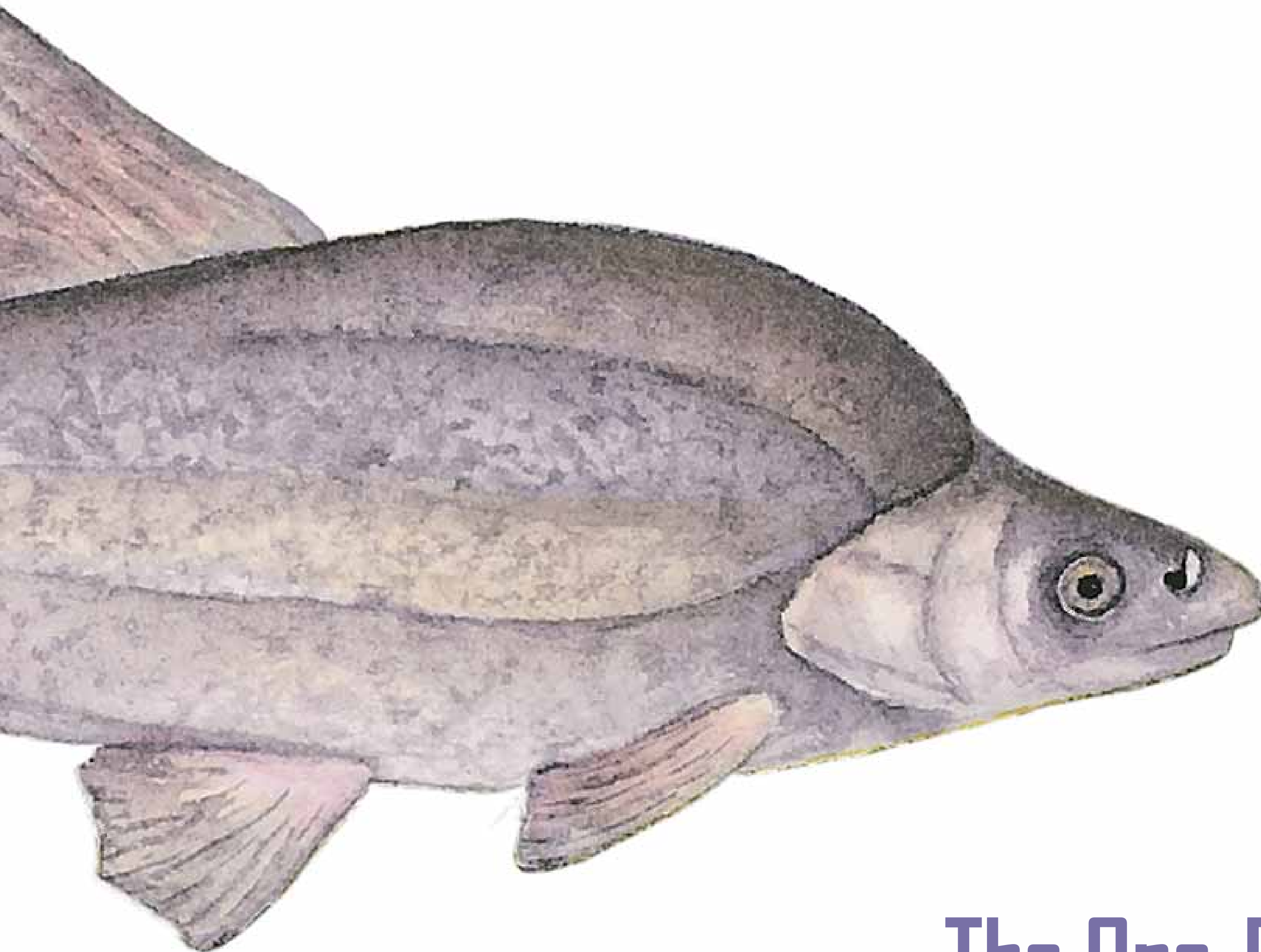
Appendix W

Copies of Unique Comment Letters

W.3 Special Interest Group/Non-Governmental Organization Comment Letters (G)



The One-Dam Solution

Preliminary report to the Bureau of Reclamation on proposed reoperation strategies for Glen Canyon and Hoover Dam under low water conditions.

July 2005

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We welcome public feedback toward the development of a subsequent edition of this report to be concluded following release of Bureau of Reclamation draft recommendations for the reoperations of Glen Canyon and Hoover Dam.

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Cover illustration of Humpback Chub ©Gloria Brown
from “A Naturalist’s Guide to Canyon Country” by Falcon Publishing www.falcon.com

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"We've got to rethink the use of water.

But if you think it's [the drought] *going to go away, the people that think well,*

we're going to go back to a wet cycle, don't bet on it."

Stewart Udall, former Secretary of the Interior

December 2003

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Summary

Life in the Southwest depends on the Colorado River. Preserving this resource requires achieving a sustainable balance between water supply and demand. However, population growth and climate change are disrupting this equilibrium and pushing the management of this resource to its limit.

Federal laws and water projects regulating the consumption of Colorado River water do not adequately reflect this imbalance. Current laws allocate more water to the basin states than the river actually provides. More federal dams have been built than are needed wasting at least 13 percent of the river's flow annually.[1] Sediment backing up behind dams represents a multi-billion-dollar management challenge that has so far been ignored. Meanwhile hundreds of millions of dollars are being invested in failed efforts to manage environmental problems resulting from dam operations.

At the heart of these challenges lie the nation's largest reservoirs, Lake Powell behind Glen Canyon Dam near the Utah/Arizona border and Lake Mead behind Hoover Dam on the Arizona/Nevada border. Combined they cause the loss of 10 percent of the Colorado's annual flow,[2] while declining surplus flows render the future filling of these reservoirs an unlikely occurrence.

Grand Canyon National Park, which lies between Glen Canyon Dam and Lake Mead, has seen its native ecosystem devastated by dam operations. Four native fish are now extinct, one is in jeopardy and another is of special concern. Glen Canyon Dam has trapped the sediment necessary to maintain habitat and beaches for wildlife and recreation, as well as the stabilization of archeological sites. So far, measures to reverse the decline of these park resources as directed by the 1992 Grand Canyon Protection Act have failed.

The desire to prevent the further filling of Lake Mead with sediment played a major role in influencing the construction of Glen Canyon Dam. However, sediment is now reducing Lake Powell's storage and if left unresolved will compromise the safe operation of Glen Canyon Dam, as well as Hoover Dam should Glen Canyon Dam fail.

As the Bureau of Reclamation now explores strategies to address the operations of Lake Powell and Lake Mead under low reservoir conditions, it is critical that the scope of this analysis be expanded. A far more comprehensive review must be undertaken that explores the overall relevance of these two facilities for storing and distributing scarce Colorado River water, including:

- Reducing the use of inefficient above-ground water storage facilities, while expanding the use of underground storage to minimize evaporation losses. Regional aquifers could provide greater storage capacity than Lake Powell and Lake Mead combined.[3]

- Employ Lake Mead as the principal water storage and distribution facility for water delivery to the lower basin states. Lake Powell storage is in excess of current and future needs resulting in unnecessary evaporative losses to a limited water supply.

- Employ Lake Mead as the starting point for transporting sediment around the lower Colorado River system.

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- Updating federal laws, especially the Colorado River 1
  Compact, to reflect the Colorado River’s limitations
  and changing societal demands.

Developing a forward-looking policy on the future operations of Glen Canyon and Hoover Dams is critical to meeting the immense challenges facing Colorado River managers. It is not something to be relegated to a stopgap response to immediate concerns, but must be a central component of the federal government’s fulfillment of its legal responsibility to provide leadership and direction for the management of the Colorado River. To this end, it is vital that a comprehensive Environmental Impact Statement be conducted on the future operations of these dams, and that this be done in consort with other water conservation measures to preserve the economic, ecological and cultural vitality of the Colorado River region.

Colorado River

The Colorado River is central to the economy of the Southwest. The basin spans 242,000 square miles as it descends 1,450 miles from the Rocky Mountains to the Gulf of California in Mexico. More than 25 million people utilize water from the Colorado River, including the metropolitan areas of Los Angeles, Las Vegas, Phoenix, Salt Lake City, Denver and Albuquerque. Agriculture consumes on average 70 percent of the river. Industry and households consume the rest. In an attempt to meet increasing demands, the Colorado River has become the most regulated river in North America. Nearly every tributary has been dammed.

The Coming Crisis

Colorado River flows have averaged just 60 percent of normal since 2000. Even with the average snow-pack in the spring of 2005, reservoir levels are unlikely to reach 60 percent of full capacity this year. These flows will barely accommodate current demands, doing little to overcome the storage deficit created by the region's use of nearly two gallons of water for every one gallon that nature has provided.[4] Absent a dramatic change in long-term weather patterns, a substantial reduction in Colorado River water use will soon become a necessity.

History shows that the current drought is not unusual. Over the past century the Colorado River experienced reduced flows around 1900, the 1930s and 1950s.[5] Moreover, the present downturn represents a minor reduction in precipitation when compared to severe droughts that occurred between 900 and 1300.[6]

During the more recent droughts, Colorado River water users were spared serious shortages because supply still far exceeded demand. This is no longer the case. As water use continues to increase there will be little, if any, surplus water to be placed in storage.

The National Academy of Sciences estimated that over the past century the Colorado River's average annual flow was 14 million acre-feet (MAF) (an acre-foot equals 325,851 gallons).[7] However, analysis using tree-ring data concludes the average annual flow of the Colorado River over the past 400 years is approximately 13.5 MAF.[8] With current Colorado River water use at approximately 12.6 MAF annually and rising, it will soon become clear that reservoir storage capacity will far exceed what can be used.[9]

Even more alarming is the Department of Energy's prediction that climate change will cause Colorado River flows to decline 14 percent by 2010, and 18 percent by 2040.[10]

While a brief period of higher flows may bring temporary respite, permanent shortages are likely to become the norm. It is therefore essential that solutions be crafted before such shortages occur.

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Flaws in the System

WATER OVER-ALLOCATED

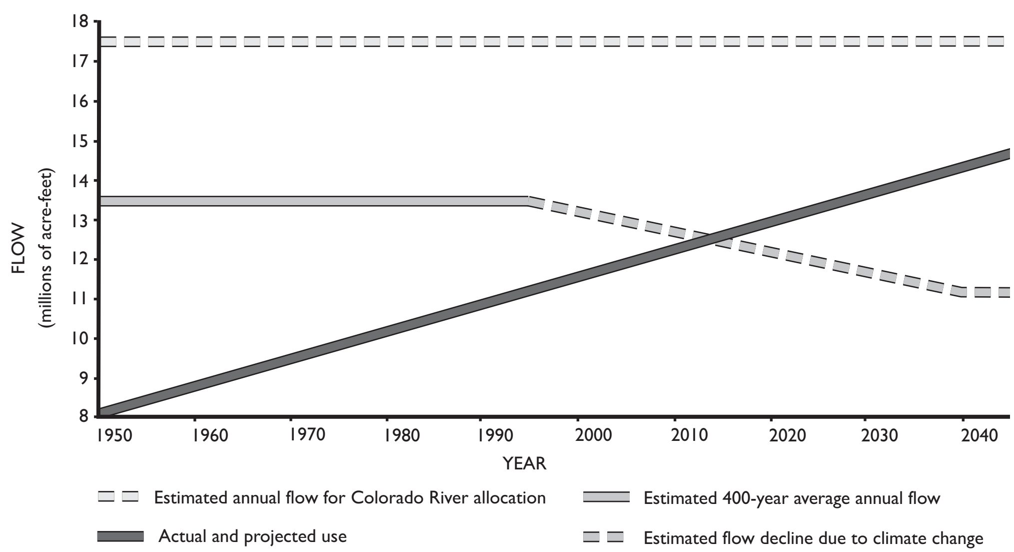
While managers and scientists debate whether Colorado River reservoirs will ever fill again, the drought has highlighted an 83-year-old problem that policy makers have ignored: more Colorado River water is allocated than the river actually produces.

In 1922 the federal government, acting as water master for the Colorado River, entered into an agreement, the Colorado River Compact, with seven western states to divide the river's total flow into two portions: the Upper and Lower Basins. The Upper Basin comprises the states of Colorado, New Mexico, Utah and Wyoming. The Lower Basin states are Arizona, California and Nevada. The Upper and Lower Basins were each awarded 7.5 MAF of water annually. In 1944 a treaty agreement awarded the Republic of Mexico 1.5 MAF, with 0.75 MAF coming from each basin.

Climate history reveals that this combined allocation of 15 MAF is 11 percent above the 400-year average of 13.5 MAF.[11] The U.S. Geological Survey and others report that the period from 1906 to 1921, partly used to formulate the Compact allocation, had been the wettest period of the 20th century if not the wettest period in nearly 800 years.[12]

In 1979 the Government Accounting Office advised Congress that unless aggressive management policies were pursued, the Colorado River system would begin to fail on the supply side by the year 2000.[13] Since 1999 system-wide storage has declined more than 40 percent.[14]

A System Over-allocated



Sources: Norris Hundley, 1975; C.W. Stockton and G.C. Jacoby, 1976; N.S. Christensen et al, 2004; Bureau of Reclamation, 2000.

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Department of Energy research predicts that by 2010 the Upper Basin will not be able to meet its full water delivery allocations to the Lower Basin 20 percent of the time, dropping to nearly 40 percent of the time thereafter.[15] Despite these warnings, there has yet to be any substantive movement to correct the over-allocation problem.

INEFFICIENT WATER STORAGE

The federal government has constructed more than 40 major dams on the Colorado River and its tributaries, principally for storing and diverting water. These reservoirs have a combined storage capacity equivalent to four and one-half years of the river's average annual flow, but they also cause the loss of up to 13 percent of these flows.[16]

Studies show that an optimum relationship exists between the basin's annual water flow and its storage capacity, since more reservoirs and canals cause more water to be lost to evaporation and seepage. Optimal water storage for the Colorado River was calculated to be about 30 MAF.[17] However, this analysis could not sway the momentum toward building fewer dams.

Lake Powell and Lake Mead are the most inefficient components in this system. Their locations are known for extremely low humidity, high summer temperatures and strong winds that maximize evaporative losses. Since its completion in 1963, Lake Powell has lost approximately 21.1 MAF to the atmosphere and Lake Mead, completed 30 years prior, has lost 57.1 MAF.[18]

In addition, the porosity of the rock that surrounds the reservoirs compounds the water loss through seepage. The problem is most pronounced at Lake Powell, where the surrounding sandstone is soft and extremely permeable resulting in 18.7 MAF being lost. At Lake Mead, where the rock is more resistant, about 1 MAF has been lost.[19] It is believed that some percentage of the seepage may return as the reservoirs recede, but it is unclear how much and how soon.

This water is incredibly valuable. Based on recent wholesale prices for untreated Colorado River water, Lake Mead and Lake Powell annually lose on average $350 million worth of water to evaporation.[20]

THE LOOMING PROBLEM OF SEDIMENT

The Colorado River is the most sediment-laden river in the country. Prior to the construction of Glen Canyon Dam, sediment had already filled ten percent of Lake Mead.[21] When Glen Canyon Dam was built, engineers estimated that its river outlet tubes would be compromised by sediment within 100 years, affecting the safe operation of the dam.[22] The Bureau of Reclamation reiterated this in 2002.[23]

Hydrologists and geomorphologists warn that sediment could affect dam operations even sooner.[24] Lake Powell's declining level (92 feet below full pool in July 2005) has exposed more than 100 miles of sediment deposits in the tributaries flowing into the reservoir. These streams are "reworking" or re-mobilizing these deposits and advancing them towards Glen Canyon Dam.

Additionally, the side canyons and tributaries of the Colorado River contain six decades of accumulated sediment that are poised to be flushed into the reservoir. A major flood, as experienced in the past, could carry this material in one large event, rapidly diminishing the operational life of the reservoir.[25]

The National Academy of Sciences estimates that 44 million tons of sediment enters Lake Powell every year, or 84 tons per minute.[26] In order for Glen Canyon Dam to be sustained over time, the annual inflow of sediment will need to be dredged and removed.

The Glen Canyon area is one of the most remote and rugged landscapes in North America. Developing and maintaining such a massive dredging, hauling and disposal program would be very costly. If the sediment is moved to the most environmentally responsible location, the Colorado River delta, transportation costs alone could be $2.6 billion annually.[27]

Sediment represents the most serious long-term problem facing the Colorado River water storage system and must no longer be ignored.

The Underground Solution

The most efficient way to store water in a dry climate is below ground where water is not exposed to the atmosphere's evaporative forces. While large reservoirs such as Lake Powell and Lake Mead can collectively cause the loss of upwards of 17 percent[28] of the water reaching them each year, storing this water underground can reduce these losses to as little as one percent once delivered to recharge facilities.[29]

Methods to introduce surface water into aquifers include direct injection using mechanical pumps and percolation in or near dry riverbeds. The primary losses associated with such recharging of underground reservoirs occur while moving the water to where it will be injected or absorbed. To minimize evaporation and conserve electricity, percolation methods can be intensified during winter months and mechanical injection methods during mild months when demand for electricity is reduced.

The arid regions dependent on the water resources of the Colorado River are endowed with natural underground locations which combined could accommodate six years of the Colorado River's annual flow.[30] Some of the largest aquifers are located adjacent to existing aqueducts such as the Central Arizona Project and the California Aqueduct. Along these aqueducts about 26 MAF of storage capacity is available for California and at least 15 MAF for Arizona. Another 25-46 MAF of storage may also be available via additional aquifers in Arizona. While Nevada and Utah's groundwater storage potential is not as well endowed or explored, they too are engaged in recharge activities in and around Las Vegas and Salt Lake City. They also could utilize the significant storage potential in Arizona and California as water banks to be used as credits against surplus withdrawals from the river.[31]

Some infrastructure to utilize aquifers for Colorado River water storage has been in place for nearly 20 years. The main factor inhibiting its expanded use is that above-ground reservoirs are being used instead. By shifting to a program to maximize underground storage, nearly all the water that would otherwise be stored in Lake Powell and Lake Mead could become available for artificial recharge. This could save 809,000 AF of water annually that would otherwise be lost to reservoir evaporation and seepage.[32]

By eliminating Lake Powell and employing Lake Mead principally to capture the annual floods for water distributed to recharge locations it is estimated that approximately 5 MAF of annual ground water recharge capacity would be necessary to capture surplus flows at Lake Mead.[33] Present recharge capacity for Colorado River water is in excess of 1.3 MAF per year.[34] Costs associated with expanding programs of artificial recharge would not be inconsistent with ongoing investments in aqueduct and pipeline development.[35]

Recharging these aquifers could also reverse the mounting problems associated with their rapid depletion, including higher pumping costs, property damage, contamination from invading seawater and plumes of human-induced pollution. In Las Vegas, for example, aquifer levels have dropped 300 feet in some areas.[36] Although ground subsidence cannot be reversed, recharging these aquifers with Colorado River water will prevent further damage. A rising water table would also revive desert riparian zones and springs that benefit wildlife habitat.

Existing Colorado River Aquifer Recharge Facilities

While the benefits of expanding groundwater recharge present a strong case for evaluating the future role of storage reservoirs along the Colorado River, there is already a compelling need to examine the merits of the system's most troublesome facility, Glen Canyon Dam.

UNNECESSARY & UNCERTAIN WATER STORAGE

Glen Canyon Dam was built to aid the Upper Basin states to deliver 8.23 MAF of water annually to the Lower Basin.[37] The rationale was that during periods of drought, Lake Powell's storage would allow the Upper Basin to fulfill this commitment without impacting its own water use.

However, a Bureau of Reclamation model demonstrated that Glen Canyon Dam's contributions to meet these deliveries are negligible.[38] Lake Mead alone would have provided all of the storage needed for the Lower Basin until recently. Not until autumn of 2004, 41 years after Glen Canyon Dam was completed, had the water stored in Lake Powell been a factor in supplementing Upper Basin water delivery to the Lower Basin.[39]

While it may appear that Lake Powell has for the first time been fulfilling its intended purpose, this has come at a significant cost. Obtaining that 23.5 MAF (the amount in Lake Powell when the drought began in July 1999) of water in Lake Powell after 41 years resulted in 35.7 MAF being lost to evaporation and seepage. This combined loss represents just 40 percent efficiency for long-term water storage.[40]

Additionally, the refilling of Lake Powell will be a rare occurrence. When the reservoir began filling in 1963, there was less demand on available water. This allowed an average surplus of 2.6 MAF annually to flow into Lake Powell, filling it in 17 years.[41] Demand has since increased nearly 100 percent in the Upper Basin and is projected to average 5.4 MAF by 2020.[42] Subtracting this annual projected use by the Upper Basin from the river's average annual flow of 13.5 MAF, then subtracting the 8.23 MAF that Glen Canyon Dam must annually release downstream leaves no surplus to help refill the reservoir. This average annual surplus goes into the red when accounting for the Department of Energy's anticipated declines in river flows due to climate change.[43]

REVIVING GRAND CANYON'S ECOSYSTEM

The river ecosystem in Grand Canyon National Park began declining as Lake Powell began to fill in 1963. Since then, river resources in the park have steadily deteriorated to a state of near collapse. If more effective measures are not taken soon, the integrity of this ecosystem will be forever compromised. The operation of Glen Canyon Dam has caused four of the Canyon's eight native fish species to become extinct. A fifth is headed in this direction and a sixth is now considered a species of "special concern." Native birds, mammals, reptiles and amphibians along the river corridor have been affected as well.[44]

In an effort to reverse this decline, Congress passed the Grand Canyon Protection Act in 1992. In 1995 an Environmental Impact Study (EIS) established mitigation measures relating to Glen Canyon Dam's operations.[45] Since the recovery program began, and after more than $223 million has been spent, one native fish disappeared from the Canyon and another has declined to nearly unrecoverable levels.[46]

Glen Canyon Dam's impacts on Grand Canyon's ecosystem

- The water below the dam is constantly cold at 47 degrees Fahrenheit. The natural river fluctuated seasonally from near freezing to 80 degrees Fahrenheit.
- River flows fluctuate daily between 8,000 and 20,000 CFS (cubic feet per second). Naturally they would fluctuate seasonally from 3,000 to 100,000 CFS.
- The dam has trapped the sediment required to maintain sandbar habitat and supply nutrients to the food web.
- The dam blocks fish migration, limiting their genetic integrity and habitat diversity.
- Non-native fish inhabit this new environment and compete with the native fish.

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As outlined in a recent report to Congress by the Secretary of the Interior,[47] no progress has been made toward meeting the mandate of the Grand Canyon Protection Act, the objectives of the EIS, or the recovery goals which attempt to bring the dam into compliance with the Endangered Species Act.[48]

In addition, the core of the National Park Service Organic Act[49]—"to leave [national parks] unimpaired for the enjoyment of future generations"—is being violated as resources continue to deteriorate in Grand Canyon National Park.

A major limitation of efforts to restore Grand Canyon thus far has been the inability to deliver sediment and nutrients to the ecosystem.[50] With nearly all the sediment trapped behind Glen Canyon Dam, there has been a continued decline in the food base and backwater habitat for endangered fish, disturbances at archeology sites and a loss of camping beaches. Resource managers have been prohibited from examining the solution that offers the greatest chance of habitat recovery—restoring the river's natural processes by decommissioning Glen Canyon Dam.

SEDIMENT COSTS

Water managers must develop a program to manage the sediment entering Lake Powell. As there is no feasible method to flush this sediment through Glen Canyon Dam, not to mention the dams downstream, sediment must be mechanically removed.

The overall scale of such a project in design, implementation and cost would rival any of the Colorado River water projects to date. Like Hoover Dam, it would be an unprecedented undertaking. A range of alternatives will need to be explored, including allowing the sediment to flow downstream and removing it from Lake Mead.

From the standpoint of convenience, Lake Mead affords much easier access to the sediment than Lake Powell. Superior transport systems are already available at Lake Mead, both highway and railroad. Topographically, Lake Mead offers a better range of disposal sites with fewer constraints should a pipeline/slurry system be preferred. Should it be deemed appropriate to transport the sediment to nature's intended destination, the Colorado River delta, the distance from Lake Mead would be half as far as from Lake Powell.

Managers must also assess the value of the sediment toward achieving compliance with federal laws guiding endangered species recovery in Grand Canyon National Park. Sediment augmentation—moving sediment around the dam—has already been discussed as a necessary next step to reverse Glen Canyon Dam's impacts on Grand Canyon.[51] However, such augmentation approaches may not contain necessary nutrients like carbon, which is essential to rebuilding a healthy, native food web in Grand Canyon.[52]

UNCERTAIN POWER, FAR FROM IRREPLACEABLE

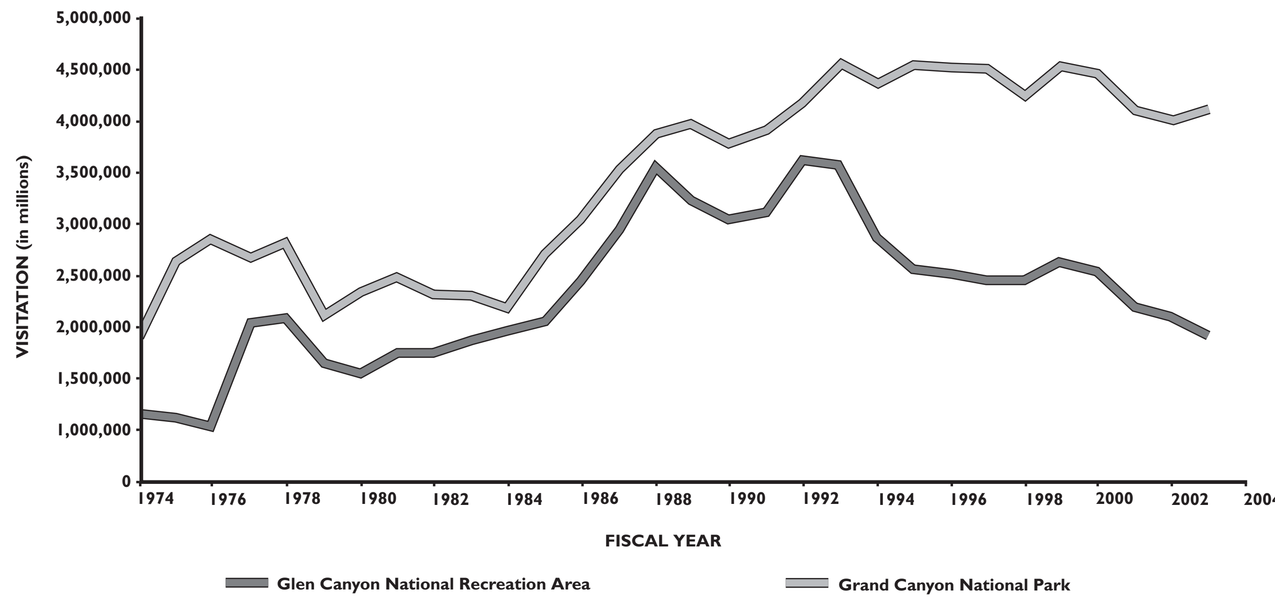
When Lake Powell is at full or near full, Glen Canyon Dam can on average generate enough power to service 389,000 homes.[53] Declining reservoir storage has caused power production to drop 40 percent.[54] Production could fall to zero should below normal inflows persist and water consumption remain unchanged.[55]

Glen Canyon Dam's customers normally enjoy a 40 percent subsidy over the prevailing market rates. Now they must obtain replacement power at competitive rates.[56] Substitute power is readily available and will continue to absorb Glen Canyon Dam's shortfalls, even if power generation falls to zero.

Since 2000, declining power revenues from Glen Canyon Dam have brought repayments on federal loans for Colorado River infrastructure to a near standstill.[57] While periodic high flows may help power production and enhance revenues for a short time, climate change and increased water demand have rendered power generation from Glen Canyon Dam far from certain.

To the extent electricity is produced, this comes at a cost of water lost to evaporation and seepage. This water itself has economic value and would provide a comparable revenue stream should the dam be decommissioned. More importantly, there is no substitute for the lost water. Since scarcity of water was the driving force behind construction of Glen Canyon Dam, recovery of this water should influence the dam's future.

30-year Visitation History of Glen Canyon National Recreation Area and Grand Canyon National Park



SOURCE: National Park Service

TOURISM

Lake Powell and the surrounding Glen Canyon National Recreation Area contribute to a tourism economy centered at Page, Arizona. However, visitation there has declined nearly 50 percent over the past 15 years.[58]

Low reservoir levels restricting boater access have accelerated these declines. In November 2004, Aramark, the area concessionaire, was forced to close facilities that had previously been open year-round.[59] The National Park Service (NPS) has invested heavily to improve facilities. Despite spending $22 million in 2004 alone,[60] NPS was unable to keep boat ramps fully operational. These problems will continue as lower reservoir levels likely become the norm.

A portion of the Navajo Nation shares its border with Lake Powell and contributes to the tourism industry as well. Their concession contractor, Antelope Point Holdings, opened a marina in 2004, but declining reservoir levels prevented the launching of boats. While modifications have been made, a cliff prevents the marina from operating when the reservoir is about 115 feet low, a reoccurring problem should low water levels persist. The Navajo Nation's desire to construct a water pipeline from the Colorado River, however, can proceed without Lake Powell.

Recreational trout fishing in the Colorado River below Glen Canyon Dam has experienced a decline in visitation similar to that of Lake Powell, from 52,000 angler days in 1983, to 25,000 in 1999.[61]

A recent survey of visitors spending the night at Page revealed that Lake Powell boating was not the only attraction. More than 50 percent of respondents were not engaged in water recreation on Lake Powell.[62] This is likely due to the town's central location along a widely used tourist route between the Grand Canyon and other popular national parks, national monuments and recreation areas.

Prior to Glen Canyon Dam, the Colorado River through Glen Canyon was emerging as a tourist destination on its own. Glen Canyon was one of the most spectacular features of the American landscape. Even now, Aramark and others are attempting to attract visitors by publicizing the uncovering of Glen Canyon's natural features at a diminishing reservoir.

The restoration of Glen Canyon by decommissioning Glen Canyon Dam could spawn a river recreation industry comparable to what now exists in Grand Canyon National Park. Hiking, biking and other land-based activities could also be as popular as they are elsewhere in the Canyon County of the Colorado River.

ELIMINATING CONCERNS FOR SAFETY

Glen Canyon Dam has a dangerous safety record. In 1983, snowmelt caused an emergency situation that nearly ended in dam failure. A faulty design in the dam's spillways led to hydraulic pressure excavating bedrock and forced dam managers to abandon the spillways' full use. Luckily, disaster was averted when inflows subsided prior to water overtopping the dam.[63]

The Bureau of Reclamation has forecasted that if Glen Canyon Dam failed when full, a wall of water 580 feet high would enter Grand Canyon.[64] A wave 68 feet high would overcome Hoover Dam and begin a flood that would subside eleven days later. Such a failure could devastate critical water distribution and transportation networks for Arizona, Nevada, Southern California and Mexico, along with the homes and businesses of tens of thousands of people.

Historically, flood control storage has not been a high priority for managers of the Colorado River system, requiring just 5.35 MAF annually to be available system-wide at the beginning of each year.[65] It was this low requirement that allowed the 1983 problems at Glen Canyon Dam to materialize. By eliminating Lake Powell and operating Lake Mead for efficient ground water diversions, nearly four times the current flood control protection could be achieved.[66]

Indian Nations

Glen Canyon Dam inundated the cultural heritage of the First Nations upstream and is slowly eroding what remains downstream in Grand Canyon National Park.

Navajo, Hopi, Zuni, White Mesa Ute, Southern Paiute, Kaibab Paiute, Shivwits Paiute, Havasupai, and Hualapai all have connections to the Colorado River in Glen and Grand Canyons, including sacred sites and artifacts dating back 10,000 years. Reports on roughly 2000 sites submerged by Lake Powell describe shelter caves, dwellings, granaries, irrigation systems, rock art panels, burials, ceramics, and projectile points.[67] Included were revered sacred sites of the Navajo for ceremonies and prayer, such as Rainbow Bridge National Monument, a 291-foot-high natural bridge.

The operation of Glen Canyon Dam currently affects some 264 archeological sites in Grand Canyon. Fluctuating river flows in response to hydropower demands destabilize riverbanks where the sites reside. These fluctuating flows disturb the cultural properties in the process. Furthermore, a failure of Glen Canyon Dam would completely obliterate some 964 known cultural sites.[68] Federal laws require the preservation of these ancestral artifacts and National Park Service and First Nation policies require that artifacts and burials be preserved in place.

Only a few remaining medicine people are truly aware of what has been submerged under Lake Powell. Some still say that choking the river with a dam brought disharmony and discontent to their people and only with the restoration of these sacred sites can their physical and spiritual health become restored.[69]

Re-examine the Colorado River Compact

Since the Colorado River Compact was approved in 1922 over-allocation, reduced supply and population growth have greatly altered the ability of the Compact to serve its intended purposes.

The goals of the Compact are "to provide for equitable division and apportionment of the use of the waters of the Colorado River System; to establish the relative importance of different beneficial uses of water; to promote interstate comity; to remove causes of present and future controversies; and to secure the expeditious agricultural and industrial development of the Colorado River basin, the storage of its waters, and the protection of life and property from floods."[74]

The Compact has not achieved an "equitable division" of water for the constituency. With the river providing on average 13.5 MAF (instead of the 15 MAF allocated by the Compact), and with Mexico receiving 1.5 MAF, just 12 MAF remains for the two basins. The Lower Basin is guaranteed 6.75 MAF (7.5 MAF minus its 0.75 MAF contribution to Mexico). Thus, in the best of circumstances the Upper Basin could on average count on just 5.25 MAF (13.5 MAF of river flow minus 7.5 MAF of Lower Basin consumption minus its own 750,000 AF contribution to Mexico) or 22 percent less than the Lower Basin.

The Compact lacks provisions for addressing real shortages. The lowering of Lake Powell and present climate conditions render this an immediate possibility today, and medium- to long-term supply and demand trends suggest that this situation is not likely to improve in the future. If Lake Powell is empty there may be times when the Upper Basin may not be able to meet its 8.23 MAF obligation to the Lower Basin.

A responsible attempt to craft a new agreement that reflects the reality of river supply must be initiated. This could be done by adjusting allocations annually to reflect actual river flows. It is becoming more evident that the current system, which evaluates the allocation to the Upper Basin after its delivery to the Lower Basin has been satisfied, has needlessly delayed prudent approaches to ensure balance in the system and to meet the challenges of future shortages.

The Compact establishes the most important use of Colorado River water to be domestic and agricultural purposes, with other uses subservient. The destruction of Grand Canyon's river ecosystem illustrates how important environmental considerations are as well. But nothing illustrates the environmental challenge more clearly than the demise of the Colorado River delta, where reduction in flows has caused the ecosystem to virtually disappear.[75] Future discussions of allocation must therefore include environmental flows.

The decommissioning of Glen Canyon Dam and the expansion of aquifer storage systems is not only consistent with this priority, but actually better facilitates the achievement of Compact purposes. Lake Mead can capture surplus water and ensure its storage for the Lower Basin, in the reservoir and through groundwater aquifers. Furthermore, as noted in Article VIII of the Compact, only 5 MAF of storage is needed in the Lower Basin to safeguard its perfected rights. Lake Mead on its own clearly satisfies this requirement.

The Compact does not provide for an equitable and timely means to reduce allocations. In order to avert major complications a basin-wide evaluation of current water use, coupled with an assessment of

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senior-perfected water rights, needs to be conducted. With this information, a systematic plan to allocate water rights between the states, Tribes and Mexico can be achieved, and will minimize future impacts to the economy and the environment.

Federal Responsibility

The Colorado River passes through seven states as well as many national parks and monuments before entering Mexico. The complexity of interstate, tribal and international agreements places the federal government at center stage in charting management strategies for the Colorado River. Congress has passed much legislation pertaining to its management, forming a body of law referred to as "The Law of the River." Many of these laws are no longer effective. They fail to achieve a sustainable balance between water supply and demand, and to adequately protect fragile ecosystems associated with the river. It is critical that Congress revisit this legislation and remedy the problems that have developed.

In 1922 Congress approved the Colorado River [Interstate] Compact that quantified Colorado River water allocations for each state and, in 1944, Mexico. Unfortunately the Compact greatly over-estimated the amount of water actually available within the watershed and allocated 3-4 MAF more than the river can now provide.

Congress passed the Colorado River Storage Project of 1956, and the Colorado River Basin Project Act of 1968, authorizing water projects that impounded or diverted water on nearly every tributary.[70] These projects increased system-wide storage to 62 MAF, well beyond the level of diminishing returns. The legislation did not include a plan or a source of funding to manage the removal of sediment from the reservoirs.

In response to public concern over the impacts of Glen Canyon Dam on the resources of Grand Canyon National Park, Congress passed the Grand Canyon Protection Act (GCPA) in 1992.[71] This act directed the Secretary of the Interior to complete an Environmental Impact Study (EIS) on the operations of Glen Canyon Dam. The GCPA also directs the Interior Secretary to "protect, mitigate adverse impacts to, and improve the natural, cultural, and recreational resource values downstream from the dam, for which Grand Canyon National Park and Glen Canyon National Recreation Area were established." On average $11 million is being spent annually in efforts that have failed to reverse declines in native species, and to restore sandbar and beach deposits.

Additionally, the National Park Service Organic Act of 1916 provides clear Congressional guidance to protect resources like Grand Canyon. Units of the National Park System are managed "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same by such means as will leave them unimpaired for the enjoyment of future generations." [72]

Lastly, the Endangered Species Act[73] requires the US Fish and Wildlife Service to protect and provide recovery for endangered species. Since the GCPA was passed the Razorback Sucker has been extirpated and the Humpback Chub population is in serious decline.

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Conclusion

Colorado River water managers have long ignored resolving administrative and structural problems affecting a critical component of the Southwest's water supply. Continued inaction will invite conflict, forcing a response to emerge from crisis as opposed to reason. More likely than not, reactionary decisions would compound the problem, merely providing an urgent response to solve a minor detail and avoiding movement towards a comprehensive solution for the watershed.

The leadership in the Bureau of Reclamation has not stepped forward in this regard. As concern over the present drought intensified, the agency merely stated that the reservoirs were performing as intended: delivering water in times of shortage.[76] Planners must re-examine how efficient the system 2
really is based on the reality of increased demand and decreased supply. This must include how Colorado River water, whatever the amount nature chooses to provide, can be stored as efficiently as possible.

In so doing, planners should not be impeded by the other incidental uses of Colorado River water, such as power generation and recreation. The prevailing need is to manage the river's finite water supply as efficiently as possible. Though power production and recreation have substitutes, there is no substitute for Colorado River water.

Nor are there substitutes for the ecosystems impacted by water projects on the Colorado River. Grand Canyon National Park is a core element of our natural heritage and laws have been enacted specifically to ensure its protection. Nonetheless, dam operations continue to undermine the famous ecosystems of the Colorado River.

With these issues in mind, and in conjunction with a larger objective of achieving sustainable water management and ecological restoration on the Colorado River, it is recommended that future operations of Lake Powell and Lake Mead be explored in conjunction with a much broader evaluation to:

1) Pursue transfers of Lake Powell and Lake Mead storage to groundwater aquifers. 3

2) Develop a sustainable sediment management program for Lake Powell and Lake Mead. 4

3) Determine the costs and benefits of decommissioning Glen Canyon Dam to restore 5
natural flows through Glen and Grand Canyons. 6

4) Identify new water allocation guidelines to reflect the amount of water the Colorado River actually 7
provides, how it should be distributed and what amounts are needed to protect critical habitats in 8
Grand Canyon and elsewhere.

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Notes

1. Historic evaporation losses for Colorado River main stem reservoirs have averaged 1.8 million acre-feet (MAF) annually (not adjusted for the river's natural evaporation), 13 percent of the river's average annual paleoclimatic flow of 13.5 MAF.
—Bureau of Reclamation. Upper Colorado Region: Water Operations. "Table LC-1 and UC-1." *Colorado River System Consumptive Uses and Losses Report (1971-2000).*

The paleoclimatic stream flow of 13.5 MAF at the Compact Point (Lee's Ferry, Arizona) is based on a 400-year, tree-ring database.
—Stockton, C. W. and G. C. Jacoby. "Long Term Surface Water Supply and Stream Flow Trends in the Upper Colorado River Basin." Lake Powell Research Project Bulletin No. 18 (University of California at Los Angeles: Institute of Geophysics and Planetary Physics, 1976).

A tree-ring reconstruction study completed in 2000 has proposed the long-term yield for the Colorado River is 13.2 MAF.
—Hidalgo, Hugo G., Thomas C. Piechota and John A. Dracup. "Alternative Principal Components Regression Procedures for Dendrohydrologic Reconstructions." Water Resources Research, Vol. 36, No. 11 (November, 2000), 3241-3249.

2. On average, Lake Powell evaporates 516,000 acre-feet (AF) and Lake Mead evaporates 828,000 AF for a total of 1.34 MAF, 10 percent of the average annual paleoclimatic flow.
—See: Note 1 (Bureau of Reclamation).

3. Arizona has approximately 15 MAF of available groundwater storage along the Central Arizona Project at existing, direct aquifer recharge facilities.
—Robson, S. G. and E. R. Banta. *Ground Water Atlas of the United States.* U.S. Geological Survey Atlas HA 730-C (1995), figures 42 and 43.
Online: http://capp.water.usgs.gov/gwa/ch_c/C-text3.html
—Tim Henley, Arizona Water Banking Authority. Personal communication, June 30, 2005.
—Another 25-46 MAF may be available in the state when considering nearby aquifer volume minus aquifer depletion as reported by the U.S. Geological Survey *Ground Water Atlas (above).*

California has the potential to store 26 MAF of Colorado River water underground along the Colorado Aqueduct.
—California Department of Water Resources. California's Groundwater: Bulletin 118 (Updated in 2003 with aquifer storage capacity estimates).
—Bill Hassencamp, Metropolitan Water District. Personal communication, July 18, 2005.
—Mark Buehler, Coachella Valley Water District. Personal communication, July 18, 2005.

4. Bureau of Reclamation. Upper Colorado Region: Water Operations. "Operations Summary and Reservoir Status." *Annual Operating Plan for the Colorado River System Reservoirs* (2000–2006).
—Bureau of Reclamation. Upper Colorado Region: Water Operations. "Beneficial Consumptive Uses and Losses." *Colorado River System Consumptive Uses and Losses Report* (1971–2000).

5. Webb, Robert H., Gregory J. McCabe, Richard Hereford and Christopher Wilkowske. *Climatic Fluctuations, Drought, and Flow in the Colorado River Basin.* U.S. Geological Survey Fact Sheet 2004-3062 (June, 2004).

6. Cook, Edward R., Connie A. Woodhouse, C. Mark Eakin, David M. Meko and David W. Stahle. "Long-Term Aridity Changes in the Western United States." *Science Vol. 306* (November 5, 2004), 1015-1018.

7. Dawdy, David R. "Hydrology of Glen Canyon and Grand Canyon," *Colorado River Ecology and Dam Management: Proceedings of a Symposium May 24-25, 1990. Santa Fe, New Mexico* (Washington D.C.: Academy Press, 1991), 46.

8. See: Note 1 (Stockton et al and Hidalgo et al).

9. Based on the 8.25 MAF delivered at the Compact Point (Lee's Ferry, Arizona) plus Upper Basin consumption of 4.4 MAF for a total of 12.65 MAF.
—Bureau of Reclamation. Upper River Region: Water Operations. "Upper Colorado River Tributaries." *Colorado River System Consumptive Uses and Losses Report* (1996-2000), 14.

10. Christensen, Niklas S., Andrew Wood, Nathalie Voisin, Dennis P. Lettenmaier and Richard N. Palmer. *The Effects of Climate Change on the Hydrology and Water Resources of the Colorado River Basin* (2004), 1-2.

11. See: Note 1 (Stockton et al and Hidalgo et al).

12. See: Note 5 (Webb et al).
—Gray, Stephen T., Stephen T. Jackson and Julio L. Betancourt. "Tree-Ring Reconstructions of Interannual to Decadal Scale Precipitation Variability for Northeastern Utah Since 1226 A.D." *Journal of the American Water Resources Association* (August, 2004), 947-960.

13. Government Accounting Office. *Comptroller General's Report to the Congress. Colorado River Basin Water Problems: How to Reduce Their Impact CED-79-11* (1979), 1.

14. See: Note 4 (Bureau of Reclamation).

15. See: Note 10 (Christensen et al).

16. See: Note 1 (Bureau of Reclamation).

17. Langbein, Walter B. *Water Yield and Reservoir Storage in the United States*. U.S. Geological Survey Circular 409 (1959).

18. See: Notes 1 & 2 (Bureau of Reclamation).

19. Bureau of Reclamation. Upper Colorado Region: Water Operations. *24-Month Study Reports*. (Lake Powell and Lake Mead bank storage columns.)
Online: http://www.usbr.gov/uc/water/crsp/studies/index.html

20. With wholesale prices of Colorado River water of at least $258 per acre-foot, and average annual evaporation losses of Lake Powell and Lake Mead of 0.516 and 0.828 MAF respectively (not adjust-

ed for the river's natural evaporation), and results in $347 million in economic losses.
—San Diego County Water Authority. *Historic Water Transfer Agreement Gets Final Approval as QSA Falters*. San Diego Water Authority press release (December 31, 2002).
21. Average annual rate of sedimentation in Lake Mead is estimated to be 102,000 AF, representing a total of 2.86 MAF deposited over the 28 years Hoover Dam operated prior to the completion of Glen Canyon Dam, or 10 percent of Lake Mead's storage capacity.
—Smith, W. O., C. P. Vetter, and G. B. Cummings. *Comprehensive Survey of Sedimentation in Lake Mead, 1948-49.* U.S. Geological Survey Professional Paper 295 (1960), 195 & 231.
22. Schultz, Ernest R. *Design Features of Glen Canyon Dam: Paper for Presentation at ASCE April, 1961 Convention*. (Phoenix: Bureau of Reclamation Construction Division), 30.
23. Spangler, Jerry. "Draining Powell Called a Pipe Dream." *Deseret News*. Salt Lake City (June 18, 2002).
24. Dohrenwend, John C. "Rapid Progradation of the Colorado and San Juan River Deltas into Lake Powell Reservoir, July 2002 to March 2004." *Four Corners Geological Society Newsletter, April 2004*. (Durango, Colorado), 4.
—University of Arizona. *Exposed Upper Colorado River Delta is Rapidly Eroding into Lake Powell*. University of Arizona press release (May 7, 2003).
25. Graf, William L. *The Colorado River: Instability and Basin Management.* (Washington D.C.: Association of American Geographers, 1985), 34.
—Hereford, Richard. "Valley-Fill Alluviation (ca. 1400-1880) During the Little Ice Age, Paria River Basin and Southern Colorado Plateau, U.S.A." *Geological Society of America Bulletin v. 114* (2002), 1550-1563.
26. Andrews, Edmund D. "Sediment Transport in the Colorado River Basin." *Colorado River Ecology and Dam Management: Proceedings of a Symposium May 24-25, 1990 Santa Fe, New Mexico*. (Washington D.C.: Academy Press, 1991), 68.
27. Annual sediment of 44 million tons would require approximately two million truckloads at standard loads of 22 tons per truck. The distance from Lake Powell's Hite Marina to the Colorado River delta is 1,300 miles round trip, requiring a fleet of 15,000 trucks working around the clock. At $1 per mile per truck, the total operating costs alone would be $2.6 billion annually.
—Owner-Operator Independent Drivers Association. *Cost Per Mile Worksheet*. Online: http://www.ooida.com/trucking_tools/CPM/cost_per_mile_print.htm
28. The average annual water flow entering Lake Powell since 1963 is estimated to be 10.9 MAF. When full, Lake Powell can cause the loss of 606,000 AF (1999). When the remainder of this water flows into Lake Mead, when it is full, another 1.23 MAF (1999) can be lost. Combined, this represents 1.84 MAF lost, or 17 percent of the 10.9 MAF inflows.
—Bureau of Reclamation. Upper Colorado Region: Water Operations. *Historic Data: Lake Powell Inflows*. Online: http://www.usbr.gov/uc/crsp/GetSiteInfo
—See: Note 9 (Bureau of Reclamation), 21 & 31.
29. Artificial recharge projects in Arizona using Colorado River water have reported evaporation losses of one percent or less.
—Central Arizona Project. *Groundwater Recharge Projects: Operations*. Online: http://www.cap-az.com/recharge/index.cfm?action=Aqua&subSection=70
30. Robson, S. G. and E. R. Banta. *Ground Water Atlas of the United States.* U.S. Geological Survey Atlas HA 730 (1995). Online: http://capp.water.usgs.gov/gwa/gwa.html
31. The Southern Nevada Water Authority currently has agreements to store 1.25 MAF in the state of Arizona.
—Southern Nevada Water Authority. *Southern Nevada Water Authority Water Resources Plan* (2005), 3:19.
32. Eliminating Lake Powell would save on average 414,000 AF of evaporation losses (516,000 AF of annual evaporation loss minus 102,000 AF lost (see Myers below) from river evaporation).
—Myers, Tom. *Water Balance of Lake Powell: An Assessment of Groundwater Seepage and Evaporation. (Salt Lake City: Glen Canyon Institute, 1999), 3.*

Maintaining Lake Mead's useable storage (not including dead pool storage) to 5 MAF (1,007 feet above sea level), the minimum required by the Colorado River Compact would reduce its average annual evaporation from 828,000 AF to approximately 433,000 AF.
—Stanley, J. W. "Chapter I: Reservoir Storage." *Comprehensive Survey of Sedimentation in Lake Mead, 1948–49.* U.S. Geological Survey Professional Paper 295 (1960), 87 & 90.
—Langbein, W. B. "Chapter J: Water Budget." *Comprehensive Survey of Sedimentation in Lake Mead, 1948–49.* U.S. Geological Survey Professional Paper 295 (1960), 97.
33. The wettest decade of the historic record (1911–1920) had an average annual surplus of 5 MAF.
—California Department of Water Resources. "Observed Natural Flow at Lee's Ferry." *Colorado River Drought Information*. Online: http://www.saltonsea.water.ca.gov/data/co_river.cfm
34. Along the Central Arizona Project, existing direct recharge projects have the ability to recharge approximately 900,000 MAF.
—Arizona Department of Water Resources. *Permitted Projects—December 31, 2003*. Online: http://www.water.az.gov/recharge/PermittedFacilities.htm
—Virginia O'Connell, Arizona Water Resources Department. Personal communication, July 18, 2005.

Along the Colorado River Aqueduct in California, existing direct recharge projects have the ability to recharge 450,000 AF, and other projects are currently under construction

that will bring the total to 700,000 AF.
—Bill Hassencamp, Metropolitan Water District. Personal communication, July 18, 2005.
—Mark Buehler, Coachella Valley Water District. Personal communication, July 18, 2005.
Las Vegas Nevada has recharged as much as 32,000 AF in one year.
—Las Vegas Valley Water District. *Las Vegas Valley Water District 2004 Artificial Recharge Annual Report* (2004), 3.
35. Examples of ongoing planning and development for water projects include the Central Utah Project, the Animas-La Plata Project, the Colorado River Return Project, and the Navajo Water Supply Project.
36. Bartolino, J. R. and W. L. Cunningham. *Ground-Water Depletion Across the Nation*. U.S. Geological Survey Fact Sheet 103-03, (February, 2004).
37. Glen Canyon Dam only releases 8.23 MAF because the Upper Basin's Paria River (below the dam and above the Compact Point at Lee's Ferry, Arizona) contributes 20,000 acre-feet annually for a total of 8.5 MAF.
38. Rosekrans, Spreck. *The Effect of Draining Lake Powell on Water Supply and Electricity Production.* (San Francisco: Environmental Defense Fund, 1997).
39. Without Lake Powell the 21st century drought would have depleted Lake Mead in the fall of 2004. At that time (2004) the combined storage at Lake Mead and Lake Powell was equal to the capacity of Lake Powell when it was nearly full in July 1999 (23.5 MAF).
—Bureau of Reclamation. Lower Colorado Region: Water Operations. *Historic Data: Lake Mead Levels*.
Online: http://www.usbr.gov/lc/region/g4000/hourly/mead-elv.html
—Bureau of Reclamation. Upper Colorado Region: Water Operations. *Historic Data: Lake Powell Levels*.
Online: http://www.usbr.gov/uc/crsp/GetSiteInfo
40. In 1999, Lake Powell was nearly full and stored 23.5 MAF of water. Lake Powell's average annual evaporation is 414,000 AF (after deducting 102,000 AF for river evaporation were the dam not there) and the total after 41 years of operation is 17.0 MAF. The total lost to seepage at Lake Powell is 18.7 MAF, for a total of 35.7 MAF (evaporation and seepage). It has therefore required a grand total of 59.2 MAF to obtain the 23.5 MAF actually used. This 23.5 MAF is just 40 percent of the total.
—See: Note 9 (Bureau of Reclamation), 23 & 31.
—See Note 19 (Bureau of Reclamation).
41. Bureau of Reclamation. Upper Colorado Region: Water Operations. *Historic Data: Lake Powell Inflow & Release*.
Online: http://www.usbr.gov/uc/crsp/GetSiteInfo
42. Bureau of Reclamation. Lower Colorado Region Water Operations. "Colorado River Water Use Since 1906."
Online: http://www.usbr.gov/lc/region/g4000/uses.html
—Department of the Interior: Bureau of Reclamation. "Attachment K. Upper Basin Depletion Schedule." *Colorado River Surplus Criteria Final Environmental Impact Statement* (2000).
43. See: Note 10 (Christensen et al).
44. National Park Service: Grand Canyon National Park. *Endangered, threatened, and sensitive wildlife of potential occurrence along the Colorado River in Grand Canyon.* Online: http://data2.itc.nps.gov/nature/documents/ACF18EB.doc
45. Department of the Interior. *Report to Congress: Operations of Glen Canyon Dam Pursuant to the Grand Canyon Protection Act of 1992, Water Years 1999-2001, Secretary of the Interior* (May, 2002), 2-8.
46. Experts believe the fourth species to be extirpated (regionally extinct) in the Grand Canyon is the Razorback Sucker.
—National Park Service: Grand Canyon National Park. *Grand Canyon National Park Profile (2004), 2.*
A total of $223 million has been invested in mitigating Glen Canyon Dam's impacts on Grand Canyon.
—*Updike, Christopher N. and Steven P. Gloss.* "Confronting Social Impediments to Adaptive Management: Lessons from the Grand Canyon Ecosystem." *Grand Canyon Monitoring and Research Center: Colorado River Ecosystem Science Symposium,* (October, 2003).
47. See: Note 45 (Department of the Interior), 22-27.
48. U.S. Fish and Wildlife Service. *Final Biological Opinion on the Operation of Glen Canyon Dam* (January, 1995), 33.
49. The National Park Service Organic Act (16 U.S.C. l 2 3, and 4), as set forth herein, consists of the Act of Aug. 25 1916 (39 Stat. 535) and amendments thereto.
50. See: Note 45 (Department of the Interior).
51. National Academy of Sciences: Commission on Geosciences, Environment and Resources. *River Resource Management in the Grand Canyon* (Washington D.C.: Academy Press, 1996), 4.
—Bureau of Reclamation. Upper Colorado Regional Office: Glen Canyon Dam Adaptive Management Program. *Fiscal Year 2006 Budget & Work Plan* (March, 2005), 19 & Worksheet 4.
52. Haden, G. Allen, Dean W. Blinn, Joseph P. Shannon, and Kevin P. Wilson. "Driftwood: An Alternative Habitat for Macroinvertebrates in a Large Desert River." *Hydrobiologia 397* (1999), 179-186.
53. Based on the average annual output of Glen Canyon Dam (5,166,000 MWh), and average annual Arizona residential electricity use at 13,300 kWh per household.
—Southwest Energy Efficiency Project. *Arizona: Energy Efficiency and Energy Consumption*. (Boulder, Colorado: Southwest Energy Efficiency Project).
54. Bureau of Reclamation. *Drought or Opportunity: Remarks Delivered by John W. Keys, III, Commissioner, Bureau of Reclamation, Colorado River Water Users Association, 2003 Annual*

Meeting, Las Vegas. Bureau of Reclamation press release *(December 12, 2003).*

Power generation for 2004 from Colorado River Storage Project dams, of which Glen Canyon is the primary contributor, dropped 40 percent from when the reservoir was near full in 1999. —*Western Area Power Administration. "Salt Lake City Area/ Integrated Projects: Powerplants". Annual Report: Statistical Appendix* (1999-2004).
Online: http://www.wapa.gov/newsroom/pubs.htm

55. See: Note 51 (National Academy of Sciences), 65.
56. Western Area Power Administration. "Continued Drought Brings Many Questions." *Closed Circuit* (May 28, 2004).
57. From 2000-2004 repayments to the federal treasury for projects in the Colorado River Storage Project Act averaged just $6.2 million on an outstanding loan due in 2050 of $2.6 billion.
—See: Note 54 (Western Area Power Administration).
58. National Park Service: Public Use Statistics Office. *Visitation.* Online: http://www2.nature.nps.gov/stats/
59. Aramark Corporation. *Powell Resorts & Marinas Announces Seasonal Operating Schedule*. Aramark press release (October 19, 2004).
60. National Park Service. *$22 Million in Facility Improvement Projects Completed or Ongoing at Glen Canyon National Recreation Area*. Glen Canyon National Recreation Area press release (October 4, 2004).
61. Jonas, Lilian. *Lake Powell Preliminary Socioeconomic Impact Analysis*. (Salt Lake City: Glen Canyon Institute, 1999), 27.
62. Ibid, 30.
63. Carothers, Steven W. and Bryan T. Brown. *The Colorado River through Grand Canyon: Natural History and Human Change*. (Tucson: University of Arizona Press, 1991), 26-29.
64. Latham, Stephen E. *Glen Canyon Dam, Arizona: Dam Failure Inundation Study*. (Denver: Bureau of Reclamation, 1998), 7-9.
65. Bureau of Reclamation. Lower Colorado Region: Water Operations. "Flood Control Operation." *Colorado River Interim Surplus Criteria, Final Environmental Impact Statement* (2000), 1:20–21.
66. Operating Lake Mead at 1007 feet above sea level to reduce evaporative losses would leave on average 21 MAF of flood control storage, nearly four times the present 5.35 MAF system-wide requirement.
—Ibid, 1:17.
67. Geib, Phil R. *Glen Canyon Revisited: University of Utah Anthropological Paper 119*. (Salt Lake City: University of Utah Press, 1996), 1.
68. Grand Canyon National Park and Northern Arizona University. *1999 Summary Report: Archeological Site Monitoring and Management along the Colorado River corridor in Grand Canyon National Park* (Executive Summary).
69. Luckert, Karl W. *Navajo Mountain and Rainbow Bridge Religion* (Flagstaff: Museum of Northern Arizona, 1977).
70. *Colorado River Storage Project Act.* 43 U.S.C. §§ 620-620o, April 11, 1956, as amended 1962, 1964, 1968 and 1980.

Colorado River Basin Project Act. 43 U.S.C. §§ 1501-1556, September 30, 1968, as amended 1974, 1978, 1980, 1982, 1984 and 1992.

71. *Reclamation Projects Authorization and Adjustment Act of 1992*. Title XVIII–Grand Canyon Protection, Section 1803-1806.
72. See: Note 49 (National Park Service Organic Act).
73. *Endangered Species Act*. 7 U.S.C. 136; 16 U.S.C. 460 et seq. 1973.
74. *Colorado River Compact*. Signed at Santa Fe, New Mexico. Ratified by act of Congress December 21, 1928. 45 Stat. 1057. Congressional Record, 70th Cong. 2d Sess. At 324-325.
75. Newcom, Joshua S. "Deciding About the Colorado River Delta: Rejuvenated Wetlands Raise New Issues About Where Flood Flow Should Go." *River Report, Spring 1999* (Sacramento: Water Education Foundation).
76. Reese, April. "Current Colorado River Basin Dry Spell Could Be Worst in 500 Years." *Land Letter*. Washington D.C. (June 24, 2004).

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From the Rocky Mountains through seven states and Mexico, the Colorado River is the artery of the desert southwest. A healthy river system is essential to the ecological integrity of the Colorado Plateau just as a well managed water resource is essential to the economic health and prosperity of the river basin states that depend on Colorado River water. However, mismanagement, greed and complacency are robbing the Colorado of its ability to achieve its ecological and economic potential.

Living Rivers/Colorado Riverkeeper empowers a movement to instill a new ethic of achieving ecological restoration that is balanced with also meeting human needs. We work to:

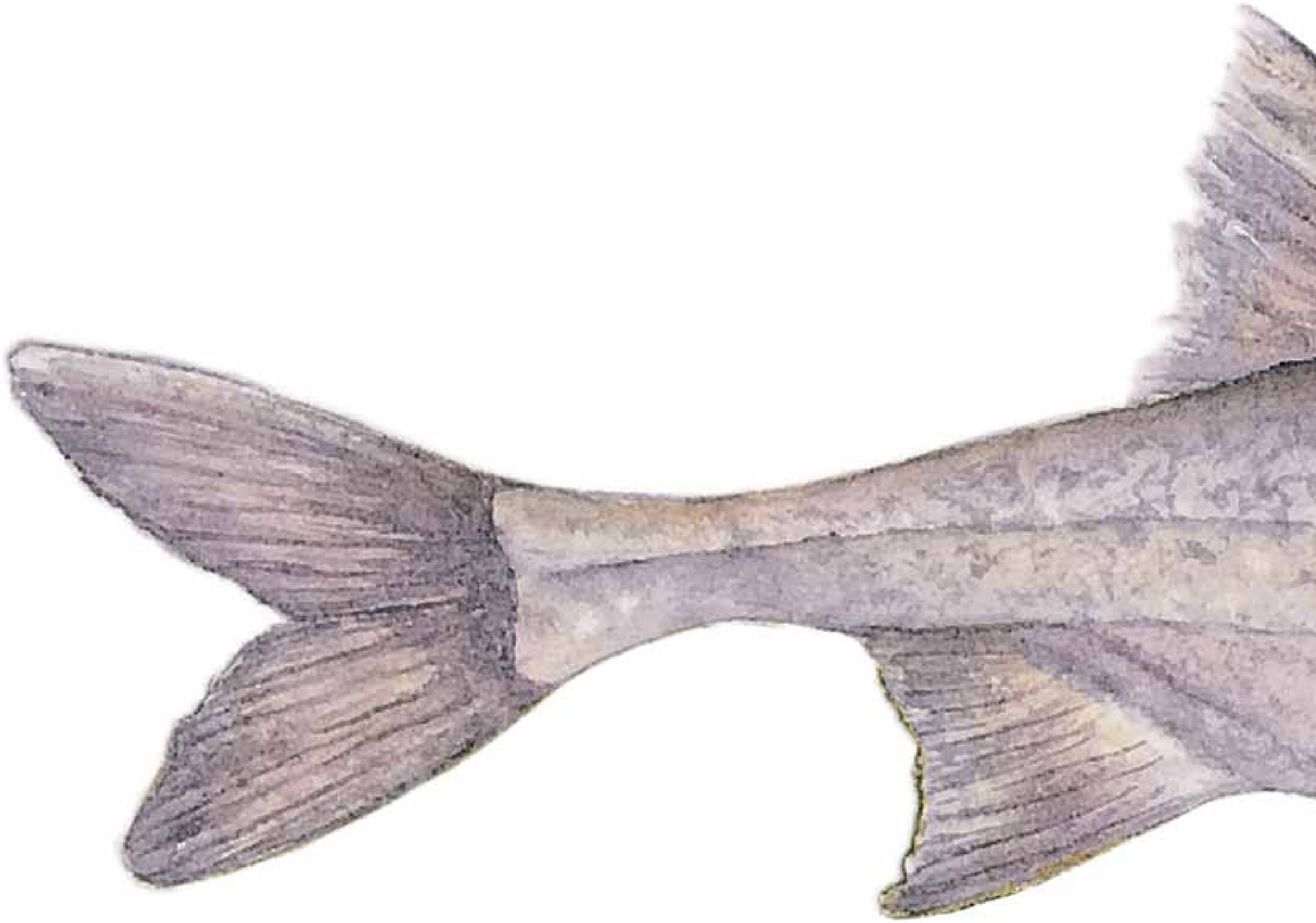
• Restore aquatic and riparian ecosystems along the river and its delta.

• Repeal antiquated laws which are resulting in chronic ecological damage and the wasting of water resources.

• Reduce unnecessary water use and its impacts on river ecology and the economy.

• Recommend sustainable solutions to Colorado River water resource management.

• Recruit constituents to aid in achieving a healthy and sustainable Colorado River system.



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Defenders of Wildlife · Environmental Defense · National Wildlife Federation
Pacific Institute · Sierra Club · Sonoran Institute

July 18, 2005

Honorable Gale A. Norton, Secretary
Department of the Interior
1849 C Street, NW
Washington DC 20240

Re: Development of Lower Basin Shortage Guidelines

Dear Secretary Norton:

Last year, you asked the Colorado River basin states to recommend approaches regarding proactive drought management actions in the basin. Last month, the Bureau of Reclamation published a notice to solicit comments and hold public meetings on the development of Lower Basin shortage guidelines (70 Fed.Reg. 34794). Defenders of Wildlife, Environmental Defense, National Wildlife Federation, Pacific Institute, Sierra Club, and Sonoran Institute respectfully submit the attached "Conservation Before Shortage" policy proposal in response to these requests. 1

We believe that it is preferable for water users to voluntarily engage in predictable, small-scale reductions in use – and receive compensation for those reductions – rather than face large-scale, involuntary, and uncompensated disruptions in water deliveries that could cut into municipal and agricultural water supplies and create unmitigated economic impacts. Our "Conservation Before Shortage" proposal would dramatically reduce the risk of large-scale, involuntary shortages to Lower Basin users and to Mexico, by implementing a series of increasing conservation targets linked to the declining elevation of Lake Mead. The required amount of water would be conserved by offering to pay Colorado River water users, located anywhere in the Lower Colorado River basin or in Mexico, to voluntarily forbear water use.

Funds to pay for forbearance would come from federal appropriations as well as a surcharge applied to all Lower Basin water users and consumers of power generated at the Hoover Dam. One of the more significant corollary benefits of the conservation program described in the "Conservation Before Shortage" proposal, beyond the primary benefit of protecting water users from involuntary and uncompensated shortages, would be the preservation of power production at Hoover Dam at higher levels and for longer durations than would otherwise occur.

CONSERVATION BEFORE SHORTAGE BENEFITS

- *Reduced need for new water projects.* The introduction of flexibility into Colorado River management will allow those who are willing and able to reduce their water use to be compensated for doing so, and will avoid the need to impose reductions in water use on those who cannot. By eliminating the potential for water shortages where they cannot easily be accommodated, this policy will limit the need for costly new water projects to protect water users that cannot tolerate interruptions in water supplies.
- *Protection of the environment.* Fish, wildlife, and natural areas on the Colorado River do not, for the most part, have their own water rights. As such, they are "last in line" for water, and are the most vulnerable of all water users to drought. "Conservation Before Shortage" reduces overall water consumption in dry years, decreasing the risk of shortages that could disproportionately impact environmental uses in the future. Also, by increasing protection against shortage for water users that have inflexible demands, it will allow some water to

remain in the river for the wildlife that needs it to survive while still meeting critical human needs.

- *Improved power production.* Consistent maintenance of reservoir storage and power head above baseline conditions in average to low flow conditions, resulting in increased power production and improved power revenues, as well as elimination of the risk that elevations at Lake Mead will drop below minimum power head, improving the reliability of power production.
- *Increased certainty for water users.* Significant reduction in the likelihood of involuntary and uncompensated shortages in the Lower Basin at levels above 500,000 acre-feet (the approximate level at which a shortage exceeds the ability of the Arizona Water Bank to readily buffer the shortage).
- *Reduces risk of involuntary shortage*. In the past, the established priority system on the Colorado River has prompted those most at risk of shortage to limit their exposure by promoting actions that could have devastated invaluable ecological resources. Minimizing this risk will benefit all Colorado River stakeholders.

We look forward to working with Reclamation on the development of shortage guidelines. Please do not hesitate to contact any of us if you would like any additional information on the Conservation Before Shortage proposal.

Sincerely,

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Conservation Before Shortage

Proposed Shortage Criteria for
Colorado River Operations

I. Background/Context

The effects of a multi-year drought have had a tremendous impact on storage in the Colorado River basin. Although above-average precipitation in the Lower Basin has led to small recoveries in system storage over the winter of 2004-2005, total system storage on the Colorado River has decreased by more than 40% over the past several years. As a result, there is a real possibility that the Secretary of the Interior will declare an actual shortage on the lower Colorado River in the near future. A shortage declaration would reduce deliveries to the Central Arizona Project (CAP) and to southern Nevada (which are among the first in line for cuts in the event of a shortage).

The surface elevation of Lake Mead dropped more than 80 feet from the end of 2000 through the end of 2004; Lake Powell dropped by more than 115 feet in this period. The Bureau of Reclamation's (Reclamation's) Riverware model of the Colorado, based on historic flow records, projects that reservoir levels at Lake Powell could head quickly towards the minimum power pool if the drought continues, and reservoir levels at Lake Mead could fall below the elevation of southern Nevada's upper intakes or remain in a long-term decline that will be difficult to reverse until Powell begins to re-fill. In addition, the model predicts that even if precipitation levels returned to average today, it could take 10-20 years for the Colorado River reservoir system to recover fully (during which time continued development of water supplies in the Upper Basin will further shrink available supplies). As a result, it is time to begin a long-delayed discussion about the method for defining, mitigating, and sharing shortages on the Colorado River.

Although the Secretary of the Department of the Interior (Secretary) has the authority to declare a shortage on the Colorado River, thereby reducing deliveries to some Lower Colorado River contractors, to date no criteria exist for determining when such a shortage will be declared. In June 2005, the Department of the Interior (DOI) noticed its intent to begin a public scoping process for the development of "Lower Basin Shortage Guidelines," (70 Fed.Reg. 34794). In 2004, DOI initiated a series of technical meetings with the Colorado Basin states to discuss drought issues, and the seven Basin states met frequently among themselves throughout the winter of 2004-2005 to discuss potential shortage criteria. Non-governmental organizations (NGOs) were not invited to participate in these discussions; however, several NGOs with interest and expertise in Colorado River issues began meeting over the winter to develop an alternative shortage proposal. These organizations met with Reclamation staff to review the results of technical modeling runs developed in support of the states' discussions, and Reclamation has provided additional modeling data to these interested NGOs in response to their inquiries and to evaluate potential shortage criteria.

These meetings led to the development of this document, which proposes an approach to the management of shortages in the Lower Colorado through the implementation of a tiered conservation program that is tied to the surface elevation of Lake Mead.

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II. Rationale for this Proposal

The basic rationale behind this "Conservation Before Shortage" proposal is that shortage criteria should attempt to maximize the reliability and predictability of water deliveries on the Lower Colorado by introducing increased flexibility into the management of river resources when shortage conditions are imminent.

Principles:

- It is desirable to protect the elevation of Lake Mead at 1050 feet (the current minimum power pool) to the extent feasible without implementing shortages that would involuntarily curtail deliveries to Lower Basin users.
- It is desirable to protect the elevation of Lake Mead at no less than 1000 feet under any condition in order to protect Southern Nevada Water Authority's lower intake structures, as well as the new minimum power pool if proposed low-pressure turbines are installed at Hoover Dam.
- It is desirable to avoid shortages in the Lower Basin above 500,000 acre-feet whenever possible (the approximate level at which shortages would cut into CAP's deliveries beyond those currently utilized for water banking).
- It is preferable for Lower Basin water users to voluntarily engage in predictable, small-scale reductions in use – and receive compensation for those reductions – rather than face large-scale, involuntary, and uncompensated disruptions in water deliveries that could cut into municipal and agricultural water supplies and create unmitigated economic impacts.
- Minimizing large, forced disruptions to normal deliveries as a result of shortage declarations will minimize the threat of unmitigated environmental impacts in the Lower Colorado River and Delta as a result of significantly decreased deliveries to low-priority users and corresponding return flows that support environmental values.
- Market-based programs, with low transaction costs and appropriate mitigation of third-party impacts, can offer a reasonable mechanism for minimizing the risk and impacts of shortage.[1]
- Users of Colorado River water in Mexico may wish to participate in short-term conservation agreements, to reduce the probability of larger, uncompensated future reductions due to a declaration of shortage under the 1944 Treaty with Mexico.
- Water can be obtained from agricultural users in the United States, and could be obtained in Mexico with an appropriate agreement,[2] through the use of voluntary, market-based forbearance programs. Economic studies of Lower Basin agricultural use, as well as recent leases of water from farmers in this area, suggest that there is a large volume of water in the basin that could be obtained for $20 - 100 per acre-foot (see Figure 9).

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[1] Some 4.5 million acre-feet of Colorado River water are used to irrigate crops in the Lower Basin states, and more than 1 million acre-feet are used to irrigate crops in Mexico. Conservation of between 200,000 and 600,000 acre-feet through the use of part-year fallowing programs, dry year options, or other similar arrangements would constitute only 4-11% of total Lower Basin agricultural use in the United States and Mexico. (However, as even small-scale reductions in agricultural water use may have third-party impacts, some portion of funds accrued for the purchase of water should be set aside to support community economic development in affected areas.) Conversely, without these small-scale reductions, water users would likely be faced with the need to curtail large amounts of water quite abruptly, with significant economic consequences. (Shortages of nearly 2 million acre-feet in a single year are predicted by Reclamation's model when the 1000 feet elevation is protected at Lake Mead without conservation measures).

[2] Such an agreement would likely require a new Minute to the 1944 Treaty with Mexico. Fallowing agreements in Mexico would have to be administered by the appropriate authorities.

III. Conservation Before Shortage Policy

The "Conservation Before Shortage" policy essentially consists of two sets of criteria tied to projected elevations at Lake Mead on January 1 of a given year, according to the Bureau of Reclamation's August 24-month study. These criteria consist of three "conservation triggers," which impose progressively increasing conservation goals as lake levels drop from 1100 feet to 1050 feet, and a "shortage trigger," which imposes involuntary shortages in the Lower Basin as are necessary to accomplish absolute protection of Lake Mead at a minimum elevation of 1000 feet.

(A) Normal Conditions

In years when the 24-month study projects the elevation of Lake Mead on January 1 will be at or above 1100 feet, the Secretary of the Interior (Secretary) shall determine a Normal or Surplus (as defined by the Interim Surplus Guidelines) year.

(B) Conservation Triggers

First Conservation Trigger: Below 1100 Feet at Lake Mead

In years when the 24-month study projects the elevation of Lake Mead on January 1 will be at or above 1075 feet but below 1100 feet, the Secretary will seek to conserve 200,000 acre-feet of water. On behalf of the Secretary, Reclamation will preferentially seek to achieve this 200,000 acre-feet of savings by means of voluntary conservation agreements (including forbearance agreements) with Lower Basin delivery-contract holders. Additionally, Reclamation will, to the extent permitted by law and through the appropriate authorities, seek forbearance or other such water conservation agreements with Colorado River users in Mexico. In the case of such agreements, U.S. deliveries of Colorado River water to Mexico at the Northerly International Boundary will be reduced by the total volume indicated by these binational agreements.

Second Conservation Trigger: Below 1075 Feet at Lake Mead

In years when the 24-month study projects that the elevation of Lake Mead on January 1 will be at or above 1050 feet but below 1075 feet, the Secretary will seek to conserve 400,000 acre-feet of water. Reclamation will preferentially seek to achieve this 400,000 acre-feet of savings by means of voluntary conservation agreements (including forbearance agreements) with Lower Basin delivery-contract holders. Additionally, Reclamation will, to the extent permitted by law and through the appropriate authorities, seek forbearance or other such water conservation agreements with Colorado River users in Mexico. In the case of such agreements, U.S. deliveries of Colorado River water to Mexico at the Northerly International Boundary will be reduced by the total volume indicated by these binational agreements.

Third Conservation Trigger: Below 1050 Feet at Lake Mead

In years when the 24-month study projects that the elevation of Lake Mead on January 1 will be below 1050 feet (minimum power pool absent the installation of low-pressure turbines), the Secretary will seek to conserve 600,000 acre-feet of water. Reclamation will preferentially seek to achieve this 600,000 acre-feet of savings by means of voluntary conservation agreements (including forbearance agreements) with Lower Basin delivery-contract holders. Additionally, Reclamation will, to the extent permitted by law and through the appropriate authorities, seek

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forbearance or other such water conservation agreements with Colorado River users in Mexico. In the case of such agreements, U.S. deliveries of Colorado River water to Mexico at the Northerly International Boundary will be reduced by the total volume indicated by these binational agreements.

(C) Shortage Trigger

Absolute Protection of Lake Mead Elevation 1000 Feet

The Secretary shall not permit the elevation of Lake Mead to drop below elevation 1000 feet (minimum low-pressure power pool and Southern Nevada Water Authority intakes) at any time. Shortages to Colorado River contractors shall be implemented in the Lower Basin and in Mexico[3] to the extent necessary to prevent such declines.

(D) Funding Mechanisms

In recognition of the federal government's continuing national obligation to replace the MODE bypass flow to Mexico, 43 U.S.C. § 1571(c), the federal government will assume responsibility for the cost of all conservation agreements up to the volume of the bypass flow that the Secretary has not otherwise replaced in the year that a conservation trigger becomes effective. Given the national interest in minimizing both environmental impacts and economic disruptions resulting from the involuntary curtailment of deliveries to Colorado River users, the federal government would also assume responsibility for half of the cost of any additional agreements required to generate conserved water for the "Conservation Before Shortage" policy, pursuant to the Secretary's authority under the Reclamation States Emergency Drought Relief Act of 1991 (Drought Relief Act),[4] conservation authorities in the Farm Bill, or other appropriate authority that may be granted by Congress.

To the extent that conservation of water is required beyond that to be funded by the federal government in the manner described above, conservation activities would be funded through one or both of the following:

Power Pool Protection Fund

The priority of water used for power generation is considered to be tertiary to that of irrigation and domestic use under the Law of the River. As a result, Hoover and Glen Canyon Dams are operated to maintain deliveries to water users regardless of the impact of declining reservoir levels on power production. However, one of the more significant corollary benefits of the conservation program described in this proposal, beyond the primary benefit of protecting water users from involuntary and uncompensated shortages, would be the preservation of power production at Hoover Dam at higher levels and for longer durations by reducing deliveries for irrigation, domestic use, and underground storage in a manner that would not otherwise occur under current practices.

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[3] In the event that a shortage is declared and is also considered to be an extraordinary drought under the 1944 Treaty, deliveries to Mexico will be reduced in the same proportion as consumptive uses in the United States are reduced.
[4] The Reclamation States Emergency Drought Relief Act of 1991, 43 U.S.C. §§ 2201 *et seq.*, provides the Secretary of Interior the authority to purchase water "from willing sellers, including, but not limited to, water made available by Federal Reclamation project contractors through conservation or other means with respect to which the seller has reduced the consumption of water." 43 U.S.C. § 2211(c).

Given the significant loss in generating capacity that has already occurred as a result of declines in power pool elevations,[5] and the even more significant impacts that would be associated with a total loss of generating capacity, the implementation of "Conservation Before Shortage" would clearly benefit power purchasers and consumers. As such, it would seem reasonable to derive a percentage of the funding for the proposed voluntary conservation program from a modest, conditional surcharge on power rates under existing or renewed contracts for hydropower produced at Hoover Dam as a means to mitigate against the loss of power head and stave off the complete loss of power production at Hoover Dam.[6] This surcharge could be imposed in years when Reclamation's August 24-month study projects that the storage in Lake Mead falls below fifty percent of its active capacity. The revenues generated by this surcharge could be collected in a "power pool protection fund," to be maintained by Reclamation for expenditure when and if lake elevations reach a conservation "trigger."

Temporary Cost Recovery/Delivery Surcharges

Pursuant to the Drought Relief Act, the Secretary of Interior is authorized to engage in water purchases from willing sellers and to seek cost recovery for water delivered from the users of that water under temporary contracts. 43 U.S.C. §2211(c), §2212(a),(c). Reclamation could utilize this authority to purchase water through temporary, part-year fallowing arrangements, dry-year options, or similar mechanisms, and would seek cost recovery from Colorado River users. In recognition of the Basin-wide interest in alleviating the impacts of drought and reducing uncertainty on the Lower Colorado, and in the interests of encouraging extraordinary conservation to minimize the likelihood of significant delivery interruptions, the cost of some portion of conservation agreements, including those with Colorado River users in Mexico, could be funded through a conservation surcharge imposed on a per-acre-foot basis on all Lower Basin contractors.

Anticipated Cost of Conservation

Current short-term leasing agreements between farmers and irrigation districts or municipal water agencies, as well as recent research on the net returns per acre-foot of irrigation water, suggest that "Conservation Before Shortage" water could be obtained for $20 - 100 per acre-foot. To ensure that such water remains available in times of increased scarcity (when market forces might otherwise increase the cost), the Secretary should be granted the authority to enter into "Conservation Before Shortage option agreements," similar to existing dry-year leasing agreements/interruptible supply agreements that have been enacted within the basin states.

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[5] Largely as a result of declining reservoir elevations, power production at Hoover and Glen Canyon has declined steadily since the onset of drought conditions in the Colorado River Basin. Annual power production at Hoover fell from 5,697 gigawatt-hours (GWh) in 1998 to 4,094 GWh in 2003, according to Western Area Power Administration (WAPA) Annual Reports, 1998 – 2003. A portion of hydropower revenues currently supports the two Upper Basin endangered fish recovery programs, the Glen Canyon Adaptive Management Program, and the Colorado River Salinity Control Program; alternative sources of revenue should be identified and implemented to fully fund these recovery programs. The Department of the Interior should also work proactively with WAPA to identify alternative sources of power for those Indian tribes that have experienced power shortages, or drastic increases in power costs, due to the declining production associated with falling reservoir levels.

[6] The rates for power produced at Hoover Dam have increased as reservoir levels and power production have declined, but may still remain well below open market rates. Although annual revenues tend to vary from year to year, revenues from Hoover Dam power production have generally been in the range of $50 million annually.

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IV. Analysis: Benefits of Conservation Before Shortage Policy

To date, actual shortage criteria for the Colorado River have not been defined. For the purposes of comparison, a ‘baseline’ was defined as the current operating conditions for the Colorado River, with the addition of a policy requiring the absolute protection of Lake Mead at 1000 feet (that is, Hoover Dam would not release any water to cause the elevation of Lake Mead to drop below 1000 feet). The baseline policy does *not* provide for the implementation of conservation measures. These ‘baseline’ conditions, reflecting current operating conditions, are depicted in the following figures.

Analysis of the “Conservation Before Shortage” policy suggests that this policy could produce significant benefits for Basin water users by:

- Consistently maintaining reservoir storage and power head above baseline conditions in average to low flow conditions, resulting in increased power production and improved power revenues;

- Significantly reducing the likelihood of involuntary, uncompensated shortages in the Lower Basin and corresponding, unmitigated economic impacts;

- Significantly reducing the likelihood of involuntary and uncompensated shortages in the Lower Basin at levels above 500,000 acre-feet (the approximate level at which a shortage imposed by the Secretary would cut into CAP deliveries, by exceeding the ability of the Arizona Water Bank to readily buffer the shortage); and

- Eliminating the risk that elevations at Lake Mead will drop below minimum power head, improving the reliability of power production and associated revenues.

The analyses below show the impacts of the “Conservation Before Shortage” (CBS) policy on reservoir operations based on historic flows in the Colorado River Basin.

Modeling Assumptions

The proposed “Conservation Before Shortage” policy was modeled using Reclamation’s Riverware model, which is based on historical records of flows in the Colorado River Basin over approximately the past century. Conservation triggers, as described in Section III, were implemented at 1100 feet, 1075 feet and 1050 feet, with the assumption that required measures to reduce Lower Basin consumptive use by 200,000, 400,000, and 600,000 acre-feet, respectively, would be implemented in years when the January 1 elevation at Lake Mead is below the triggers. An absolute protection trigger was implemented at Lake Mead elevation 1000 feet, with releases from Lake Mead to meet delivery obligations to Lower Basin users reduced as necessary to maintain that level. To avoid even modestly under-predicting the elevations of Mead and Powell pools, particularly in the near term, this modeling has assumed that the schedule of Upper Basin depletions will effectively begin with the last reported actual level for CY 2000, will increase at a slower rate than projected by the Upper Colorado River Basin Commission through CY 2009, and will increase at the rate projected by the Commission thereafter.[7]

For purposes of the model, the minimum objective release out of Lake Powell was assumed to be 8.23 maf per year (reflecting current operating conditions).[8] Alternative scenarios for conjunctive management were not modeled, and the protection of a minimum power pool at Lake Powell was not incorporated into this proposal; either or both of these assumptions would affect the elevation of Lake Powell. Model runs used end-of-year 2004 elevations at Lake Mead and Lake Powell to establish initial conditions for 2005, and were run through year 2025.

Protection of Lake Mead

Figures 1 -3 show the potential value of implementing the CBS policy, under a range of average to extremely low flow conditions. **These and following figures show that the CBS policy would greatly benefit the elevation of Lake Mead.**

As shown in Figure 1 below, under average conditions, the CBS policy would maintain reservoir elevations at Mead approximately 30 feet above the baseline policy. As shown by Figures 2 and 3, the CBS policy would significantly reduce the rate of decline in the lower 25th and in the very low 10th percentile reservoir elevations for Mead and maintain even these lower reservoir elevations above the 1000 foot protection level. Model runs showed essentially no impact of the CBS on the higher 90th percentile Mead elevations, so no figure is provided.

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[7] *See* "Estimates of Future Depletions in the Upper Division States," Upper Colorado River Commission Memorandum, December 23, 1999. This schedule predicts a 440,000 acre-foot increase in Upper Basin depletions between 2000 and 2010 and a 542,000 acre-foot increase over actual CY2000 depletions, as reported in Reclamation's Consumptive Uses and Losses 1996-2000 report (see Tables UC-1 & UC-6). Actual increases in Upper Basin depletions water may not keep pace with this schedule, because water that would otherwise have been utilized has been and may continue to be physically unavailable for depletion in the Upper Basin due to drought conditions, and in other cases, projects that were proposed to have been constructed during this period may not yet have been or will not be completed through CY 2009. A slower rate of increase from 2000 to 2009 was modeled by subtracting four increments of 100,000 acre-feet from the Commission's schedule from CY 2005 to 2009. This and all other Riverware modeling exercises should be revised to reflect actual increases in Upper Basin depletions as soon as more current information becomes available.

[8] This assumption is not intended to endorse or reject the Secretary's current use of 8.23 maf as the minimum release objective for Powell, the protection of a minimum power pool at Powell, or proposals for the conjunctive management of the combined storage of Mead and Powell. Alternative release scenarios should be incorporated into the modeling for this proposal as they are developed. As a general matter, none of the assumptions used in this proposal should be construed as an interpretation of the 1922 Colorado River Compact, the 1944 Treaty with Mexico, or any other aspect of the Law of the River.

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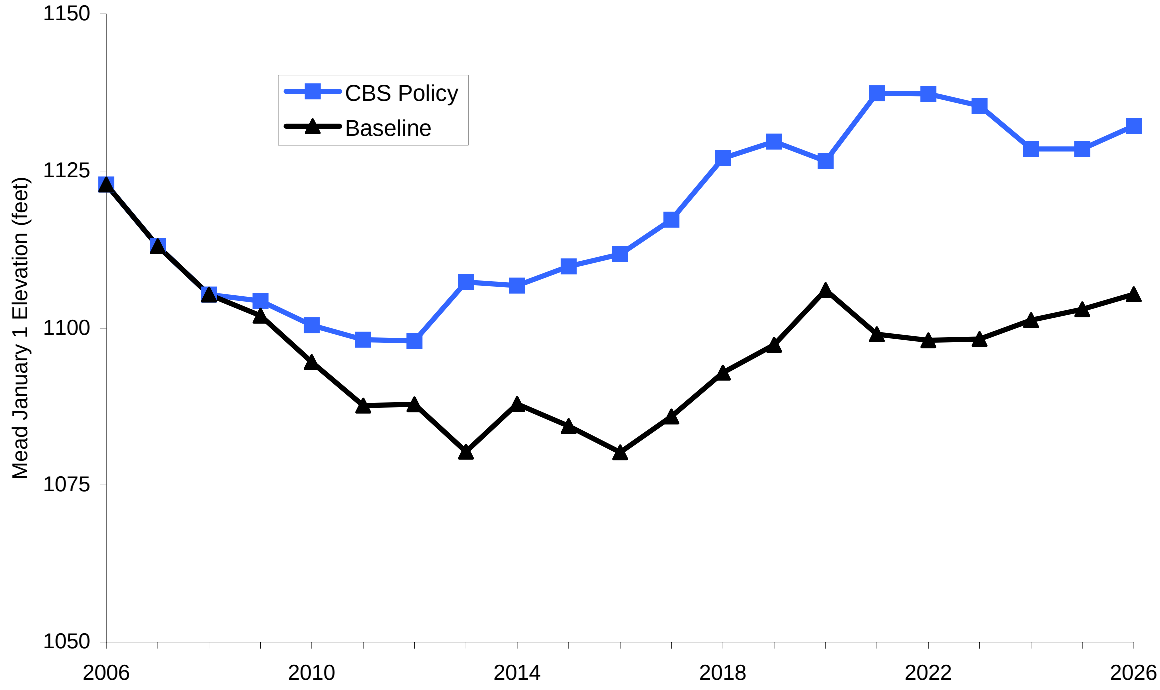

Figure 1. Impact of CBS policy on elevations at Lake Mead, at 50th percentile elevation.

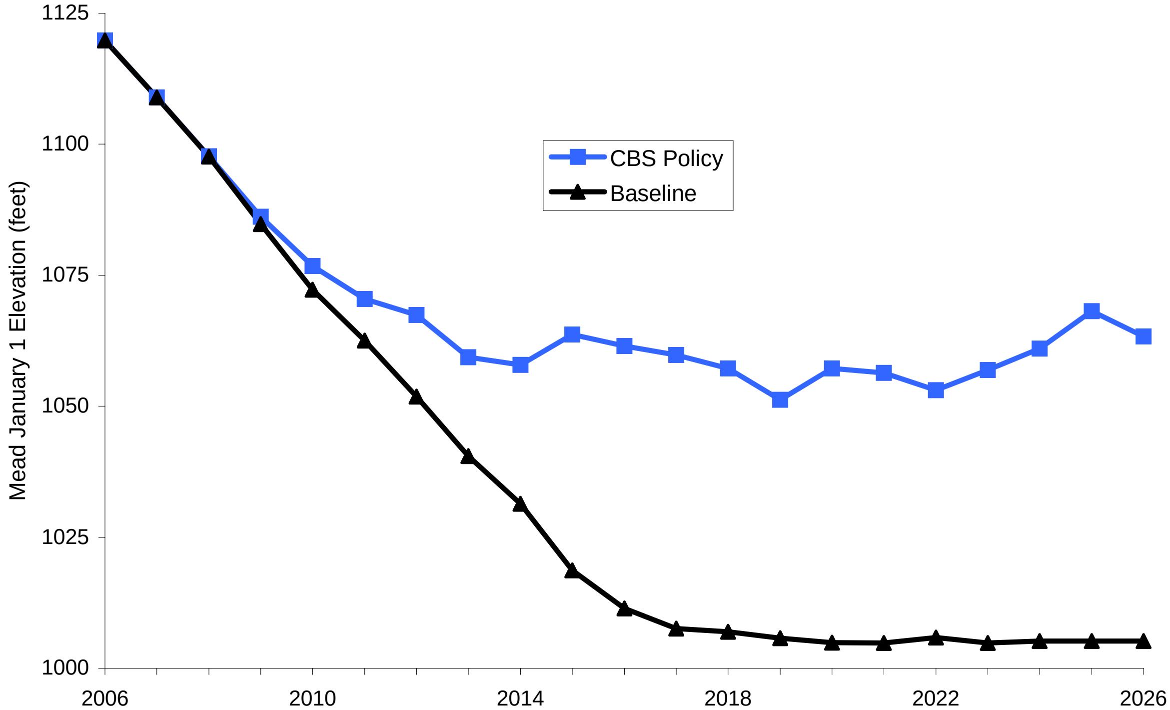

Figure 2. Impact of CBS policy on elevations at Lake Mead, at 25th percentile elevation.

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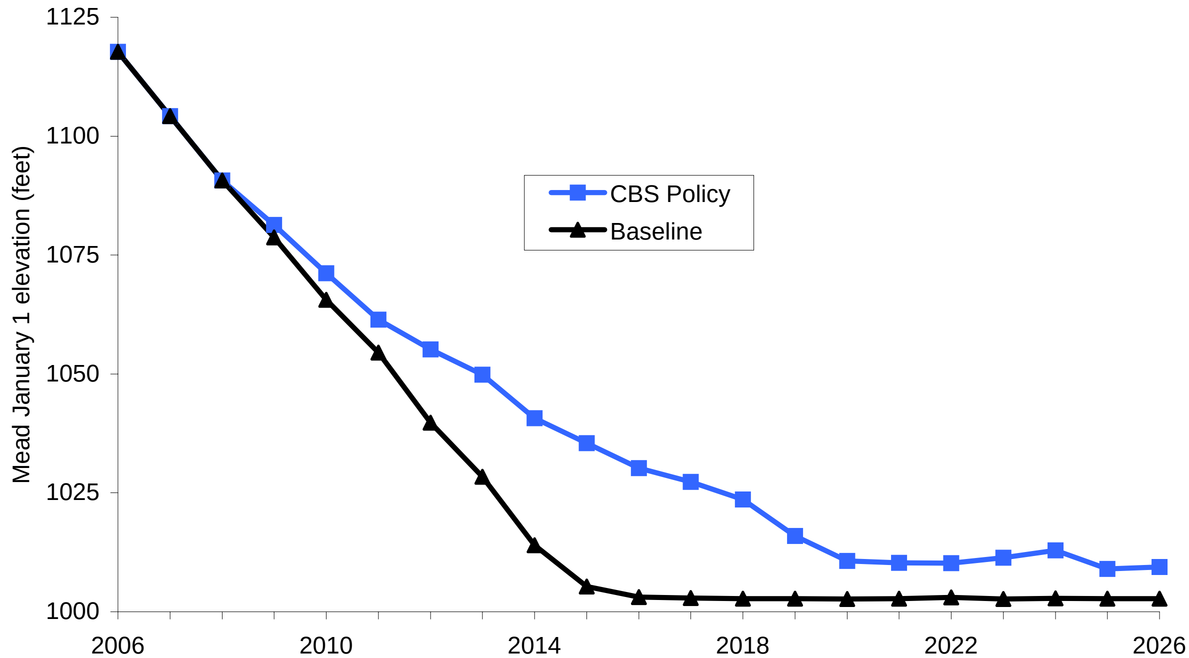

Figure 3. Impact of CBS policy on Lake Mead elevation, at 10th percentile elevation.

Probability of Shortages

As noted above, a primary goal of the CBS policy is to significantly reduce the probability of an involuntary, uncompensated shortage in excess of 500,000 acre-feet (the approximate level at which CAP deliveries would be reduced beyond that currently utilized for water banking). **As shown in Figure 4, below, the probability of shortages exceeding 500,000 acre-feet is reduced to 5% or less through the entire modeled period under the CBS policy. By contrast, the probability of shortage under the baseline policy rapidly approaches 30% during this same period. Furthermore, as shown in Figure 5, below, the CBS policy reduces the probability of any involuntary shortage by approximately 20% over the next 20 years.**

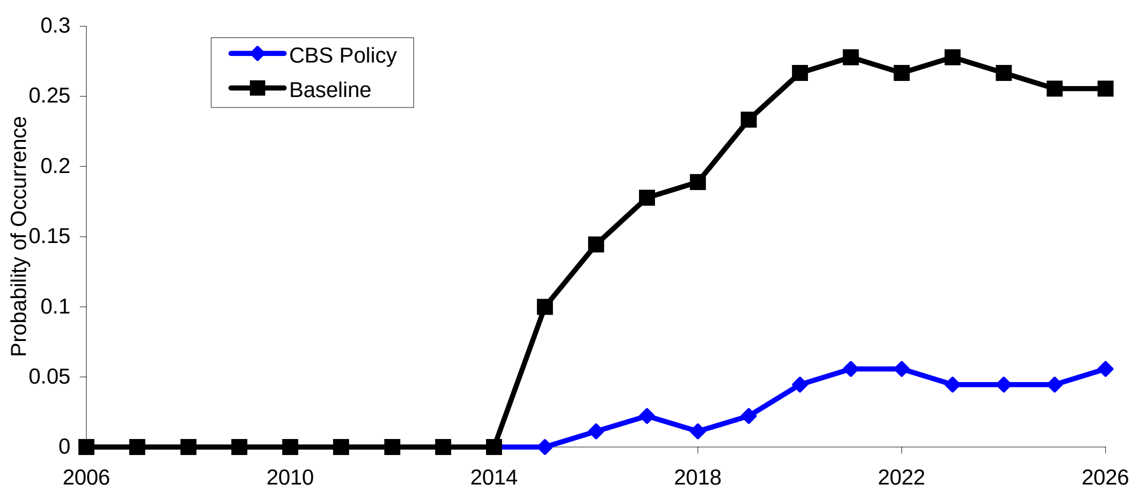

Figure 4. Impact of CBS policy on probability of involuntary Lower Basin shortage greater than 500,000 acre-feet.

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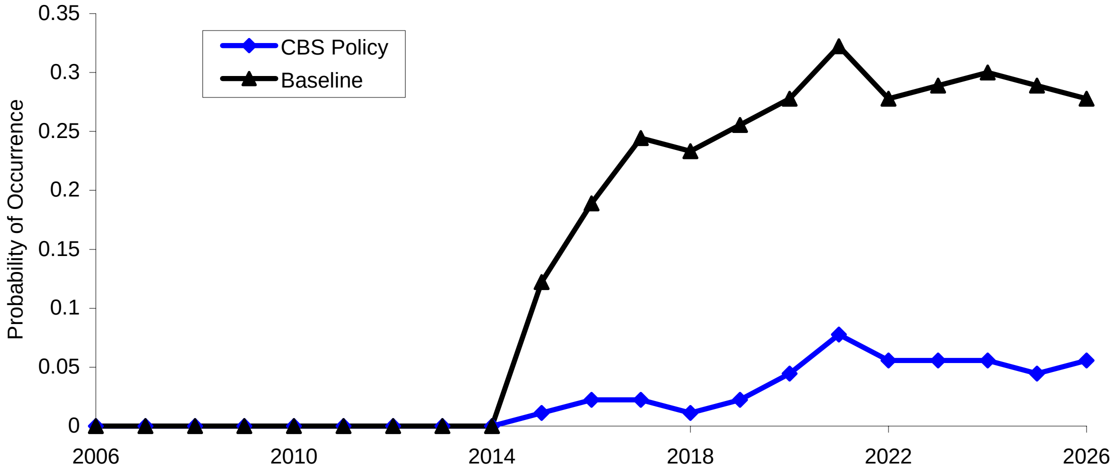

Figure 5. Impact of CBS policy on probability of any involuntary shortage in the Lower Basin.

Probability of Reaching Conservation Triggers

Figures 6 - 8, below, show the relative probability of reaching or exceeding any of the proposed conservation triggers at 1100 feet, 1075 feet and 1050 feet. As one might expect, the probability of reaching the first two triggers is highest in the earlier years of the modeled period, while the probability of reaching the third trigger is higher towards the end of the modeled period. However, the probability of reaching and continuing to remain below a given trigger for an extended period of time appears to be low because of the conservation measures tied to the triggers. For obvious reasons, trigger levels are most likely to be reached under low or very low flow conditions, and are rarely (if ever) reached under high flow conditions.

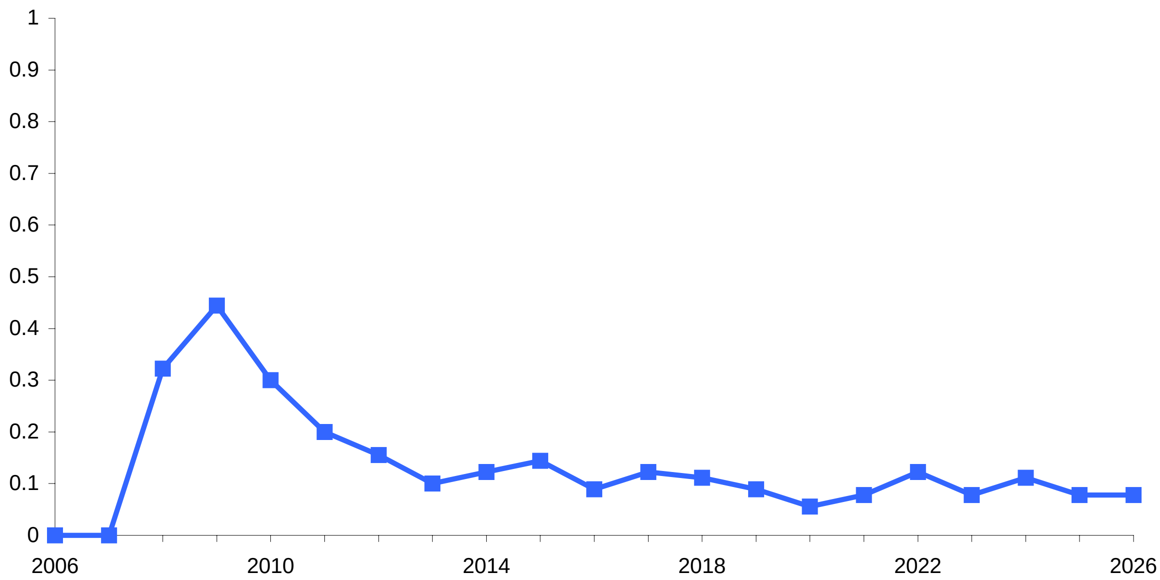

Figure 6. Probability of Lake Mead January 1 elevation occurring in a bounded range of 1100 feet to 1075 feet, with CBS policy in place.

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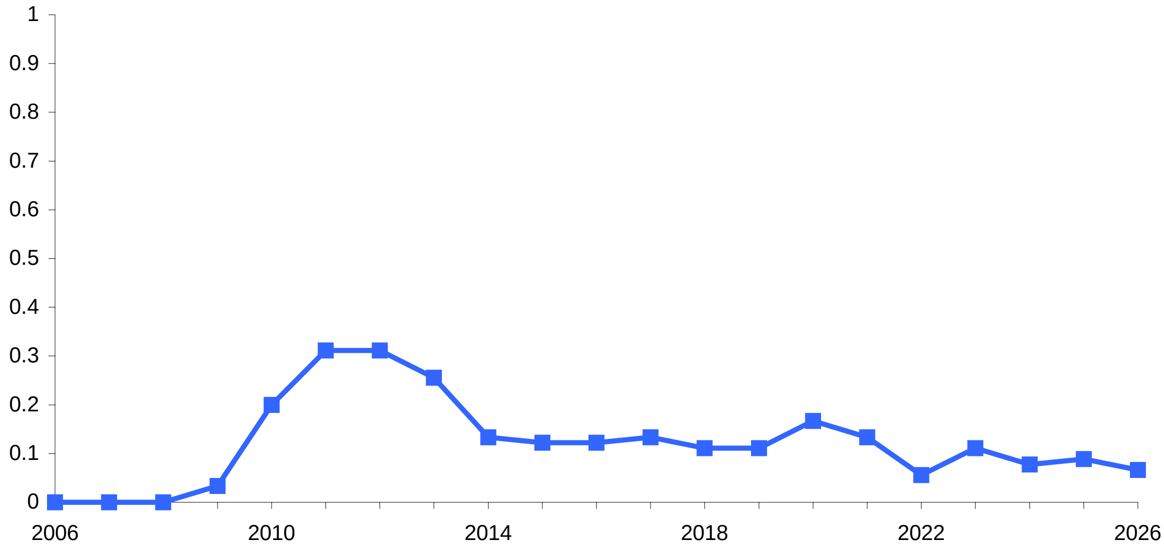

Figure 7. Probability of Lake Mead January 1 elevation occurring in a bounded range of 1075 feet to 1050 feet, with CBS policy in place.

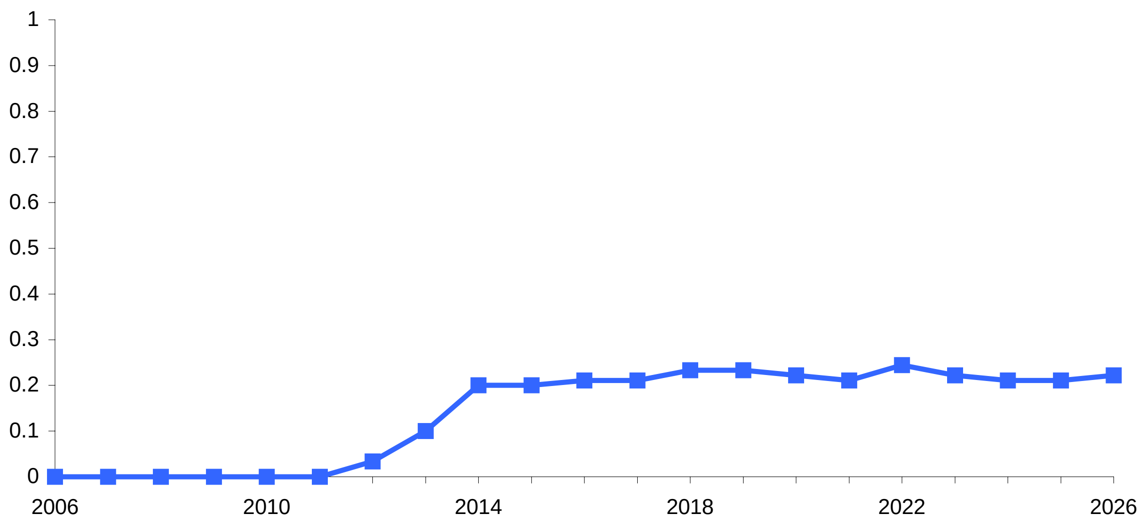

Figure 8. Probability of Lake Mead January 1 elevation occurring below 1050 feet, with CBS policy in place.

Cost of Implementing Conservation Triggers

The cost of implementing conservation triggers is directly related to the cost of obtaining water using the proposed voluntary, market-based conservation mechanisms. Recent purchases of water from farmers in the Lower Basin, as well as analysis of agricultural production in this area, suggest that there is a substantial volume of water used for irrigation which could potentially be obtained on a temporary basis for $20 - 100 per acre-foot. For example, in 2004, the Imperial Irrigation District acquired water from its farmers for less than $60 per acre-foot.

As shown in Figure 9, a recent economic study by Environmental Defense into the profits returned by field crops suggests that slightly more than 2.3 million acre-feet of agricultural water

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is being used by Lower Basin farmers in California and Arizona to produce profits of less than $100 per acre-foot; more than one million acre-feet of agricultural water is being used to produce profits of less than $20 per acre-foot. (Figures are based on the average volume of water applied to produce a crop unit and market rates for each crop, less costs of production.)

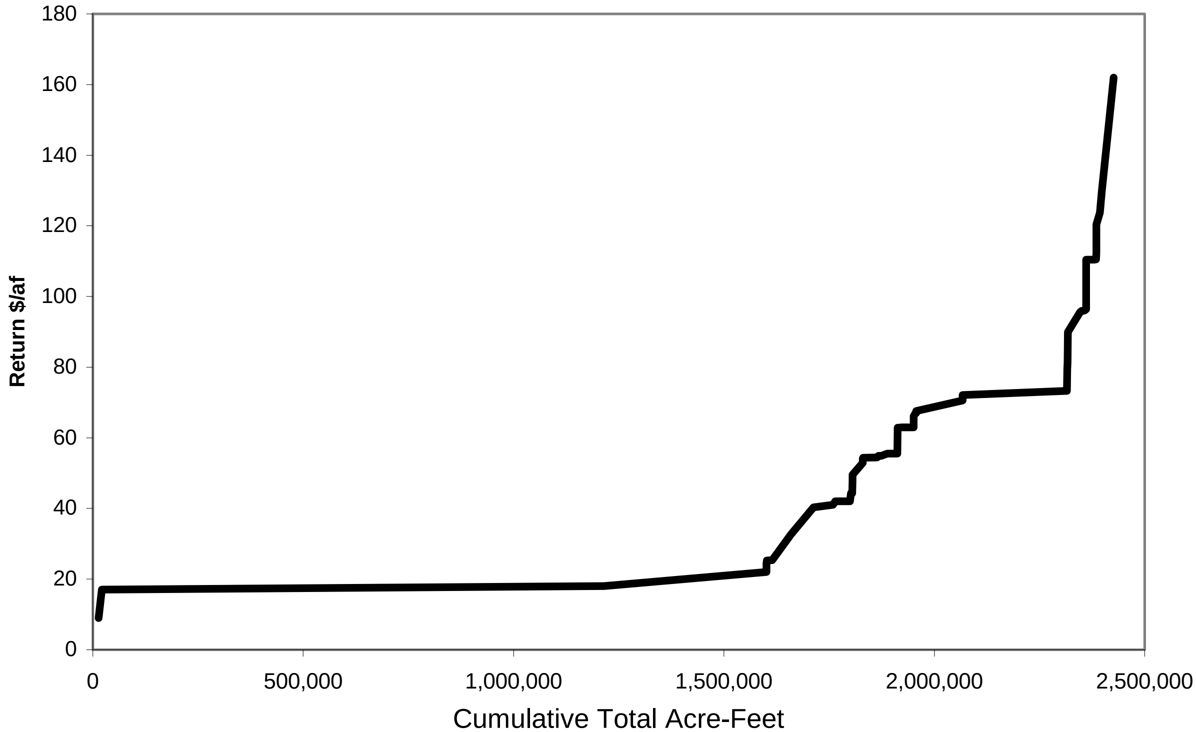

Figure 9. Profits per acre-foot returned on Colorado River water used in the production of selected crops in the Lower Colorado River Basin. [9]

While these figures do not necessarily reflect the amount at which any given water user would be willing to take part in a part-year fallowing program or agree to a dry-year option, they do suggest that if an open, market-based approach is used to identify potential participants, a number of water users in the Lower Basin would probably be willing to temporarily reduce or forgo the use of water for agricultural production in a price range between $20 and $100 per acre-foot (as the sale of water in this range would produce equal or greater monetary returns to the user than the use of water to irrigate crops).

In order to mitigate third-party impacts of fallowing, the federal government could establish a drought economic adjustment fund that would provide economic development grants to affected communities in the counties of origin. These funds preferentially would go to established county-based farm labor assistance programs to the extent that such programs exist, and could include lump sum payments to displaced workers based on a percentage of foregone annual income.

[9] This graph has not been published elsewhere. For methodology, please contact Jennifer Pitt at jpitt@environmentaldefense.org. A study using similar methodology, but limited to crop values in the Wellton-Mohawk Irrigation and Drainage District, has been published previously (Pitt et al., New Water for the Colorado River: Replacing the Bypass Flow, 6 U. Denver Water L. Rev. 68 (2002)). The study found a range of prices similar to that represented here for profits derived from water use in that area.

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Using these assumptions for water acquisition costs, Table 1 suggests the approximate range of costs for implementing each of the conservation triggers under the CBS policy.

Table 1. Approximate federal and power/water user cost of implementation of CBS policy conservation trigger levels (assumes that water can be acquired temporarily for $20 - $100/acre-foot, and that the annual federal bypass obligation of 110,000 acre-feet has not otherwise been satisfied).

Trigger	Conservation required	Federal obligation (bypass + 50%)	Federal cost (millions)	Remaining Obligation	Water user cost (millions)	Power Surcharge (millions)	User cost per af (all Lower Basin users)
1075-1100	200,000 af	155,000 af	$3 - $15.4	45,000 af	$0.45 - $2.3	$0.45 - $2.3	$0.06 - $0.30
1050-1075	400,000 af	255,000 af	$5 - $25.4	145,000 af	$1.5 - $7.3	$1.5 - $7.3	$0.19 - $0.97
Below 1050	600,000 af	355,000 af	$7 - $35.4	245,000 af	$2.5 - $12.3	$2.5 - $12.3	$0.33 - $1.63

Cost of Not Implementing "Conservation Before Shortage" Policy

Although the "Conservation Before Shortage" policy would impose notable costs on water and power users, and on taxpayers generally, these costs should be compared with the much larger financial costs that would occur if the Secretary were to impose involuntary, uncompensated shortages, as well as the costs due to the lack of certainty and reliability that would exist without the CBS policy. The recent drought and decrease in power production at both Hoover Dam and Glen Canyon Dam point to the dramatic costs imposed by the loss of reservoir storage.

If Lake Mead falls to 1050 feet, power rates will need to be increased to an approximate composite rate of 2.31 cents/kWh, which is a 44.3% increase over current rates. Replacement power purchases would be (depending on the user) 2.9 to 3.7 times the Hoover rate. In FY03, replacement power may have cost customers an additional $24 million.

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From: Dan Silver <dsilverla@earthlink.net>
To: <strategies@lc.usbr.gov>, <strategies@uc.usbr.gov>
Date: 7/25/05 9:59PM
Subject: Development of Management Strategies for Lake Powell and LakeMead Under Low Reservoir Conditions

July 25, 2005

Regional Director
Bureau of Reclamation, Lower Colorado Region
Attention: BCOO-1000
P.O. Box 61470
Boulder City, Nevada 89006-1470

Regional Director
Bureau of Reclamation
Upper Colorado Region
Attention: UC-402
125 South State Street
Salt Lake City, Utah 84318-1147

RE: Development of Management Strategies for Lake Powell and Lake Mead Under Low Reservoir Conditions

Gentlepersons:

Please accept the following comments from Endangered Habitats League, a Southern California regional organization dedicated to ecosystem protection and sustainable land use. For the reasons outlined below, we urge your consideration of the [3]One Dam Solution.[2]

1. No longer a need for a single-use dam at Glen Canyon

It was not until the fall of 2004, more than 40 years after Glen Canyon Dam began impounding Lake Powell that Lake Powell water storage actually augmented water storage downstream. But with climate change already causing 1
long-term flow reductions, and water consumption levels near the river's historic average flow and rising, it's unlikely that Lake Powell will fill again. The surplus water that filled it during 17 years the first time is no longer there to build a storage cushion. Even should surplus water accumulate, Lake Mead on its own could accommodate it.

2. It's time for more efficient storage

With Lake Powell and Lake Mead losing to evaporation upwards of 17 percent of the water that flows into them, it's time that more efficient means be explored for storing this precious water. Vacant space in underground aquifers on, or accessible to, existing Colorado River infrastructure could 2
accommodate more water than these two reservoirs combined-and with far greater efficiency. Upwards of 810,000 acre-feet of water annually-enough water for 1.6 million households of four people each-could be saved by eliminating Lake Powell and operating Lake Mead principally for distribution to groundwater recharge facilities.

3. Revive Grand Canyon 3

Between Lake Powell and Lake Mead lies one of the world's most famous and geologically and ecologically unique river canyons, Grand Canyon National Park. The operation of both these reservoirs has impacted the Canyon, but Glen Canyon Dam has been far more devastating. Since its completion four of eight native fish have gone extinct and the dam has trapped the sediment necessary to maintain habitat and beaches for wildlife and recreation, as well as the stabilization of archeological sites. 3 Cont.

4. Manage the sediment

Sediment is a major unresolved problem threatening the long-term operations of Lake Powell and Lake Mead. Ultimately, sediment will have to be removed from one or both of these reservoirs. Removing sediment from Lake Mead rather than Lake Powell is the most feasible and least expensive likely alternative. While original estimates projected that sediment would not effect the safe operations of Glen Canyon Dam for another 60 years, scientists now warn that major problems could occur sooner. 4

5. Revise the Colorado River Compact

The Colorado River Compact of 1922, which largely governs the discharge of flows from Lake Powell to Lake Mead, cannot meet its intended purpose of sharing Colorado River water equitably between the Upper and Lower Basin states. The Compact allocated 11 percent more water than the river has to give, and affords the Lower Basin 20 percent more water than the upper basin. With river flows expected to decline 18 percent by 2040, this inequity will worsen as the Upper Basin is required to deliver to the Lower Basin its full share regardless of declines in river flow. 5

Given the growing challenges and looming shortages facing Colorado River water users as a result of these dams, a far more comprehensive assessment addressing the issues above is fully warranted, and should be done through an Environmental Impact Statement. 6

Sincerely,

Dan Silver
Executive Director
Endangered Habitats League
8424-A Santa Monica Blvd., #592
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July 30, 2005

Regional Director
Bureau of Reclamation, Lower Colorado Region
Attention: BCOO-1000
P.O. Box 61470
Boulder City, Nevada 89006-1470

Sent by Fax (702) 293-8156

Dear Regional Director:

On behalf of the thousands of members of the Maricopa Audubon Society here in central Arizona, we urge you to abandon and decommission Glen Canyon Dam. Our members visit all of the Colorado River wildlife habitats for study and recreation. Each time a new dam is built the wildlife habitats become more sterile and less dynamic. Our members were greatly saddened when Glen Canyon added to the death of that river. 1

Remarkably, it was not until the fall of 2004, more than 40 years after Glen Canyon Dam began impounding Lake Powell that Lake Powell water storage actually augmented water storage downstream. But with climate change already causing long-term flow reductions, and water consumption levels near the river's historic average flow and rising, it's unlikely that Lake Powell will fill again. The surplus water that filled it during 17 years the first time is no longer there to build a storage cushion. Even should surplus water accumulate, Lake Mead on its own could accommodate it.

We believe its long overdue to institute more efficient storage 2

With Lake Powell and Lake Mead losing to evaporation upwards of 17 percent of the water that flows into them, it's time that more efficient means be explored for storing this precious water. Vacant space in underground aquifers on, or accessible to, existing Colorado River infrastructure could accommodate more water than these two reservoirs combined-and with far greater efficiency. Upwards of 810,000 acre-feet of water annually-enough water for 1.6 million 3

DEDICATED TO THE PROTECTION OF NATURAL WETLANDS IN AN ARID ENVIRONMENT households of four people each-could be saved by eliminating Lake Powell and operating Lake Mead principally for distribution to groundwater recharge facilities.

Revive Grand Canyon

Between Lake Powell and Lake Mead lies one of the world's most famous and geologically and 4
ecologically unique river canyons, Grand Canyon National Park. The operation of both these reservoirs has impacted the Canyon, but Glen Canyon Dam has been far more devastating. Since its completion four of eight native fish have gone extinct and the dam has trapped the sediment necessary to maintain habitat and beaches for wildlife and recreation, as well as the stabilization of archeological sites.

Manage the sediment

Sediment is a major unresolved problem threatening the long-term operations of Lake Powell
and Lake Mead. Ultimately, sediment will have to be removed from one or both of these 5
reservoirs. Removing sediment from Lake Mead rather than Lake Powell is the most feasible and least expensive likely alternative. While original estimates projected that sediment would not effect the safe operations of Glen Canyon Dam for another 60 years, scientists now warn that major problems could occur sooner.

Revise the Colorado River Compact

The Colorado River Compact of 1922, which largely governs the discharge of flows from Lake 8
Powell to Lake Mead, cannot meet its intended purpose of sharing Colorado River water equitably between the Upper and Lower Basin states. The Compact allocated 11 percent more water than the river has to give, and affords the Lower Basin 20 percent more water than the upper basin. With river flows expected to decline 18 percent by 2040, this inequity will worsen as the Upper Basin is required to deliver to the Lower Basin its full share regardless of declines in river flow.

The growing challenges and looming shortages facing Colorado River water users as a result of 7
these dams indicate that a far more comprehensive assessment addressing the issues above is fully warranted, and should be done through an Environmental Impact Statement.

Sincerely,

Robert A. Witzeman

Robert A. Witzeman, M.D., Conservation Chairperson
602 840-0052, witzeman@cox.net

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FAX COVER SHEET

Date: August 29, 2005

To: Regional Director, Bureau of Reclamation

1. Upper Colorado Region

   FAX # (801)524-3858

2. Lower Colorado Region

   FAX # (702)293-8156

From: Robert Lippman
Rock the Earth
Sent from FAX # (435)259-9846; voice contact, (435)259-1182
Re: Comments on Management Strategiesfor Lake Powell and Lake Mead Under Low Reservoir Conditions [BCOO-1000; ADM-5.10] [UC-402]

No. Pages (including cover): 9

ROCK the EARTH

Defending the Planet One Beat at a Time

1536 Wynkoop St.
Suite B200
Denver, CO 80202

August 29, 2005

VIA FASCIMILE & U.S. MAIL

Mr. Bob Johnson
Regional Director
Bureau of Reclamation
Lower Colorado Region
Attention: BCOO-1000
Box 61470
Boulder City, NV 89006-1470
FAX (702) 293-8156

Mr. Rick Gold
Regional Director
Bureau of Reclamation
Upper Colorado Region
Attention: UC-402
125 South State Street
Salt Lake City, UT 84318-1147
FAX (801) 524-3858

RE: COMMENTS OF ROCK THE EARTH REGARDING DEVELOPMENT OF MANAGEMENT STRATEGIES FOR LAKE POWELL AND LAKE MEAD UNDER LOW RESERVOIR CONDITIONS [BCOO-1000; ADM-5.10]

Dear Regional Directors:

Rock the Earth ("RtE") is a Colorado nonprofit corporation with a national membership of concerned citizens. Like many other Americans, RtE members rely on the Colorado River Basin for a multitude of needs. RtE Members regularly seek the peace, quiet, and solitude of the national public lands for recreational, artistic, naturalist, and spiritual activities, including but not limited to hiking, camping, non-motorized water sports, photography, and meditation. Our members utilize the Colorado River as a source for drinking water as well as recreational activities and will be directly affected by the forthcoming Management Strategies for Lake Powell and Lake Mead under low reservoir conditions (the "Plan") as it will allow for changes in the way that the Colorado River is managed.

We appreciate this formal opportunity to comment on the matter of Colorado River Reservoir management, as we believe that an expanded, comprehensive, coordinated and forward-looking study and action plan for water management in the Colorado Basin is mandated by significantly changed, problematic conditions and needs. These include, but are not limited to, changing climatic and hydrological conditions, overallocation of the Colorado's water resources, outmoded legal and administrative water rights infrastructures, increasingly expanding demands on the system, inequities and waste regarding Colorado River water appropriations, storage and delivery, overdeveloped and inefficient Colorado River water storage and delivery systems, continuously degrading ecological systems and health, increasing water pollution and salinity, the utter lack of planning regarding sedimentation and its effects (including the likelihood of reaching "deadpool" conditions at Lake Powell, hereafter referred to as Powell Reservoir), and the ongoing inability to bring the system into compliance with a number of environmental mandates. The Colorado River water management infrastructure is largely outmoded, unsustainable, and unable to accomplish even its originally intended purposes, under present and anticipated conditions. It fails to adequately address shortages and changing hydrological and climatological conditions, and exacerbates the already severe ecological impacts of the structural system.

Observations.

1. Diminishing returns and system inefficiency.

It is well documented that the historical average run-off in the Colorado is lower than the figure upon which the Colorado River Compact is predicated (1). Water from the Colorado is overallocated by at least 11% above the 400 year average (2). Rapid development in the Upper Basin has diminished the availability of surpluses, and the situation is further exacerbated by documented climatic change and resulting drought in the Western United States (3). Colorado River flows are expected to continue to decline (4). Even prior to the present drying trend, studies predicted the Colorado system would fail on the supply side by the year 2000 (5).

Compounding the problem and trend are factors involving the inefficiency of the system, due to tremendous evaporation losses (6). Under present scenarios, storage exceeds an "optimal," efficient level by 100% (7, 8). Because of this, the chances of Powell Reservoir filling again in the near future are negligible (9). It should also be noted that power generation is also compromised by, and may be discontinued by, continual low reservoir levels (10). Sedimentation is also reducing storage capacity and the system's lifespan at a rapid rate (11, 12). Draining Powell Reservoir as a rational response to these trends and problems would not jeopardize long term water delivery commitments to the Lower Basin (13).

2. Ongoing ecological degradation.

The environmental changes and decline in ecological health of the system are well documented (14). Powell Reservoir has not only inundated hundreds of miles of natural and free-flowing river ecologies and resources, but has also disrupted the riparian and riverine ecology of Grand Canyon National Park, with the erosion of beaches, changes in water characteristics, and extirpation and endangerment of approximately 6 species of fish (15). Present mitigation efforts to protect endangered species are failing (16), and the ecological impacts and disruptions under present infrastructure and management have devastated the formerly productive Colorado River delta (16). Present infrastructures, management strategies and agency priorities have raised ongoing issues regarding the inability of the Bureau of Reclamation to bring the system into compliance with the Endangered Species Act, the Clean Water Act, the Grand Canyon Protection Act, the Archeological and Historical Protection Act, the Colorado River Storage Project Act, and the National Environmental Policy Act (17).

Additionally, salinity and the accumulation of toxic materials and metals are increasing due to evaporation, leaching and sedimentation, resulting in water quality degradation, large scale agricultural damage, increased costs and compromised ecological systems and health (18). Human recreational and commercial uses, along with motorized recreation activities, have polluted the waters of the Colorado River with petroleum products and waste, and with harmful bacteria and coliforms (19).

The full scope of systemic impacts and management options for the Colorado River has never been properly addressed, and environmental studies have been unduly limited and narrowed (20).

3. Recreation and Tourism.

The factors noted above have also had a direct impact on recreational resources and tourism, as visitation to Glen Canyon NRA (Lake Powell) has been consistently declining (by nearly 50 percent over the past 15 years) (21), while reservoir navigation has become problematic, marina facilities have been closing, and Park Service costs for maintaining access have been increasing (22).

4. Safety.

In 1983 and 1984 high flows and a lack of adequate planning and management for flood control caused a near catastrophic occurrence/failure at Glen Canyon Dam. Spillway failure from the high flows required lowering releases, nearly causing overtopping of the dam by the rising, impounded waters; only a temporary, 8 foot plywood barrier prevented overtopping (23). The maximizing of power revenues and political pressure from the Colorado Basin states and recreational interests to maintain Powell Reservoir as full as possible seriously compromise flood control needs and priorities, as well as safety. Although recent hydrological studies indicate that the filling of Powell Reservoir is unlikely in the near future, a dam failure would result in the overtopping of Hoover Dam and all other downstream facilities, destroying water delivery systems and inundating communities in Arizona and California (24). The elimination of Powell Reservoir will actually increase flood control capability of the system, as Mead Reservoir levels would be drawn down to provide for Lower Basin water uses (25).

Recommendations.

Rock the Earth submits that the present, crisis situation provides an unprecedented opportunity for articulation and implementation of long-overdue changes in the management paradigm. Present and anticipated conditions and experience call for a new vision, and a goal of balancing present and future hydrological, ecological, social and technological realities with system resources and management options, through the development of a comprehensive plan for sustainable Colorado River water management.

1. A comprehensive and synergistic environmental impact statement should be immediately undertaken and placed on a fast track for implementation of sustainable water management and sound ecological practices. Management of the diverse interests and resources of the Colorado River must be coordinated and balanced in a long range view and plan. 1

2. The option of decommissioning Powell Reservoir should be fully examined (with a report and recommendation to Congress to remove any political impediments to this necessity) in a cost-benefit context, in terms of system and management inefficiencies, water losses, ecological impacts, and other externalities and diminishing returns. Issues surrounding the implementation of this option should be articulated, and solutions/alternatives crafted based upon defensible science and documented hydrological and climatological factors. 2

3. Maintain and manage Hoover Dam and Mead Reservoir as the primary storage and flood control facility in the system. Mead storage capacity is more than adequate to safeguard and provide the Lower Basin's "perfected rights." A fully maintained Mead allows for ecological restoration of Glen Canyon, Grand Canyon, and the Colorado delta, and is more efficient in terms of water and power delivery than two partially filled reservoirs. Mead is also better sited for implementing sediment transport access and 3

technical solutions than Powell, and the removal of Powell Reservoir will decrease salinity and pollution impacts to the system, while increasing available water supply.

4. Bank any surplus water flows (enhanced by removal of Powell) in underground aquifers, accessible by existing aqueducts, most notably in Arizona (but also considering Utah, Nevada and California possibilities), for simple retrieval when needed. In addition to mitigating the evaporation loss problem, incidental benefits from such banking would inure to areas presently plagued with groundwater mining, subsidence, falling water tables, rising pumping costs, and habitat losses. These aquifers would also provide much more long-term storage capacity than reservoirs. 4

5. Implement aggressive water conservation strategies in the Colorado Basin, considering equity (Tribal and Mexican rights, balanced water priorities and uses, and fair allocations), efficiency, sustainability and growth issues. 5

6. Study and make firm recommendations to facilitate the updating and transformation of Western water law and the "Law of the River" to reflect the river system's limitations, present and anticipated future conditions, and the interests of sustainability, conservation, ecological health, and equity. The concepts of senior appropriators, beneficial use, and non-use triggered lapses need to be reassessed and replaced with a sustainable, conservative water management and allocation paradigm that recognizes and balances ecological and instream uses/benefits with sustainable and equitable water allocations and deliveries. 6

7. Embark on realistic and now-feasible restoration projects in the Colorado Basin. Glen Canyon has shown to be capable of short-term restoration through documented sediment transport. Recreational opportunities on a restored river system would offset the loss of the flatwater recreational economy of Powell Reservoir. Tribal interests (sacred sites, religious freedom, archaeological protection, etc.) would be respected and enhanced by restoration. Restoration efforts for Grand Canyon would require more creative and diligent efforts due to the complexity and cost of sediment transport and the potential problems involving environmental quality; however, a free-flowing Colorado through the Grand Canyon would provide the most hope and opportunity for species recovery and habitat restoration. Eliminating evaporative water losses and managing water delivery through banking and a single primary reservoir (Mead), will free up sufficient water for delta restoration, while providing a greater measure of equity and guarantee for Mexican interests as recognized by Treaty and Compact. 7

8. Study and develop plans for sediment transport/removal from Glen Canyon, Mead Reservoir and other impoundments. 8

Again, Rock the Earth appreciates this opportunity to comment on this matter of such critical importance and impact. The failure to plan for a sustainable future for the American Southwest will result in devastating and insurmountable problems and contention; the vision to overcome political inertia and confront the challenges of climate change, unsustainable growth and declining environmental quality may allow us as a society and species to move towards the hope of a sustainable future.

For Rock the Earth:

Bob Lippman
Member, Advisory Board

Marc A. Ross
President & Executive Director

C: -Governors Offices of the 7 basin States (Arizona, California, Nevada, Utah, New Mexico, Colorado, Wyoming)
-Gail Norton, Secretary of the Interior
-Director, United States Fish and Wildlife Service
-Director, National Park Service

Notes.

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