Glen Canyon Dam
Adaptive Management Work Group

Ad Hoc Committee on Strategic Planning

Report to AMWG, April 2001
QUALITATIVE TARGETS

Strategic Plan Update

This document consists of the following components, which should be viewed as an integrated whole. Together, they guide the work of the Glen Canyon Dam Adaptive Management Work Group.

- Vision and Mission
- Principles
- Goals
- Objectives
- Glossary

Vision and Mission

The Grand Canyon is a homeland for some, sacred to many, and a national treasure for all. In honor of past generations, and on behalf of those of the present and future, we envision an ecosystem where the resources and natural processes are in harmony under a stewardship worthy of the Grand Canyon.

We advise the Secretary of the Interior on how best to protect, mitigate adverse impacts to, and improve the integrity of the Colorado River ecosystem affected by Glen Canyon Dam, including natural biological diversity (emphasizing native biodiversity), traditional cultural properties, spiritual values, and cultural, physical, and recreational resources through the operation of Glen Canyon Dam and other means.

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

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

Principles

The Glen Canyon Dam Adaptive Management Work Group embraces the following Principles. They guided development of the Goals and Objectives for the Glen Canyon Dam Adaptive Management Program (GCDAMP). These Principles are:

1. The Goals represent a set of desired outcomes that together will accomplish our Vision and achieve the purpose of the Grand Canyon Protection Act. Some of the Objectives and actions that fall under these Goals may not be the responsibility of the GCDAMP, and may be funded by other sources, but are included here for completeness.

2. The construction of Glen Canyon Dam and the introduction of non-native species have irreversibly changed the Colorado River ecosystem.

3. Much remains unknown about the Colorado River ecosystem below Glen Canyon Dam and how to achieve GCDAMP ecosystem Goals.

4. The Colorado River ecosystem is a managed ecosystem. An ecosystem management approach, in lieu of an issues, species, or resources approach, will guide our efforts. Management efforts will prevent any further human-induced extirpation or extinction of native species.

5. An adaptive management approach will be used to achieve GCDAMP ecosystem Goals, through experimentation and monitoring, to meet the intent of the Grand Canyon Protection Act, the Environmental Impact Statement, and the Record of Decision.

6. Management actions, including changes in dam operations, will be tried that attempt to return ecosystem patterns and processes to their range of natural variability. When this is not appropriate, or beyond the range of operational or legal flexibility of the dam, experiments will be conducted to test other approaches.

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

8. If the target of a management objective proves to be inappropriate, unrealistic, or unattainable, the AMP will reevaluate that target and the methods used to attain it.

9. Recognizing the diverse perspectives and spiritual values of the stakeholders, the unique aesthetic value of the Grand Canyon will be respected and enhanced.

Goals

1. Protect or improve the aquatic foodbase so that it will support viable populations of desired species at higher trophic levels.

2. Maintain or attain viable populations of existing native fish, ~~and~~ remove jeopardy from humpback chub and razorback sucker, and prevent adverse modification to its critical habitat.

3. Restore populations of extirpated species, as feasible and advisable.

4. Maintain a wild reproducing population of rainbow trout above the Paria River, to the extent practicable and consistent with the maintenance of viable populations of native fish.

5. Maintain or attain viable populations of Kanab ambersnail.

6. Protect or improve the biotic riparian and spring communities, including threatened and endangered species and their critical habitat.

7. Establish water temperature, quality, and flow dynamics to achieve GCDAMP ecosystem goals.

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

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

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

11. Preserve, protect, manage, and treat cultural resources for the inspiration and benefit of past, present and future generations.

12. Maintain a high-quality monitoring, research, and adaptive management program.

Goal 1. Protect or improve the aquatic foodbase so that it will support viable populations of desired species at higher trophic levels.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target
1.1	Maintain or attain	Primary producers: algae on hard substrates, rooted macrophytes on soft substrates, and diatoms	Biomass Composition	Mainstem from Glen Canyon Dam to the Paria River in both pools and on cobble bars identified by specific sampling sites	The target for all the Management Objectives in Goal 1 is adequate food availability to support trout and native fish above the Paria River, and native fish below the Paria River.
1.2	Maintain or attain	Benthic invertebrates	Biomass Composition	Mainstem from Glen Canyon Dam to Paria River	
1.3	Maintain or attain	Primary producers: algae on hard substrates, rooted macrophytes on soft substrates, and diatoms	Biomass Composition	Mainstem below the Paria River on cobble bars identified by specific sampling sites	
1.4	Maintain or attain	Benthic invertebrates	Biomass Composition	Mainstem below the Paria River	
1.5	Maintain or attain	Foodbas e drift: Diptera *Gammarus* Other Bugs, Coarse Particulate Organic Matter, Fine Particulate Organic Matter, DOC	Abundance	Mainstem below GCD	

Goal 2. Maintain or attain viable populations of existing native fish, ~~and~~ remove jeopardy from humpback chub and razorback sucker, and prevent adverse modification to its critical habitat.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target
2.1	Maintain or attain	Humpback chub (150 mm and larger)	Abundance	LCR aggregation* Eight mainstem aggregations	The target is viable populations and removal of jeopardy.
2.2	Maintain or attain	Humpback chub (51 mm to 150 mm)	Year class strength	LCR aggregation Eight mainstem aggregations	The target is viable populations and removal of jeopardy.
2.3	Maintain or attain	Humpback chub (> 200 mm)	Recruitment	LCR aggregation 8 mainstem aggregations	The target is viable populations and removal of jeopardy.
2.4	Establish	Humpback chub	Spawning aggregation	CRE below GCD	The target is removal of jeopardy.
2.5	Attain	Humpback chub	Condition	LCR aggregation 8 mainstem aggregations	The target is viable populations and removal of jeopardy.
			Disease and other parasites	LCR aggregation 8 mainstem aggregations	
2.6	Reduce	Native fish	Mortality due to non-native fish predation as a % of overall mortality	LCR Mainstem	The target is reduction of non-native fish predation so it does not impinge on native fish viability.
2.7	Attain	Razorback sucker	Abundance	CRE below GCD	The target is derived from the capability of the habitat to support the species, and includes the removal of jeopardy.
2.8	Maintain	Flannelmouth sucker	Abundance Distribution	CRE below GCD	The target is viable populations.
		Bluehead sucker	Abundance Distribution		
		Speckled dace	Abundance Distribution		

*The definition of the LCR aggregation will be resolved following completion of the stock assessment workshop and the PEP review.

Goal 3. Restore populations of extirpated species, as feasible and advisable.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target
3.1	Restore	Colorado pikeminnow	Abundance	CRE downstream of GCD	The qualitative target is specified in the goal.
		Bonytail			
		Roundtail Chub			
		River otter			

Goal 4. Maintain a wild reproducing population of rainbow trout above the Paria River, to the extent practicable and consistent with the maintenance of viable populations of native fish.

NOTE FOR GOAL 4: The purpose of this goal is recreation. It is limited by MO 2.6.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target
Linkages: See Issue Paper B (trout).					
4.1	Maintain or attain	Rainbow trout (RBT)	Abundance	Mainstem from Glen Canyon Dam to Paria River	The target is adequate abundance of wild-reproducing Rainbow trout to maintain a quality recreational fishery, while not adversely affecting native fish population viability.
			Proportional Stock Density*		The qualitative target is specified in the goal.
			Length at age		
			Condition		
			Whirling disease and other parasitic infections		
			Spawning habitat		
			Natural recruitment		This MO restates and measures the goal.
4.2	Limit	Lees Ferry RBT	Distribution	CRE below the Paria River	The target is minimal competitive or predator / prey effect on downstream native fish.

*Proportional Stock Density is the ratio that results by dividing the number of fish great than 16" by the number of all fish greater than 12". This provides a measure of the abundance of fish at a certain size, which should translate into a target for both abundance and length at age.

Goal 5. Maintain or attain viable populations of Kanab ambersnail.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target
5.1	Attain and maintain	Kanab ambersnail	Population	Vasey's Paradise	The target is a viable population.
5.2	Maintain	Kanab ambersnail	Habitat	Vasey's Paradise	The target is the level needed to sustain a viable population.

Goal 6. Protect or improve the biotic riparian and spring communities, including threatened and endangered species and their critical habitat.

NOTE FOR GOAL 6: This goal is intended to help achieve the biological, cultural, and recreational goals.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target
The target ~~for the goal as a whole~~ is an achievable and appropriate mix of four types of communities: marsh, open sand beach, old high water zone (OHWZ), and new high water zone (NHWZ). All four communities are important for maintaining the diversity of wildlife visitor use, and cultural resources. See the Riparian Issue Paper for more information. ~~The Old High Water Zone is a high priority because of the threat of losing it. One way of maintaining it is through high flows, which may have a negative effect on marshes and New High Water Zones. Considering the legal and regulatory mandates of the NPS to protect natural landscapes and native species and communities, considering regenerative capabilities, and recognizing the dynamic and successional nature of these communities, the other three zones would be a lower priority.~~					
6.1	Maintain	Marsh community	Abundance	CRE below GCD, and above Lake Mead's dynamic water level as it fluctuates due to Hoover Dam operations	
			Composition		The target is no loss of native species.
			Area		
6.2	Maintain	New high water zone community	Patch number and distribution	CRE below GCD, and above Lake Mead's dynamic water level as it fluctuates due to Hoover Dam operations	~~In all river reaches where it was documented by aerial photography in 1984, t~~The target is to allow for scouring of ~~some~~ NHWZ vegetation to 1984 levels for patch number and distribution, ~~due to periodic high flows,~~ and ~~to~~ then allow its return through successional processes.
			Composition		The target is to allow no loss of native plant or animal species.
			Area		
6.3	Maintain	Old high water zone community	Abundance	CRE below GCD, and above Lake Mead's dynamic water level as it fluctuates due to Hoover Dam operations	The target is no loss of area.
			Composition		The target is no loss of native plant or animal species.
			Distribution		
6.4	Maintain	Sand beach community	Abundance	CRE below GCD, and above Lake Mead's dynamic water level as it fluctuates due to Hoover Dam operations	
			Composition		
			Distribution		

Goal 6. Protect or improve the biotic riparian and spring communities, including threatened and endangered species and their critical habitat.

NOTE FOR GOAL 6: This goal is intended to help achieve the biological, cultural, and recreational goals.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target
~~6.5~~	~~Maintain~~	~~Culturally Important Species~~	~~Abundance~~ ~~Distribution~~	~~CRE below GCD~~	
6.5	Reduce	Invasive non-native species	Abundance*	CRE below GCD, and above Lake Mead's dynamic water level as it fluctuates due to Hoover Dam operations	The target is the level at which these species do not impinge on biological, recreational, and cultural resources.
			Distribution		The target is no spreading of invasive non-native species to areas where they do not already occur.
6.6	Maintain	Spring and wetland	Habitat occupied by rare and endemic species	CRE below GCD, and above Lake Mead's dynamic water level as it fluctuates due to Hoover Dam operations	The target is to maintain the capability of these habitats to support the rare and endemic species known to live there. The targets should recognize the dynamic nature of these habitats as influenced by flow events.
6.7	Maintain	Southwest willow flycatcher	Riparian habitat	CRE below GCD, and above Lake Mead's dynamic water level as it fluctuates due to Hoover Dam operations	The target is the capability of the habitat to support the species. The target is a dynamic mosaic of NHWZ, OHWZ, and marsh vegetation. ~~The NHWZ should be dominated primarily by willows and/or tamarisk at least 4 meters high and in patches at least 20 meters wide.~~

*Abundance of invasive on-native species refers to number of individuals within the species. These species should be limited to invasive ones, not just non-natives.

Goal 7. Establish water temperature, quality, and flow dynamics to achieve GCDAMP ecosystem goals.

NOTE FOR GOAL 7: The phrase, "to achieve GCDAMP ecosystem goals," indicates that this goal is a method to achieve certain other goals. In this case, "ecosystem goals" includes biological goals, recreational goals, and the cultural goal.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target
7.1	Attain	Water	Temperature range Seasonal variability of temperature	Mainstem	The target is a temperature range and pattern of seasonal variability based on the range of natural variability, the range of operational flexibility of the dam, the range of legal flexibility, and the range that optimizes conditions for the targeted resources. Targeted resources may include ~~are~~ foodbase, native fish, trout, and people (human health and safety – microorganisms and hypothermia). Temperature patterns should have as their first priority the improvement of conditions for native biological resources, including native fish, and including foodbase and trout interactions. This is based on the special status of native fish
7.2	Maintain	Water	Quality	Mainstem	The target for MO 7.2 is water quality based on the range of natural variability, the range of operational flexibility of the dam, the range of legal flexibility, the legally-defined state water quality standards, and the range that optimizes conditions for the targeted resources. The targeted resources may include ~~are~~ foodbase, native fish, trout, Southwestern willow flycatcher, riparian and spring communities, the recreational experience, and cultural resources.
7.3	Maintain	Flow dynamics	Power plant operations BHBF flows Habitat maintenance flows	Mainstem	The qualitative target is specified in the goal.

Goal 8. Maintain or attain levels of sediment storage within the main channel and along shorelines to achieve GCDAMP ecosystem goals.

NOTE FOR GOAL 8: The phrase, "to achieve GCDAMP ecosystem goals," indicates that this goal is a method to achieve certain other goals. In this case, "ecosystem goals" includes biological goals, recreational goals, and the cultural goal.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target
The target for Goal 8 is enough sediment to achieve the biological, recreational, and cultural goals. Given limited sediment inputs, we need to retain enough sediment in the system to achieve ecosystem patterns in these goals. For the biological goals, the purposes are habitat and nutrient storage. For the cultural goal, the purposes are enhancing plant habitat and preserving historical properties. For recreational goals, the purposes are camping beaches and trout spawning habitat. Linkages: Recreational, biological, and cultural goals: 1-4, 7-10, and 12.					
8.1	Maintain or attain	Fine sediment	Abundance Grain-size Distribution	Main channel ~~up to power plant capacity~~ below 8,000 cfs	The target level should consider spawning habitat for trout in Glen Canyon and sediment needed for BHBFs.
8.2	Maintain or attain	Fine sediment	Abundance Grain-size Distribution	Channel margins (not eddies) from 8,000 to 25,000 cfs	
8.3	Maintain or attain	Fine sediment	Abundance Grain-size Distribution	Eddies ~~up to~~ below 25,000 cfs	
8.4	Maintain or attain	Fine sediment	Abundance Grain-size Distribution	Shorelines between 25,000 cfs and uppermost effects of a maximum dam release ~~BHBF~~	

Goal 9. Maintain or improve the quality of recreational experiences for users of the Colorado River ecosystem, within the framework of GCDAMP ecosystem goals.

NOTE FOR GOAL 9: The phrase, "within the framework of GCDAMP ecosystem goals," is intended to indicate a hierarchy or order of precedence. That is, the accomplishment of this goal should be undertaken in such a way that the likelihood of achieving the biological goals and the cultural goal is not impaired.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target	
9.1	Maintain	Visitor	Physical access ~~and safety~~	Mainstem		The target level should be within the capacity of the CRE to absorb visitor impacts. The target level should consider GLCA and GRCA Management Plans.
			Physical safety (other than whitewater boating)		The target is to minimize river-related injuries and deaths.	
9.2	Maintain or improve	Recreational opportunities ~~spectrum~~	Quality and quantity	Glen Canyon		
				Grand Canyon		
9.3	~~Maintain or i~~Increase	Camping beaches	Size	Mainstem		
			Quality	Mainstem		
			~~Number~~			
			Distribution	Critical reaches		
				Non-critical reaches		
9.4	~~Maintain or~~ Improve	Rapids	Navigability	Mainstem	The target should address navigability across the range of flows allowed within the ROD.	
			Whitewater boating safety		The target is to minimize river-related injuries and deaths.	
9.5	Maintain or enhance	Experience	Wilderness	Grand Canyon	Metric to include parameters for primitive character, unconfined experience, undeveloped natural and wild character, opportunities for solitude, sounds of nature and scenic beauty. The target level should consider GRCA Management Plans (in progress).	

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

NOTE FOR GOAL 10: The phrase, "within the framework of GCDAMP ecosystem goals," is intended to indicate a hierarchy or order of precedence. That is, the accomplishment of this goal should be undertaken in such a way that the likelihood of achieving the biological goals, the recreational goals, and the cultural goal is not impaired.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target
10.1	Maintain or increase	Power	Marketable capacity and energy ~~Generation flexibility~~	GCD	The qualitative target is specified in the goal.
10.2	Maintain	Power	Existing emergency criteria for WAPA system	GCD	
10.3	Maintain	Power	Existing emergency criteria for WSCC system	GCD	
10.4	Maintain	Power	Regulation	GCD	

Goal 11. Preserve, protect, manage, and treat cultural resources for the inspiration and benefit of past, present and future generations.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target
11.1	Preserve	Register-eligible properties	National Register integrity	Area of Potential Effect	The target is to preserve register-eligible properties via protection, management, and/or treatment (data recovery) for the purpose of federal agency compliance with NHPA, and AMP and AMWG compliance with GCPA.
11.2	Preserve	Traditionally important ~~Other cultural~~ resources	Resource integrity Cultural values	CRE	The target is to preserve (stabilize or improve based on current cultural values) other traditionally important resources that are not sufficiently addressed under other MOs. Specifically, this MO addresses resources not considered Register-eligible.
11.3	Protect and maintain	Traditional cultural resources	Physical access	CRE	The target is ~~designed~~ to provide ~~prevent AMWG~~ meaningful consultation on AMP activities ~~from undertaking events~~ that might restrict or block physical access by Native American religious practitioners~~, without meaningful consultation~~.

Goal 12. Maintain a high-quality monitoring, research, and adaptive management program.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target
12.1	Maintain or attain	Socio-economic data	Hydropower	N/A	The target level is how much socioeconomic data is needed for adequate decision-making.
			Air quality		
			Wilderness		
			Recreation		
			Non-use values		
			Tribal & spiritual values		
12.2	Integrate and synthesize	Cultural and environmental data ~~Information~~	Interdisciplinary information ~~Cultural and other resources~~	CRE	The target is to ensure that data can be used both for increased understanding of the past and for ongoing interactions of humans within the CRE.
12.3	Attain and maintain	Monitoring and research program	Natural, cultural, and recreational resources	CRE	The target is a plan that has been completed, agreed to by the TWG and AMWG, and reviewed by the SAB, and that will subsequently be reviewed on a periodic basis.
12.4	Attain and maintain	AMP composed of all stakeholders	That acknowledges uncertainty and uses experimentation, monitoring & research	N/A	The target is a Strategic Plan that describes the processes for science-based collaborative resources management.
			Participation		
12.5	Attain and maintain	AMP ~~Management action~~	Effective tribal consultation* (i.e., inclusion of tribal values and perspectives into the AMP)	CRE	The target is to achieve, at a minimum, effective, legally mandated government-to–government consultation. To achieve this MO it is important to provide adequate funding, but funding alone is not a sufficient indicator of successful achievement.

*Tribal consultation in the AMP is defined as the formal dialogue with designated governmental representatives and other AMWG members, through AMWG and TWG meetings, about trust assets, resources, and other tribal interests, that results in all the members of the AMWG understanding and appreciating tribal perspectives and the inclusion of tribal values within the AMP. Additionally, this consultation assists federal agencies in realizing their trust responsibility to tribal nations and fulfills the federal government's consultation requirements. Such consultation and the subsequent inclusion of tribal values can add to the knowledge base of the AMP, and tribal perspectives and values can temper the traditional western scientific approach used by the AMP, thus making it stronger.

Goal 12. Maintain a high-quality monitoring, research, and adaptive management program.

MO #	Perform some action	On some element	On some attribute	At some place	Qualitative Target
12.6	Attain and maintain	Management activities, research, and long-term monitoring activities ~~Funding~~	Tribal participation*	AMP	The target is a ~~level of funding adequate to meet each tribe's needs to participate in the Adaptive Management Program~~ set of activities consistent with the attached definition of tribal participation* that meets each tribe's interests to ensure that tribal values are incorporated in the scientific activities of the adaptive management program, and that tribal interpretations of monitoring and research data are considered.

* Definition of Tribal Participation: Tribal participation ensures that tribal values inform the interpretation of the quantity and quality of resources that results from a Western scientific approach to monitoring and research. Tribal participation is defined as a set of activities that may include one or more of the following: conducting and/or collaborating in resource projects awarded through the competitive process, participating in discussions with PIs regarding where and how they will conduct monitoring and research activities, and tribally relevant data analysis and information sharing.

12.7	Conduct	Experimental flows	Flow dynamics	Mainstem	The target level is the experiments needed to gain critical understanding of ecosystem function under different dam operations, e.g., BHBFs, HMFs, biological opinion flows, and financial exception criteria flows.
12.8	Conduct	Management experiments	Other management actions	CRE	The target level is the experiments needed to gain critical understanding of ecosystem function under different management alternatives outside of dam operations.
12.9	Build	AMP	Public support	N/A	The target is adequate public support for AMP experiments and adaptive management, and a diverse funding base.
12.10	Maintain or attain	Funding	Foundation and corporate Appropriated State Agency Power revenues	N/A	The target is adequate funding to meet the goal.
12.11	Maintain or attain	Participation	Externally-funded investigators	CRE	The target is contributions to meeting Information Needs by externally funded investigators.