension of the Run-of-the-River alternative is to decommission the dam, either leaving it in place or removing it. This was mentioned in many comments. If left in place, dam levels would be equalized to upstream inflows. Lake Powell water levels would drop, and the sediments would begin to cut new banks and form a new channel that would flow around and through Glen Canyon Dam. Comments advocating the decommissioning of the dam mentioned the benefits of opening currently submerged areas to new recreational activities; restoring the environmental, recreational, and cultural resources of the Grand Canyon and the Colorado River basin to their pre-dam conditions; and positively affecting the health of the Colorado River ecosystem.

If the dam were dismantled and removed, a number of steps would be required, including preparing for sediment removal from the former reservoir, avoiding the potential failure of an aging infrastructure, and a variety of land and water management activities. One comment mentioned replacing the lost hydropower with solar power in the Wahweap Basin. Should the dam be decommissioned, one commenter said that the upper basin development scheme may be too ambitious and should be reevaluated to improve water efficiency and to include best management practices overall.

Frequent High-Flow Releases Separated By Steady Flows. A number of commenters advocated various steady-flow alternatives (seasonally adjusted or year-round steady flows) that incorporated regular or periodic high flows triggered by sediment inputs from tributaries. Commenters stated that science has consistently concluded that regular high flows under sediment-enriched conditions combined with seasonally adjusted steady flows will most closely mimic pre-dam conditions and perform the best for Grand Canyon resources, including the beaches, native fish, and cultural sites. This flow regime will not compromise in any way the Law of the River or the Colorado River Compact, because it is concerned with regulating the types of flows and not the volumes of water distributed to the states.

Comments stated that seasonally adjusted steady flows need to be a well-defined, key component of proposed LTEMP alternatives. The seasonally adjusted steady-flow alternative would be a close approximation of the pre-dam hydrography; and it can be designed to comply with the Law of the River. This flow regime needs to be sufficiently long — more than two months in the fall — to produce a biological signal that is followed by a full synthesis of impacts

on biological, physical, social, economic, and cultural resources. Seasonally adjusted steady flows still need further testing to determine system response and to test USFWS's reasonable and prudent alternative, but some comments suggested alterations at 10-day intervals to correspond with inflows over a 10-day period; the effect would be as if the dam did not exist.

Commenters also suggested evaluating year-round steady flows as a viable alternative. This alternative was presented as the "best case scenario" for preserving sand based on Wright et al. (2008). It is based on the conclusion that the optimal intervening dam operation for rebuilding and maintaining sandbars is year-round steady flows, which would export the least amount of sand compared to other potential dam operations. One commenter suggested steady flows as part of a 12-year series of 3×4-year experimental blocks (described below), in which 2 steady-flow alternatives would be tested.

Pre-1996 ROD Operations. One commenter suggested that pre-1996 ROD operations be considered as one alternative to allow for a better understanding of the effects of MLFF operations.

Full-Powerplant Capacity Operations. Two commenters recommended that the LTEMP EIS consider the impacts of operating the dam at full power plant capacity on a constant basis and a fluctuating-flow regime that allows for maximum power plant capacity releases.

Modified Low Fluctuating Flows. This alternative serves as a "no action" alternative, and commenters agreed this alternative should be evaluated in the EIS. Some comments said that further study should be done on the effects of MLFF (the flow regime selected in the 1996 ROD). Other comments stated that these flows still jeopardize the continued existence of the native fish species (e.g., humpback chub and razorback sucker) and threaten to destroy or adversely modify designated critical habitat. Different comments stated that this operating regime, which resulted in the constraint of hydropower generation levels (e.g., maximum and minimum generation/flow and limits on up and down ramps) in favor of downstream concerns, has not produced the intended results.

12-Year Experiment of 2 Steady-Flow Alternatives. One comment suggested a 12-year series of 3×4-year experimental blocks. The first four-year period would be a seasonally adjusted steady flow. The next four-year block would be MLFF. The final four-year block would be year-round steady flow. All three flow regimes would include high-flow releases under sediment-enriched conditions. After 12 years, the 3 regimes would be analyzed to determine which had the most favorable results consistent with the GCPA.

Species Community and Habitat-Based Alternative. This proposed alternative is intended to contribute to the conservation or recovery of endangered or extirpated species, such as the humpback chub, razorback sucker, southwestern willow flycatcher, and Kanab ambersnail (*Oxyloma haydeni kanabensis*). It would also contribute to the conservation of other non-listed aquatic and riparian species (including flannelmouth sucker, bluehead sucker, and speckled dace) to reduce the need to list them under the ESA. This would include an ESA Recovery Implementation Program focused on supporting native species communities that ensures that their habitat-based needs are met. This alternative would include a management program for the

trout at Lees Ferry that also provides for protection of humpback chub and other native fish populations downriver, and a quality recreational fishery at Lees Ferry. The alternative describes objectives (but not an operational regime) to achieve those goals.

Stewardship Alternative. Commenters suggested consideration of a stewardship alternative that utilized a flow regime that would best serve Grand Canyon and be aligned with the GCPA, with no consideration given to hydropower sales. The alternative describes objectives (but not an operational regime) to achieve those goals.

Related comments recommended consideration of an alternative that involves mechanically augmenting sediments; timing spring releases to coincide with native fish spawning periods; varying water temperatures as they varied before Glen Canyon Dam; implementing selective temperature control; removing nonnative fish; repatriating extirpated species; removing tamarisk and restoring the native riparian plant community for sensitive bird species; implementing low steady flows in summer and fall and peaking flows for shoreline deposition; and identifying and implementing replacement power without increasing carbon emissions and without constructing other dams or pump-back hydropower facilities.

3.7.2 Suggested Alternative Considerations

The following considerations related to alternatives were submitted by one or more commenters. These considerations are aspects or elements of alternatives that commenters felt were important to consider.

Augment sediments. Many commenters suggested mechanically augmenting sediment and sand to enhance camping beaches and sandbars along the Colorado River.

Implement a temperature control device. Commenters suggested that the EIS should consider an alternative that evaluates the efficacy of installing a Temperature Control Device (TCD) onto Glen Canyon Dam's intake structures. This device would allow water to be drawn from different depths of the reservoir to provide temperature control flexibility and improved water quality. A TCD would also maximize experimental flexibility and thus, the potential for achieving a positive result for native fish recovery and ecological restoration. It was noted that some of the risks associated with the TCD could be overcome by incorporating other operational strategies (such as sediment importation) into the system to disadvantage hunt-by-sight predators, and by initiating a periodic-spike flow. It was further suggested that the LTEMP EIS team consult with the USFWS to help address the costs, benefits, and risks associated with a TCD.

Provide bubblers in forebay. Bubblers in the dam's forebay would break down the thermocline and increase the release temperature. This was offered as an inexpensive temporary method to elevate water temperatures downstream, which could be used to test hypotheses about the benefits and detriments of temperature changes.

Do not mechanically remove trout. Many commenters wanted alternatives that did not include mechanical removal of trout.

Mechanically remove brown trout only. Some commenters advocated mechanical removal of brown trout only because this species is more likely to feed on native fishes than is the rainbow trout.

Control trout to improve fishery and benefit humpback chub population. Include trout control in alternatives by reducing reproduction or preventing migration into certain areas, with the intent of protecting humpback chub.

Implement greater fluctuations to dry trout redds in spring. Fluctuations can be used to control trout numbers by exposing trout spawning areas and killing eggs.

Restore extirpated and other native species to Grand Canyon. Comments requested a river corridor ecosystem that matches the natural conditions as closely as possible, including a biotic community dominated in most instances by native species.

Relocate more humpback chub to tributaries. Tributaries tend to have higher water temperatures than the main river corridor, and this could provide a healthier environment for the humpback chub. Bright Angel Creek should be considered as a possible relocation spot if the habitat there meets the humpback chub's preferences.

Paria River sediment check dams. To enhance turbidity conditions downstream for reduction of trout predation.

Continue research and experimentation. Overall, comments were in favor of conducting research on the impact of dam operations on the Colorado River ecosystem. Comments addressed the need for longer-term and more aggressive experiments.

Modify monthly and annual flows. Alternatives should consider changes to the current annual and monthly release volumes. Alternatives should employ the inherent flexibility in the Colorado River Compact for designing water releases. A commenter noted that the Compact does not require a particular annual release volume, but rather, it requires that the "... states of the upper division will not cause the flow of the river at Lees Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of 10 consecutive years reckoned in continuing progressive series beginning with the 1st day of October next succeeding the ratification of this compact." In addition, there are no legal requirements mandating particular monthly release patterns over a given year.

Release equalization flows in ways that minimize impacts and provide benefits. The adverse impacts of 2011 equalization flows were mentioned by several commenters. It was suggested that alternatives should consider adjusting timing and magnitude of equalization flows to coincide with available sediment from the Paria and Little Colorado Rivers to help rebuild beaches in the Grand Canyon. It was also suggested that equalization flow releases should be implemented over several years rather than in a single year, as currently envisioned.

Implement high-flow releases in rapid response to sediment inputs. Comments called for HFEs as a part of all alternatives. Commenters specifically mentioned the need to respond

rapidly to sediment inputs to conserve sediment. High flows released on a regular basis when sufficient sediment is in the river system can help build beaches, improve other sediment-related resources, and increase carbon storage in the old high-water zone. In addition, the finalized HFE Protocol Environmental Assessment should be incorporated into the design of all LTEMP alternatives.

Implement high-flow releases that are greater than 45,000 cfs. Comments suggested considering introducing variability by changing the level and timing of HFEs, to include more than just 41,000–45,000 cfs flows or releases in early spring. Sediment science suggests that flows of 60,000 cfs and more would be extremely beneficial for the sediment-based resources in Grand Canyon. Increase the magnitude of high flows for experimental sediment, geomorphology, and vegetation management, when the Lake Powell water supply permits. Flood events are a natural occurrence of free-flowing rivers; before the construction of Glen Canyon Dam, annual spring snow melts averaged 55,000 cfs. Controlled floods were introduced in Grand Canyon to mimic those highly variable pre-dam flood events. Experimental beach habitat-building flows could be undertaken during the historic hydrographic peak, the monsoon season, and winter flood events.

Reduce flow fluctuations. Commenters suggested consideration of reducing flow fluctuations to reduce impacts on ecological resources and improve navigability and the safety of boaters and other downstream recreational users.

Establish minimum flows of 8,000 cfs. Flows of no less than 8,000 cfs have been suggested by commercial operators as a minimum for safety and convenience; however, private boaters could probably go with a lower flow for both safety and convenience.

Adjust ramping rates. Some commenters requested that ramp rates not be increased and that down ramps should be slowed even further. Other commenters requested that increased down-ramp rates should be considered to increase hydropower operational flexibility.

Restrict camping on certain beaches with alternative camp shelving in lieu of beaches. This suggested alternative consideration would allow for testing impacts on recreational users and monitoring sand losses.

Store water underground. A comment suggested transferring the contents of Lake Powell and Lake Mead to underground storage locations to avoid losing water to evaporation. The commenter stated that there are abundant nearby natural underground locations that could accommodate the volume of water from six years of the Colorado River's annual flow.

3.8 Other Issues

The following various other issues were raised in comments and may or may not be considered in the preparation of the EIS:

- Give the NPS authority to protect Grand Canyon National Park.

- Amend the Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations of Lake Powell and Lake Mead (2007) to include consideration of the requirements of the GCPA.

- Continue to engage a professional facilitator in GCDAMP meetings.

- Post revised instructions for using NEPA and Reclamation's Department Manual on Reclamation's web site before developing a scoping report.

- Establish a higher funding cap for GCDAMP activities to allow successful completion of the work to be accomplished under the LTEMP, There is now a much better understanding of program needs, and the funding needed to complete it.

- Eliminate the lottery for obtaining river permits so that individuals have the opportunity to enjoy the Colorado River wilderness. Ensure fairness in the wait list so that those applying for their first permit receive priority over those re-applying.

- Address irrigation from upstream states, so there is a healthy flow of water that reaches the lower Colorado River system.

- Ensure that the team leaders who are developing the LTEMP EIS go down the Grand Canyon as a part of the EIS process. This will allow them to see firsthand what is happening down there, because this place is so complex, and some of the issues can only be understood fully if you see them with your own eyes.

- With the availability of a huge amount of very cheap clean safe fusion power in the future, the possibility of removing and mining the sediments in Lake Powell impoundments may one day become a windfall resource.

3.9 Stakeholder Involvement

Overall, comments requested that agency responsibilities be clearly defined, communication be improved, mechanisms be created for productive information-sharing, and project redundancies between NPS management programs in Grand Canyon National Park (i.e., resource monitoring and translocations of native fish) and the GCMRC be eliminated. The LTEMP EIS should clarify the role and level of involvement of each agency in preparing, commenting on, and finalizing the LTEMP EIS, as well as the decision-making and implementation process to follow. Some comments were concerned with improving federal communication and outreach to non-federal constituents, partners, stakeholders, and the general public. In particular, one comment, concerned about the growing regional population and a potentially unsustainable water supply, called for informing the public, planners, and local and state governments of estimates of water availability and the studies used to determine those estimates. Improved communications would also include distinguishing between proposed

experimental and management actions in the operation of Glen Canyon Dam; stakeholders would then be better able to determine whether and to what extent a proposed action should be accepted as necessary to gain experience and knowledge in reservoir operations and environmental resources, without waiving rights established under the Law of the River.

A specific plan for stakeholder involvement was presented by one commenter: (1) set clear goals and involve stakeholders in developing a collaborative process; (2) use professional neutrals when appropriate and commit to building common ground; (3) incorporate joint fact-finding to deal with scientific uncertainty; (4) produce collectively supported written agreements; and (5) build long-term adaptive management capabilities.

A commenter, aware that Grand Canyon is a world-renowned riverine resource, wanted DOI to act in the public's interest, guided by the most rigorous interpretation of the laws, regulations, and policies that govern Grand Canyon and the operation of Glen Canyon Dam. Recreational, hydropower, and GCMRC's interests should not dominate public interest. The perceived bias toward hydropower interests is discussed in more detail in Section 3.9.2.

3.9.1 Tribal Involvement

Commenters indicated that they want the 11 American Indian Tribes affiliated with Grand Canyon and the Colorado River to be involved respectfully and substantively in the LTEMP development stage and beyond, rather than asking for their input after plans have been made. Tribal voices, values, perspectives, and knowledge need to be heard and incorporated in the LTEMP. Tribes should also participate in the development of desired future conditions and management actions.

Ancient habitations, arts, artifacts, and sites that are central to tribal traditions are located in Grand Canyon. Comments said this requires that the tribes fully participate in the development and ongoing decision making regarding the Colorado River ecosystem, so that tribal spiritual and cultural needs are considered side-by-side with rigorous scientific and other considerations. One comment pointed out that if tribes are to have this role, they should be provided with funding for their monitoring programs.

3.9.2. Representation of Various Interests

Based on the comments received, there are stakeholders who are under-represented, over-represented, or not represented at all. The commenters clearly hoped that this situation would be corrected. The LTEMP EIS process should not reflect only one part of a community, but should consider future generations and protect their future experiences. The public needs to have a voice in the process, which should consider the social challenges the region faces as well as the short- and long-term environmental challenges. Many of the comments said that the primary interest should be in the preservation of the cultural and natural downstream resources, and that interest is best represented by the NPS, USFWS, and the tribes.

A commenter noted that the seven basin states should participate in developing LTEMP EIS alternatives and would likely propose their own alternative; another commenter said that the AMWG is dominated by representatives from the basin states, hydropower marketers and consumers, as well as environmental and recreation interests. These groups have no legal responsibility, yet have been given de-facto decision-making authority for determining the fate of the Colorado River ecosystem. One commenter stated that because the Grand Canyon Trust has brought lawsuits against some other members of the AMWG, it should be removed from participation in the AMWG. Even though some comments stated that recreational interests are overrepresented, other comments stated that it is disproportionately low, as is tribal participation. According to these comments, both recreational and tribal interests should have greater representation and a stronger role in the decision-making components of the management program.

There are representatives on the AMWG working for nonnative fish protection, and 1 of the 12 goals of the AMWG is to "Maintain a naturally reproducing population of rainbow trout above the Paria River, to the extent practicable and consistent with the maintenance of viable populations of native fish"; yet nonnative fish protection is not mentioned, directly or indirectly, in the GCPA.

Many comments perceived a bias in favor of hydropower and water supply interests in the timing and quantity of water releases as well as the decision-making process, stating that the GCDAMP has been and continues to be controlled by water and energy groups whose self-interest lies with avoiding long-term change and maintaining the status quo; these groups are not dedicated to, or even concerned with, the protection and recovery of downstream resources. Although the GCPA makes specific reference to preserving flows to meet water delivery obligations, it does not do so with regard to hydropower generation. Yet, commenters pointed out that 1 of the GDCAMP's 12 goals in its strategic plan is to: "Maintain power production capacity and energy generation, and increase where feasible and advisable, within the framework of the Adaptive Management ecosystem goals."

Comments stated that issues affecting hydropower generation are heavily debated among the AMWG, and also said that the concern of hydropower companies should be with their marketing and distribution plans and mitigation strategies in compliance with the GCPA, but they should play no role in determining how, when, or if the mitigation strategies are implemented. For instance, comments stated that Western exerts "undue influence" on the GCDAMP's direction and decisions; Western's goal (maximizing power generation) is perceived to be contrary to the habitat needs of the river corridor through Grand Canyon National Park and the Colorado River's natural hydrography. For instance, comments noted that beach habitat-building flows introduced in 1996 could have improved or mitigated damage done to the beaches, but the GCDAMP was "overwhelmed by the lopsided [hydropower] membership." Past management decisions have been seen as considering hydropower generation or the economic impacts of Lake Powell and Lake Mead. A further issue is that GCDAMP funding comes from hydropower revenue, which creates a conflict of interest in recovery management choices and decisions.

3.9.3 Grand Canyon Monitoring and Research Center

Many commenters pointed to the USGS's GCMRC as the leading research body for the Colorado River; it has contributed substantially to the body of knowledge about the river. Those comments advocated the involvement of GCMRC as a central and significant resource in the development and implementation of the LTEMP and LTEMP EIS. GCMRC and its previous findings and research capabilities can inform decisions and the identification of desired future conditions; develop and evaluate alternatives; provide expertise on flow regimes and sediments; and develop scientifically credible solutions for the Colorado River ecosystem.

Comments noted that GCMRC should be used to monitor progress toward goals. The GCMRC already conducts experiments and has studied the downstream impact of dam releases extensively, and it would provide an objective, scientific approach to the LTEMP process. The objectivity of the GCMRC could prove useful in balancing competing interests. A comment was concerned about objectivity and independence, though, and suggested that the GCMRC be reorganized outside of the DOI to mitigate against agency bias and shortcomings.

One comment requested that current and former GCMRC employees and consultants be surveyed on their views of the Center's scientific rigor, efficiency of experiments, follow-through with regard to scientific findings, and leadership. The survey should also address competing objectives and their influence on management actions and the efficacy of the response to the findings in the report *Downstream: Adaptive Management of Glen Canyon Dam and the Colorado River Ecosystem* (NRC 1999).

One commenter suggested a new approach to managing scientific research, with competitive proposals to be administered by the National Science Foundation and excluding from consideration current federally employed or GCMRC-contracted scientists for a period of five years to allow for the perspective of a fresh and respected group of scientists.

3.9.4 Glen Canyon Dam Adaptive Management Program (GCDAMP)

Commenters recognized the significant role the AMWG plays in recommending management actions on dam operations; because of this, there should be a more balanced stakeholder group than currently exists. Some commenters expressed concern that the AMWG favors water development and power generation interests and does not always reflect the ecological, cultural, and recreational values of Grand Canyon. Commenters expressed concern that the LTEMP process might be "blocked, slowed, or stymied" by the water and power voting blocs on the AMWG. Thus, they called for a fair balance among advocates of water supply; power production; and protecting, mitigating adverse impacts on, and improving Grand Canyon National Park and Glen Canyon National Recreation Area. In any case, the AMWG is comprised of stakeholders with an in-depth knowledge of the complex issues, and DOI should be encouraged to examine its recommendations.

Commenters said that the GCDAMP Science Advisors should play a key role in evaluating alternatives. The Science Advisors could be asked to review science planning and the credibility of NPS and GCMRC programs and could play a role in advising agency-level

managers in integrating findings into improved Colorado River ecosystem stewardship and collaborating to reduce or eliminate redundant research efforts. If the work scope of the Science Advisors is to be expanded, the membership would need to be reconfigured and more funding made available. Commenters recommended that a wholly independent scientific body be commissioned; that body would work with NPS, USFWS, and the tribes to achieve goals congruent with the GCPA.

Many comments addressed the organizational structure, functionality, and management of the GCDAMP, suggesting that it be replaced with a structure that would base its advice and decisions primarily on scientific principles. A change in the structure might also allow for the accomplishment of GCDAMP's mission and goals. One commenter was concerned about the costs incurred thus far with no significant and sustainable changes in dam operations, evidenced by two decades of similar agenda topics still awaiting resolution; topics have increased in complexity, but the outcomes (no change) are the same.

Commenters wanted a group that has the ability and willingness to act adaptively based on what has been learned. Commenters also claimed that the GCDAMP evades recommendations that would create legal conflicts among the NPS Organic Act, the ESA, NEPA, and the GCPA. Collaboration and consultation among the science and policy experts of the basin states, GCDAMP representatives, the AMWG, the Technical Workgroup, the Science Advisors, and the GCMRC could move issues beyond an individual stakeholder interest in the Colorado River.

Comments suggested that the GCDAMP include only DOI's responsible agencies such as Reclamation, NPS, and USFWS, and the 11 affiliated tribes as sovereigns; all other agencies and interests should participate on the same tier as public citizens. Some comments said that the responsible agencies should include only those with primary jurisdiction over the management of downstream cultural and natural resources in Glen Canyon National Recreation Area and Grand Canyon National Park. On the other hand, one comment stated that Reclamation should have no role in decision making when GCPA compliance is an issue.

Although the GCDAMP was promoted by many commenters, one commenter believed that the program shields DOI from those criticizing its lack of progress on mitigating the downstream impacts of Glen Canyon Dam. Another group of comments pointed to a scholarly article by researchers in the field of public dispute mediation, in which the researchers identified six shortcomings of the GCDAMP: (1) an inadequate approach to identifying stakeholders; (2) a failure to provide clear goals and involve stakeholders in establishing the operating procedures that guide the collaborative process; (3) inappropriate use of professional neutrals and a failure to cultivate consensus; (4) a failure to establish and follow clear joint fact-finding procedures; (5) a failure to produce functional written agreements; and (6) a failure to manage the GCDAMP adaptively and cultivate long-term problem-solving capacity (Camacho et al. 2010).

One comment called for transparent and measurable regulatory targets through effective leadership within DOI and GCDAMP; an independent audit of the GCDAMP would measure its performance against its charter, its strategic plan, and the goals of the GCPA.

According to some comments, water issues have become so complex that the common citizen has effectively been removed from the process, which argues for the establishment of an independent commission or a reinvigorated GCDAMP. Stewardship of the Colorado River ecosystem, in full accord with the GCPA, was also mentioned in comments, with a scientific advisory committee to integrate and coordinate science activities. A suggestion toward improved stewardship was to develop an annotated administrative history of Colorado River ecosystem management so that new participants would have a ready resource to understand the core issues; such a history is under consideration by the AMWG.

It was suggested that the AMWG could meet twice a year with a 30-day comment period prior to each meeting. Technologies exist today, such as interactive telephone and video conferencing, that did not exist during the earlier EIS process, and using such technologies would enable more stakeholders to be heard.

4 INTERAGENCY COOPERATION AND GOVERNMENT-TO-GOVERNMENT CONSULTATION

Reclamation and NPS initially invited 25 federal, tribal, state, and local government agencies to participate in preparation of the LTEMP EIS as cooperating agencies. To date, 15 agencies and tribes have expressed an interest in participating as cooperating agencies and efforts are underway to establish Memorandums of Understanding. These 15 agencies include the Arizona Game and Fish Department, Bureau of Indian Affairs, Colorado River Commission of Nevada, The Havasupai Tribe, The Hopi Tribe, The Hualapai Tribe, Kaibab Band of Paiute Indians, The Navajo Nation, The Pueblo of Zuni, Salt River Project, USFWS, Upper Colorado River Commission, Utah Associated Municipal Power Systems, Western Area Power Administration (Western), and the Yavapai-Apache Nation. Regular meetings with cooperating agencies are planned as the LTEMP EIS is developed.

In accordance with the requirements of Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments," Reclamation and NPS are coordinating and consulting with tribal governments, Native American communities, and tribal individuals whose interests might be directly and substantially affected by activities being considered in the LTEMP EIS. This government-to-government consultation has just begun.

5 FUTURE OPPORTUNITIES FOR PUBLIC INVOLVEMENT

Scoping is the first phase of public involvement provided under the NEPA process. The public will have future opportunities to be involved during the preparation of the LTEMP EIS. The lead agencies will release information to the public at various times during LTEMP EIS development including a presentation of the results of scoping and a description of draft alternatives once these have been identified.

The public will have an opportunity to review and comment on the draft EIS. At this time, Reclamation and NPS anticipate releasing the draft EIS for public review in late 2012; a

90-day comment period will be provided. The public also will have an opportunity to review and comment on the final EIS when it is published.

Information about all opportunities for public involvement in the LTEMP EIS, including announcements of public meetings and releases of documents for review, will be maintained on the project website (http://ltempeis.anl.gov) and will be announced via the email subscription list, press releases, and social media (Twitter and Facebook).

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