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Undamming Glen Canyon: Lunacy, Rationality, or Prophecy?

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I. INTRODUCTION

At the fall meeting of Richard Ingebretsen's newly-formed Glen Canyon Institute, David Brower sat and ardently listened to the discussion about draining Lake Powell, the reservoir created by Glen Canyon Dam.[1] Two weeks later, on November 16, 1996, in what was the culmination of a fifty-year fight to protect the Colorado River and its canyons from dams, Brower proposed that the Sierra Club's Board of Directors formally endorse the idea of decommissioning Glen Canyon Dam. The dam would not even have to be torn down, Brower explained. Its two diversion tunnels could transport up to 200,000 cubic feet per second ("cfs"),[2] enough to handle the highest "natural"

[1] Interview with David Wegner, Science Director, Glen Canyon Institute (Nov. 24, 1999); Richard Ingebretsen, President, Glen Canyon Institute, *History of Glen Canyon and the Glen Canyon Institute* (visited Nov. 26, 1999) <http://wwwglencanyon.org/history.htm>. The Institute was founded in 1996 to study the proposal and "to provide leadership in re-establishing the free flow of the Colorado River through a restored Glen Canyon." *See* Glen Canyon Institute, *Glen Canyon Institute Mission Statement* (visited Nov. 21, 1999) <http://wwwglencanyon.org/mission.htm>. Thus, contrary to popular belief, the proposal to decommission Glen Canyon Dam is more accurately termed the Glen Canyon Institute's. Nevertheless the proposal is commonly referred to as "the Sierra Club's" and this Article does as well. *See, e.g.,, Joint Hearing on the Sierra Club's Proposal to Drain Lake Powell or Reduce Its Water Storage Capacity: Joint Hearing Before the Subcomm. on National Parks and Public Lands and Subcomm. on Water and Power of the House Comm. on Resources*, 105th Cong. (1997) [hereinafter *Lake Powell Hearing]*.

[2] *See* David Brower, *Let the River Run Through It*, SIERRA, Mar./Apr. 1997, at 42.

flows on today's developed river. After his ten-minute speech, the Board of Directors voted unanimously to endorse the idea.[3]

The reaction of western politicians on Capitol Hill to the Sierra Club's proposal varied in terminology but not in tone. Their responses ranged from "nonsense" to "absolutely ridiculous" to "a certifiably nutty idea" to an "absurdity" to "the silliest proposal discussed in the 105th Congress" to "more than a little absurd" to "myopic, selfish, [and] impractical."[4] How could the Sierra Club Board of Directors—the governing body of a grass roots organization with over half a million members—unanimously endorse such a "ridiculous" idea after only fifteen minutes of consideration and without consulting their regional chapters, and then defend it a year later in congressional hearings as "a natural decision for the Sierra Club?"[5] Perhaps more incredible was that the decision truly was a "natural" one for the Club—and for many others. Before long, some observers were calling the proposal "exhilarating," "breathtaking," "not such a crazy idea," "fascinating," and "words of hope that deserve ... an important conversation."[6]

The debate over the proposal to drain Lake Powell is in many ways true to the history of the Colorado River. For the last century, the Colorado has carried a reputation as the "River of, Controversy"—"the most disputed body

[3] The description of the Board meeting is from a telephone interview with David Brower, Chairman, Earth Island Institute, Nov. 26, 1999.

[4] *Lake Powell Hearing*, *supra* note 1, at 62 (statement of Melvin F. Bautista, Executive Director, Navajo Nation Division of Natural Resources); *id.* at 18 (statement of Michael Hacskaylo, Administrator, Western Area Power Administration); Adrianne Flynn, *Idea to Drain lake Powell Is Ridiculed*, ARIZ. REPUBLIC, Sept. 24,1997, at A1; Ed Marston, *Sierra Club Moves To Fortify Its Drain Lake Powell Campaign*, HIGH COUNTRY NEWS Oct. 13, 1997, at 5; Tom Wharton, *Study Draining Lake Powell: Ex-Reclamation Head Says Idea "Fascinating " But Research Needed*, SALT LAKE TRIB., Oct. 10, 1997, at B2; Jason Zengerle, *Water Over the Dam: The Sierra Club's Strange Bid To Drain a Lake*, NEW REPUBLIC, Nov. 24, 1997, at 20; Utah Representative Chris Cannon introduced a resolution denouncing the proposal and touting Lake Powell's benefits. The resolution was supported by more than two dozen representatives and was referred to the committee on resources. *See Lawmaker Defends Lake Powell*, ROCKY MOUNTAIN NEWS Mar. 6, 1998, at A18.

[5] *Lake Powell Hearing*, *supra* note 1, at 34 (statement of Adam Werbach, President Sierra Club); Marston, *supra* note 4 (describing internal fallout resulting from the Board of Director's decision).

[6] Daniel P. Beard, *Dams Aren't Forever*, N.Y. TIMES, Oct. 6, 1997, at A1. Ed Marston, *Drain Lake Powell? Democracy and Science Finally Come* West, HIGH COUNTRY NEWS, Nov. 10. 1997, at 1; Mark Muro, *Can the River Run Again? Draining Lake Powell Not Such a Crazy Idea*. ARIZ. DAILY STAR, Apr. 20, 1997, at 1E; Wharton, *supra* note 4.

water in the country and probably the world."[7] Through the many years of controversy, passion and irrationality over the river (and over western water generally) have become entrenched in the Western consciousness. The same passion and irrationality extend into the present debate over Glen Canyon Dam's future, resulting in many unconsidered responses from both sides of the debate.

This Article attempts to shed light on this debate and the implications of decommissioning Glen Canyon Dam. They are far reaching, significant, complex, and in many cases yet unknown. At stake are values such as river regulation, the availability of water, hydropower, recreation, the survival of species, and Glen Canyon itself.

Despite the bewilderment on Capitol Hill**,** the proposal is in many ways simply the logical next chapter in one of the most important stories of the West. As Chairman Jim Hansen observed in the opening statement of the 1997 congressional hearings on the proposal, "[t]here is a long history behind the development of the Colorado River. And the Glen Canyon Dam provides perhaps the most interesting part."[8] This history provides the context and logic for the Sierra Club's proposal. To understand the proposal itself, then, is well as the arguments on either side, it is necessary to understand the story behind Glen Canyon Dam.

II. "THE STREAM OF HISTORY":[9] THE COLORADO RIVER AND GLEN CANYON

A. The Colorado in Its Natural State

The story of Glen Canyon Dam begins over five million years ago,[10] when the Colorado River began scratching its present course into the Colorado Plateau, forming what would eventually be the most impressive canyons on Earth. These canyons offer extraordinary environmental diversity: In many places, there are more vertical feet than horizontal; within six miles, the altitude can change

[7] Norris Hundley, Jr., *The West Against Itself: The Colorado River—An Institutional History* in NEW COURSES IN FOR THE COLORADO RIVER: MAJOR ISSUES FOR THE NEXT CENTURY 9, 9 (Gary D. Weatherford & F. Lee Brown eds., 1986) [hereinafter NEW COURSES FOR THE COLORADO RIVER].

[8] *Lake Powell Hearing*, *supra* note 1, at 1 (testimony of James V. Hansen, Chairman, Subcomm. of Nat'l Parks and Public Lands).

[9] Wallace Stegner, THE SOUND OF MOUNTAIN WATER 116 (1980) [hereinafter STEGNER MOUNTAIN WATER].

[10] *See* Bureau of Reclamation U.S. Dep't of the Interior, OPERATION OF GLEN CANYON DAM: FINAL ENVIRONMENTAL IMPACT STATEMENT 68 (1995) [hereinafter FEIS].

up to 7200 feet; forests, grasslands, slickrock, sand, and lush vegetation adjoin each other; and summer lasts anywhere from a few short months in the mountains to almost an entire year in the lowlands.[11]

The Colorado River itself is no less impressive in its variability. Although the Colorado has never carried a particularly large amount of water,[12] prior to its damming it was "like a forty-pound wolverine that can drive a bear off its dinner ... unrivaled for sheer orneriness."[13] In the spring, water draining 108,000 square miles[14] and falling up to 11,000 vertical feet from the mountains of Colorado and Wyoming[15] raged through the canyons of the Plateau at up to 400,000 cfs.[16] In the late summer and fall, the river slowed to as little as 1000 cfs.[17] The flow could change from a few thousand cfs to a couple of hundred thousand cfs in just a few days.[18] The total flow was also highly variable, ranging from 4.4 million acre-feet ("maf") to more than 22 maf per year.[19]

Each spring, as the Colorado River barreled through the Colorado Plateau, the floodwaters tore away at the soft sandstone, accumulating more sand and sediment than any river in the world.[20] On a typical June day with high water, the Colorado River carried through the Grand Canyon enough sediment to fill the Rose Bowl

[11] *See* PHIL R. GEIB, GLEN CANYON REVISITED 201 (1996).

[12] The flow of the Columbia River is about 16 times greater than the natural flow of the Colorado. *See* CHARLES F. WILKINSON, FIRE ON THE PLATEAU: CONFLICT AND ENDURANCE IN THE AMERICAN SOUTHWEST 184 (1999) [hereinafter WILKINSON, FIRE ON THE PLATEAU].

[13] MARC REISNER, CADILLAC DESERT THE AMERICAN WEST AND ITS DISAPPEARING WATER 121 (rev. ed. 1993).

[14] *See* FEIS, *supra* note 10, at 68.

[15] *See id.* at 67 (stating that Glen Canyon Dam sits 3100 feet above sea level).

[16] *See* Edmund D. Andrews, *Glen Canyon Dam: Flood Flows and Adaptive Management in the Lower Colorado River Basin* 1, in DAMS WATER AND POWER IN THE NEW WEST (Eighteenth Annual Summer Conference of the Natural Resources Law Center, University of Colorado School of Law 1997) [hereinafter DAMS]. A flood of 300,000 cfs is enough water to cover a football field 10 feet deep every second. *See* George Sibley, *Glen Canyon: Using a Dam To Heal a River*, HIGH COUNTRY NEWS July 22, 1996, at 9.

[17] *See* Andrews *supra* note 16, at 1, 2.

[18] *See* REISNER, *supra* note 13, at 122.

[19] *See* David H. Getches & Charles J. Meyers, *The River of Controversy: Persistent Issues* in NEW COURSES FOR THE COLORADO RIVER *supra* note 7, at 51, 55. An acre-foot of water, equivalent to 325,829 gallons, is the amount of water that will cover one acre of land one foot deep. One acre-foot of water is sufficient to satisfy the domestic needs of two average homes in the West for a year. *See* Steven J. Shupe. *Indian Tribes in the Water Marketing Arena* 15 AM. INDIAN L. REV. 185 188 n. 6 (1990).

[20] *See* PHILIP L. FRADKIN, A RIVER NO MORE: THE COLORADO RIVER AND THE WEST 333 (Univ. of Ariz. Press 1984) (1981).

to the rim during a football game[21]. In some years, high summer floods transported more than 100 million tons of sediment[22] through the Grand Canyon, averaging 65 million tons each year. In contrast, during the low flows of late summer and early fall, the river ran nearly clear.[23] Water temperature varied widely too, ranging from 35°F in winter to 85°F in mid-summer.[24]

These phenomenal variations in water flow, temperature, and sedimentation created a unique ecosystem with a highly specialized biota adapted to the stressful environment. The variations in water flow, combined with the high sediment load, created a river channel characterized by sandbars in areas of relatively low turbulence.[25] These sandbars became important parts of the aquatic and riparian ecosystems.[26]

The aquatic environment was severe and unproductive. At high water, organisms faced strong currents and high turbidity. The sediment choked all but the most highly adapted life from the river.[27] At low water, high temperatures and low oxygen levels

[21] This figure is based on the data collected in the Grand Canyon from June 9 through 19, 1957, when the average flow was 112,001 cfs and the average sediment load was 2,370,000 tons/day. *See* U.S. Geological Survey, QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1957: COLORADO RIVER BASIN TO PACIFIC SLOPE BASINS IN OREGON AND LOWER COLUMBIA RIVER BASIN 166 (Water Supply Paper No. 1523,1961). The calculation was also based on the average dry weight of sediment in the Colorado River delta of Lake Mead prior to the impoundment of the Colorado River behind Glen Canyon Dam, which was 64.6 pounds per cubic foot. *See* U.S. Geological Survey, COMPREHENSIVE SURVEY OF SEDIMENTATION IN LAKE MEAD, 1948,49, at 196 (Geological Survey Professional Paper No. *295,* 1960). The total volume of the Rose Bowl is approximately 10,000,000 cubic feet. Telephone Interview with Charles Thompson, Public Relations Manager, Rose Bowl gone June 10,1999). Based on these data, the calculations reveal that the Rose Bowl would fill in about three hours and fifteen minutes, or, as Marc Reisner described it, "[i]f the river, running high, were diverted through an ocean liner with a cheesecloth strainer at one end, it would have filled the ship with mud in an afternoon." REISNER, *supra* note 13, at 122.

[22] *See* Andrews, *supra* note 16, at 1, 2. From 1922 to 1935, the Colorado River carried from 45.4 to 455 million tons of sediment through the Grand Canyon. *See* W.L. Minckly, *Native Fishes of the Grand Canyon Region: An Obituary?* in COLORADO RIVER ECOLOGY AND DAM MANAGEMENT 124, 126 (1991) [hereinafter COLORADO RIVER ECOLOGY]. However, there is evidence that the sediment load during this period was uniquely high. *See* Edmund D. Andrews, *Sediment Transport in the Colorado River Basin,* in COLORADO RIVER ECOLOGY, *supra,* at 54, 63-66 (1991*)* [hereinafter Andrews, *Sediment Transport].*

[23] *See* Dean W. Blinn & Gerald A. Cole, *Algal and Invertebrate Biota in the Colorado River Comparison of Pre- and Post-Dam Conditions,* in COLORADO RIVER ECOLOGY, *supra* note 22. at 102, 102.

[24] *See* Andrews , *supra* note 16, at 2.

[25] *See* Andrews, *Sediment Transport, supra* note 22, at 54, 68.

[26] *See id* at *69; See also* NAT'L RESEARCH COUNCIL, RIVER RESOURCE MANAGEMENT IN THE GRAND CANYON 70 (1996)

[27] *See* Minckley, *supra* note 22, at 126.

could be lethal, not to mention the danger of the water disappearing altogether from all but the main channel of the Colorado and its main tributaries.[28]

A specialized biota highly adapted to the stressful environment was the result. The existence of thirty-two species of fishes endemic to the Colorado River, six endemic to the Glen and Grand Canyon region alone, demonstrates the uniqueness of the aquatic ecosystem.[29] The fact that only eight species of fishes lived in the canyons of the Colorado River at all demonstrates the severity of the environment.[30] The native fishes of the Colorado River canyon country are remarkably large, muscular, and streamlined-with small, depressed skulls, and large, muscular keels on their backs providing them with the power and hydrodynamics to navigate the fastest major river in the United States.[31] Tiny eyes, embedded of virtually absent scales, and thick and leathery skin—especially on the head and anterior body—protect them from sediment abrasion and reduce friction.[32] These distinctive animals have exceptionally long life spans, a good adaptive strategy in an unpredictable environment.[33]

After leaving the rapids of the Grand Canyon, the Colorado River made its way into what is now Mexico, emptying into the Sea of Cortez[34] an average of 13.5 maf of water[35]--about half of the freshwater input.[36] On its way, it deposited over 177 million tons of

[28] *See id.* at 127.

[29] The six species are: the speckled dace (*Rinichthys osculus*), roundtail chub (*Gila robusta*), humpback chub (*Gila cypha),* bonytail chub (*Gila elegans*), Colorado pikeminnow *(Plychocheilus lucius*), which was previously called the Colorado squawfish, and the razorback sucker *(xyrauchen texanus*). *See id.* at 124,131-32. Although these six species are often referred to as endemics of the Grand Canyon, all six species were historically were found in Glen Canyon as well. *See id.* at 135, 151, 153*; See also* FEIS, *supra* note 10, at 109, 114. An "endemic" species is one that is found only in a defined geographic area *See, e.g.*, Malcolm L. Hunter, Fundamentals of Conservation Biology 25 (1996). With 93% endemism, "the Colorado River Basin supports the most distinctive icthyofauna in North America." Minckley, *supra* note 22, at 128.

[30] *See* Minckley, *supra note 22, at 131*. The two species of native fishes not mentioned in *supra* note 29 are the flannelmouth sucker (*Catostomus latirinnis*) and the bluehead sucker *(Pantosteus discobolus*).

[31] *See* STEGNER, MOUNTAIN WATER, *supra* note 9, at 105.

[32] *See* Minckley, *supra* note 22, at 128.

[33] *Id.*

[34] The Sea of Cortez is also known as the Gulf of California.

[35] *See* David Meko et al., *The Tree-Ring Record of Severe Sustained Drought*, 31 WATER RESOURCES BULL. 789, 800 (1995).

[36] *See.* BERNARDO VILLA RAMIREZ, RECOVERY PLAN FOR THE VAQUITA (NTIS Rep. No.PB 93-169415, 1993) (report to the Marine Mammal Comm'n, U.S.Dep't of Commerce)

sediment[37]-—550 Rose Bowls full—each year, creating one of the greatest accumulations of sediment in the world.[38] The result was one of the world's great estuaries, its vast wetlands supporting an estimated 200 to 400 species of vascular plants and legendary swarms of waterfowl and fish.[39]

The waters of the Colorado also helped create one of the world's most diverse and productive marine ecosystems in the Upper Sea of Cortez.[40] For example, the massive totoaba fish fed and spawned exclusively in the brackish waters of the Upper Sea and delta, relying on the Colorado to provide nutrients and to regulate the temperature and salinity of its environment.[41] The vaquita, an endemic porpoise also known as the cochito, is the smallest species of its Order.[42] Its unusually high echolocation signals and long fins are unique adaptations to its warm and turbulent environment.[43] Thus, from the Colorado Plateau to the Sea of Cortez, the Colorado River was an extremely difficult place to live. Only the most highly adapted species could survive the harsh, ever-changing conditions. But they did—for millions of years.

B. From Dams to Dories

The canyons of the Colorado River are no strangers to dams. A million years ago, the earth under the Colorado Plateau was alive with volcanic activity.[44] The first dam was the result of volcanic activity underneath the Plateau over one million years ago.[45]

[37] *See* id,

[38] *See* JASON L. MORRISON ET AL., THE SUSTAINABLE USE OF WATER IN THE LOWER COLORADO RIVER BASIN 22 (1996).

[39] *See* Edward P. Glenn et al., *Effects of Water Management on the Wetlands of the Colorado River Delta, Mexico*, 10 CONSERVATION BIOLOGY 1175, 1176 (1996); *See also* MORRISON ET. A1., *supra* note 38, at 21-22.

[40] *See* Morrison et al., *supra* note 38, at 22..

[41] *See* Miguel A. Cisneros-Mata et al., *Life History and Conservation of* Totoaba macdonaldi CONSERVATION BIOLOGY 806, 811-12 (1995): *See also* J. C. Barrera Guevara. *The Conservation of* Totoaba macdonaldi (*Gilbert*), (*Pices: Sciaenidae*) *in the Gulf of California*, Mexico. J. FISH BIOLOGY 201, (Supp. A), in THE BIOLOGY AND CONSERVATION OF RARE FISh (Alwyne Wheeler ed., 1990).

[42] A.A. Hohm et. al., *Life History of the Vaquita*, Phocoena sinus *(Phocoenidae, Ceacea*), ZOOLOGY LONDON 235, 235-42 (1996). The vaquita grows. to about 4.5 feet and 95 pounds. *See id.* at 241-42. The bottlenose dolphin grows to about 13 feet and 600 pounds. *See* Stephan Leatherwood & Randall R. Reeves, THE SIERRA CLUB HANDBOOK OF WHALES AND DOLPHINS 269 (1983).

[43] *See* RAMIREZ, *supra* note 36, at 5.

[44] *See* W. KENNETH HAMBLIN, LATE CENOZOIC LAVA DAMS IN THE WESTERN GRAND CANYON 7 (1994).

[45] *See, id.* at 1.

The activity eventually pushed up a lava flow that spilled into the foot of the Grand Canyon, creating Prospect Dam.[46] Within months, the dam rose some 2300 feet above the present river bed, more than three times as high as one that would block the river in 1963. Its 324-mile-long lake extended all of the way through Grand and Glen Canyons, and past where Moab, Utah, sits today.[47] The powerful forces of the Colorado River quickly went to work on the dam, however, completely destroying it within 20,000 years.[48]

The next dam to inundate Glen Canyon was 1800-foot-high Lava Butte Dam, but neither it nor any of the other eleven lava dams that formed in the Grand Canyon lasted much longer than the first.[49] In some cases, the Colorado simply blew out the lava dams sending the several years of water and several hundreds of years worth of sediment that had been stored behind the dam crashing down the river in one great wave.[50]

Glen Canyon was a much more serene place when geologic forces created another dam just off the mainstream of the river sometime later. This time, sands washed from the Colorado Plateau were deposited at the mouth of Lake Canyon, eventually accumulating into an earthen dam.[51] As the dam rose, Lake Pangarit formed behind it.[52] The lake survived until 1915, when heavy rains sent the lake over, and then through the dam.[53]

Lake Pangarit still existed, however, when the first humans arrived in Glen Canyon nearly 12,000 years ago.[54] Ancestral Puebloans (often called "Anasazi")[55] erected the first human-made dam in Glen Canyon about 1000 years ago beneath a spring just above the main stem of the river.[56] The U-shaped, double-walled masonry dam stored water to a maximum depth of about six feet.

[46] *See id.* at 37.
[47] *See id.* at 27-30, *42*.
[48] *See id.* at 41.
[49] *See id.* at 30, 32.
[50] *See id.* at 31-32.
[51] *See* JESSE D. JENNINGS, GLEN CANYON: A SUMMARY 50-51 (1966) (Glen Canyon Series No. 31); RUSSELL MARTIN, A STORY THAT STANDS LIKE A DAM: GLEN CANYON AND FOR THE SOUL OF THE WEST (1999).
[52] *See* JENNINGS, *supra* note 5 1, at 50-5 1. 53. *Id.*
[53] *Id.*
[54] *See* GEIB, *supra* note 11, at 7.
[55] *See* WILKINSON, FIRE ON THE PLATEAU, *supra* note 12, at 253 (explaining why using the term "Ancestral Puebloans" is a sensible approach to avoiding objections to the term "Anasazi")
[56] MARTIN, *supra* note 51, at 109, The dam was located at Creeping Dune in Glen Canyon. *See* JENNINGS, *supra* note 51, at 44-45.

A sandstone water gate could regulate the flow from the reservoir into a stone-lined ditch system that led to terraced gardens.[57] The Ancestral Puebloans left the canyon a few hundred years later, about 600 years ago.[58] Along with the dam, the Ancestral Puebloans left over 2500 archaeological sites in Glen Canyon.[59]

In 1857, Lieutenant Joseph Ives, one of the first white men to see the Colorado River's canyons, ventured up the river by steamboat. Just into the lower reaches of the Grand Canyon[60], Ives abandoned his river journey, but not before "penning one of the least prophetic valedictories in southwestern history."[61]

> The region last explored is, of course, altogether valueless ....Ours has been the first, and will doubtless be the last, party of whites to visit this profitless locality. It seems intended by nature that the Colorado River, along the greater portion of its lonely and majestic way, shall be forever unvisited and undisturbed."[62]

At the least, Ives was grossly mistaken about his first two assertions. Even if he was correct about nature's intents, however, the white man quickly became set on frustrating them. Virtually since Europeans arrived in North America, they had been warring with "wilderness," struggling to conquer nature and advance civilization.[63] "With few exceptions later pioneers continued to regard wilderness with defiant hatred…".[64] The manifest destiny of westward expansion reflected "the transcendent importance they attached to conquering wilderness."[65]

[57] *See* JENNINGS, *supra* note 51, at 44-45. According to Jennings, "[n]othing resembling [the masonry dam at Creeping Dune] has been elsewhere reported." *Id.* at 44. This is not to say that extensive Ancestral Puebloan water developments were not found elsewhere in Glen Canyon. For example, an Ancestral Puebloan development diverted water from Beaver Creek to an extensive ditch system, which irrigated a number of terraced agricultural fields. "Flow was apparently regulated by a series of notched slabs which are thought to have served to check both volume and velocity of flow. The excavators reckoned that the farm land supported a community of over 20 household units." *Id.* at 45; *See also* MARTIN, *supra* note 51, at 109.
[58] *See* JENNINGS, *supra* note 51, at 35; *See. also* Geib, *supra* note 11, at 9.
[59] *See* MARTIN, *supra* note 51, at 110.
[60] *See* WALLACE STEGNER, BEYOND THE HUNDREDTH MERIDIAN: JOHN WESLEY POWELL AND THE SECOND OPENING OF THE WEST 43 (1954) [hereinafter STEGNER HUNDREDTH]
[61] BRUCE BABBITT, GRAND CANYON: AN ANTHOLOGY 5 (1978).
[62] LIEUTENANT JOSEPH C. IVES, REPORT UPON THE COLORADO RIVER OF THE WEST, H. R. Exec. Doc. No. 36-90, Pt. 1, at 110 (1861).
[63] *See generally* RODERICK NASH, WILDERNESS AND THE AMERICAN MIND 8-43 3d ed.1982).
[64] *Id.* at 24.
[65] *Id.* at 37.

John Wesley Powell was perhaps one of the exceptions. Powell, who floated down the still-pristine Colorado River in 1869, was likely the first white man to see Glen Canyon.[66] After spending a second night in the canyon's Music Temple, just upriver from Rainbow Bridge Canyon, Powell wrote of his continuing journey down the mysterious river:

> August 3-Start early this morning. The features of the canon are greatly diversified. Still vertical walls at times ....
>
> On the walls, and back many miles into the country, numbers of monument-shaped buttes are observed. So we have a curious *ensemble* of wonderful features—carved walls, royal arches, glens, alcove gulches, mounds, and monuments. From which of these features shall we select a name? We decide to call it Glen Canon.
>
> Past these towering monuments, past these mounded billows of orange sandstone, past these oak-set glens, past these fern-decked alcoves, past these mural curves, we glide hour after hour, stopping now and then, as our attention is arrested by some new wonder . . . [67]

On the one hand, Powell's daring and appreciation for the beauty and wildness of the Colorado's canyons inspired David Brower, Wallace Stegner, and Edward Abbey in the fight against damming the Colorado. On the other, his staunch advocacy of reclamation[68] inspired generations of federal engineers like Floyd Dominy[69] to fulfill Powell's dream of making the desert bloom.

III. The Law of the River

Over time, the Colorado River came to symbolize both wildness and reclamation—and everything in between. As variable as the river is itself, the laws that govern the Colorado reflect the wide array of interests and aspirations associated with the river ever since Powell first floated through its canyons. These laws are collectively known as the "Law of the River."[70] All water use and development that takes place on the Colorado, whether diverting two

[66] With the possible exception of James Ohio Pattie. *See* STEGNER, HUNDREDTH MERIDIAN, *supra* note 60, at 88.

[67] John Wesley Powell, THE EXPLORATION OF THE COLORADO RIVER AND ITS CANYONS 91-92 (The American Museum of Natural History 1961) (originally TITLED EXPLORATION OF THE COLORADO RIVER OF THE WEST AND ITS TRIBUTARIES (1875) (emphasis in original).

[68] *See* CHARLES F. WILKINSON, CROSSING THE NEXT MERIDIAN: LAND, WATER, AND THE FUTURE OF THE WEST 237-38 (1992) [hereinafter WILKINSON, CROSSING THE NEXT MERIDIAN].

[69] Floyd Dominy stands not far behind John Wesley Powell as one of the most important figures in the history of the Colorado River *See infra* Part III.C.

[70] *See generally* Paul L. *Bloom Law of the River: A Critique of an Extraordinary Legal System*, in NEW COURSES FOR THE COLORADO RIVER, *supra* note 7, at Hundley, *supra* note 7.

acre-feet of water for irrigation or providing in-stream flows for the Grand Canyon, must comply with this body of law. Of all of the laws that constitute the Law of the River[71], the Colorado River Compact of 1922 is the centerpiece.

A. *The Colorado River Compact of 1922*

The events leading to the adoption of the Colorado River Compact can fairly be traced to the 1848 discovery of gold in California.[72] The masses of miners that flocked to California in search of gold quickly created their own laws for divvying up the land's minerals and the water necessary to harvest them: "First in time, first in right"—limited, of course, by the amount of water actually used—was the foundational principle.[73] In 1859, major strikes were made in Nevada and Colorado.[74] As the miners pursued gold and silver throughout the West, they brought with them California's new water law—the doctrine of prior appropriation. In 1883, gold was "discovered" in Glen Canyon (in fact, Hoskininni, a Navajo, gladly showed an inquiring prospector where to find it).[75] Like the fantastic Klondike, Glen Canyon's sandy beaches them-

[71] What comprises the Law of the River is the subject of some disagreement. For example according to one Bureau of Reclamation document, the Law of the River is comprised of sixteen components: eight Acts of Congress, two Compacts, one Agreement, one Treaty, and four sets of Criteria and Regulations.- *See* Bureau of Reclamation, U.S. Dep't of the Interior, *Glen Canyon Data 5*, in *Information Publicly Available from the Bureau of Reclamation, Upper Colorado Regional Office: Proposals by Groups to Drain Lake Powell—Data on Possible Impacts & Technical Information* (available from the Bureau) (hereinafter *Information Publicly Available*]. in another document, however, the Bureau lists sixteen somewhat different components of the Law of the River: six acts of Congress, two compacts, one agreement, one treaty, four sets of criteria and regulations, one court case, and three court decrees. *See* FEIS, *supra* note 10, at 8-9. One scholar lists 46 legal devices as the "Major Components of the Law of the River. " *See* DALE PONTIUS & SWCA, INC., COLORADO RIVER BASIN STUDY FINAL REPORT app. B (Western Water Policy Review Advisory Comm'n, 1997). According to Paul Bloom, the Law of the River is "an odd composite of state, federal, and international laws and decisions Nowhere are its perimeters explicitly defined. They must be discovered and applied from case to case." Bloom, *supra* note 70, at 139.

[72] *See* WILKINSON, CROSSING THE NEXT MERIDIAN, *supra* note 68. at 231-35. For more on the California Gold Rush see RODMAN W. PAUL, CALIFORNIA GOLD (1965).

[73] *See, e.g.*, Morton v. Solambo Copper Mining Co., 26 Cal. 527, 533 (1864) (holding that the governing law for mining disputes would be "the customs, usage, or regulations established in force at the bar or diggings embracing such claims"); Irwin v. Philips, 5 Cal. 140 (1855) (holding that the miners' doctrine of prior appropriation. rather than riparian doctrine. would govern water dispute); *See also* DAVID H. GETCHES, WATER LAW IN A NUTSHELL 6, 74 (3d ed. 1997) [hereinafter GETCHES, WATER LAW].

[74] *See* WILKINSON, CROSSING THE NEXT MERIDIAN, *supra* note 68, at 37

[75] *See*, MARTIN, *supra* note 51, at 125-26.

selves were full of gold.[76] By 1889, some 1000 miners were sifting Glen Canyon's sands.[77] At the same time, farmers began irrigating patches of land from Colorado to Mexico with Colorado River water, quickly borrowing the miners' water law to govern its use.[78] So too did the ranchers.[79] But while the mining in Glen Canyon did not last,[80] the miners' water law did. "Prior appropriation swept across the West" and was "adopted nearly wholesale in every western state."[81]

Prior appropriation worked well in the West, except for the fact that it caused heated debates between upstream and downstream states. Such a debate arose in 1911 when Wyoming sued Colorado in the United States Supreme Court. The debate focused on the waters of the Laramie River, which the upstream and relatively fast-growing state of Colorado was quickly depleting, even planning a major out-of-basin diversion.[82] The Court eventually held that prior appropriation would apply between the states, and that Colorado was entitled to divert water out of the Laramie River Basin.[83]

Even though both states won in the Supreme Court, which split on the States' arguments,[84] it spelled huge trouble for both of them. In fact, it spelled huge trouble for every state in the Colorado River Basin-except California. At the time, Southern Cali-

[76] *See id.* at 126.

[77] *See id.* at 127.

[78] *SEE, E.G.*, UNITED STATES V. RIO GRANDE DAM & IRRIGATION GO., 174 U.S. 690, 704 (1899); GETCHES, WATER LAW, *supra* note 73, at 6, 74; WILKINSON, CROSSING THE NEXT MERIDIAN *supra* note 68, at 234.

[79] *See* WILKINSON, CROSSING THE NEXT MERIDIAN, *supra* note 68, at 234.

[80] Although miners worked the canyon for thirty years, it seems no one ever even made a day's work. The problem was not a lack of gold—in fact, there was plenty. Rather, the gold was just dust, and it would not sink in the miners' pails and sluices. To make matters worse, the sand and mud clogged every piece of machinery the miners hauled into the canyon. *See* MARTIN, *supra* note 5 1, at 126-30.

[81] Wilkinson, WILKINSON, CROSSING THE NEXT MERIDIAN, *supra* note 68, at 234-35.

[82] *See* Wyoming v. Colorado, 259 U.S. 419 (1922);*See* also Coffin v. Left Hand Ditch Co., 6 Colo. 443 (1882) (holding that the doctrine of prior appropriation would govern dispute over out-of-basin diversion from the headwaters of the Colorado River): Norris Hundley, Jr. WATER AND THE WEST: THE COLORADO RIVER COMPACT AND THE POLITICS OF WATER IN THE AMERICAN WEST 76-79 (1975) (hereinafter HUNDLEY, WATER AND THE WEST.

[83] *See Wyoming*, 259 U.S. at 466, 470; *See* also HUNDLEY, WATER AND THE WEST, *supra* note 82, at 177-78.

[84] Wyoming won on the issue of the applicability of the doctrine of prior appropriation. The Court rejected Colorado's argument that because the Laramie River arose within Colorado's borders, it had the right to divert virtually all of its water. Colorado on the other hand, won on the issue of the legality of its proposed out-of-basin diversions from the Laramie River. *See Wyoming* 259 U.S. at 466, 470.

fornia was the fastest growing place on Earth[85] and its cities and rich desert valleys were poised to slurp up the Colorado River. The other six basin states were either largely uninhabited or simply had not begun using any substantial quantities of Colorado River water.[86] If they did not do something quickly, they feared, the river would belong to California. The doctrine of prior appropriation naturally encouraged, indeed, demanded water development. Within such a scheme, the fight against time and California would surely be a losing one.

At the same time, California's growth was quickly exceeding its supply of water. True, the Colorado was there for the taking, but taking it was "like trying to drink from a fire hose."[87] In 1901, California developers cut an irrigation ditch (the Alamo Canal) from the Colorado River, through Mexico, and to the Imperial Valley, which held 600,000 acres of rich, though arid, farmland.[88] It was an immediate success. Eight months after water had arrived in the valley, there were 2000 settlers, 400 miles of irrigation ditches, and 100,000 acres of farmland ready for cultivation.[89]

But by 1904 the head of the canal had already silted up, necessitating a bypass.[90] Two more times the canal silted up, and two more headgate bypasses succeeded only temporarily.[91] In 1905, the raging Colorado tore out the gate, diverting the entire river through the canal and into the Imperial Valley. Roaring along its new course, the river turned the Salton Sink into the Salton Sea, and flooded the Imperial Valley, leaving Californians watching "as their fields were being eaten and as their homes swam away."[92]

Importantly, however, the Imperial Valley was not a lonely victim of the rogue river. During the same timeframe, the Colorado was causing more than a million dollars of damage each year along its southern reaches, not to mention loss of lives. Nevertheless, the Imperial Valley had 360,000 acres under cultivation by 1918 and

[85] *See* MARTIN, *supra* note 51, at 24.

[86] *See* REISNER, *supra* note 13, at 124.

[87] George Sibley, *A Tale. of Two Rivers: The Desert Empire and the Mountain*, HIGH COUNTRY NEWS, Nov. *10, 1997*, at *12* [hereinafter Sibley, *A Tale of Two Rivers*].

[88] *See* NORRIS HUNDLEY, JR., THE GREAT THIRST: CALIFORNIANS AND WATER, *1770s–1990s*, at *205 (1992)* [hereinafter HUNDLEY, THE GREAT THIRST]; HUNDLEY, WATER AND THE WEST, *supra* note 82, at 18; REISNER, *supra* note 13, at 122-23.

[89] *See, supra* note 82, at 21.

[90] *See* REISNER, supra note 13, at 123.

[91] *Id.*

[92] *Id.; See also* HUNDLEY, THE GREAT THIRST, *supra* note 88, at 205-06.

was expanding.[93] By 1920, Los Angeles had grown to a metropolis of nearly 600,000[94] and was looking to the Colorado River not only for its future supply of water, but also for its power.[95]

The United States Bureau of Reclamation was just the outfit for the job. As the Imperial Valley's repeated failures evidenced, reining in the Colorado River was going to be a big job—a job that picks and shovels and farmers just could not get done. In recognition of the problem and similar problems across the West,[96] Congress passed the Reclamation Act of 1902,[97] creating the Bureau of Reclamation to build projects to draw water from the rivers and settlers to the West.[98] The Act was a leading example of "cooperative federalism"—the federal government would build the projects, but the states would regulate the use of their water.[99] It was intended as a great tool for democracy.[100]

The effects of the reclamation program can be seen in the "solid farming and ranching communities across the West, whether it be the Snake River plain, in the lower Yellowstone River valley, or in the Gunnison River valley."[101] But nowhere did the Bureau and its reclamation program leave a greater mark than on the Colorado River. The Act was fathered by powerful Colorado River men—Senators Francis Newlands and Bill Stewart of Nevada, Elwood Mead of Wyoming, and Major John Wesley Powell of the Colorado River itself[102]--and they were succeeded by powerful Colorado River men, men like Wayne Aspinall of Colorado, and Stewart and Mo Udall of Arizona. The result was a powerful triumvirate. The Basin States and their water users would call to Washington for federal projects, their delegates would demand them, and the Bureau would build them and propose more: the "Iron Triangle" of the Colorado River.[103]

These bonds can be traced to 1921, when Californians first

[93] *See* HUNDLEY, WATER AND THE WEST, *supra* note 82, at 4, 32, 90.

[94] *See* DONALD B. DODD, HISTORICAL STATISTICS OF THE UNITED STATES: TWO CENTURIES OF THE CENSUS, *1790 - 1990,* at 451 (1993).

[95] *See* FRADKIN, *supra* note 20, at 187.

[96] *See* California v. United States. 438 U.S. 645, 649 (1978).

[97] Act of June 17,1902. ch. 1093, 32 Stat. 388 (1902) (codified as amended in scattered sections of 43 U.S.C.).

[98] *See* GETCHES, WATER LAW, *supra* note 73, at 371-72.

[99] *See California,* 438 U.S. at 650.

[100] WILKINSON. CROSSING THE NEXT MERIDIAN, *supra* note 68, at 243, 246-47.

[101] *Id.* at 248.

[102] *See id*. at 236-47.

[103] FRADKIN, *supra* note 20. at 61.

called Bureau Commissioner Arthur Powell Davis, John Wesley's nephew, to the Colorado River.[104] The Bureau of Reclamation, with determination to match the river's might, responded by proposing to build the Imperial Valley irrigators the All-American Canal to transport Colorado River water. The Bureau also proposed to build California, the only state in a position to significantly use the river, a large dam upstream on the mainstem of the river.[105] The proposal heightened the other basin states' fear of losing their "fair share" of the Colorado to California.[106] California had the equities against it: Ready to take four or five million acre-feet of Colorado River water, California contributed virtually nothing to its flow, most of which came from the mountains of Colorado and Wyoming.[107] Acting on their fear, the other basin states rallied their political power in the United States Senate and successfully blocked the proposals.[108]

By 1920, all parties felt a need to negotiate their claims to the river. California needed the other basin states to acquiesce at least to its bid for a canal and dam on the Colorado for water and power. An agreement would also protect California from the possibility that the upstream states would simply take all of the water.[109] The other states needed protection from California's insatiable demand for water. After eight meetings,[110] delegates of all seven basin states finally settled on a way to divvy up the Colorado. Based on the geography, topography, and climate of the Colorado basin, the states agreed to split the river in two.[111] The Upper Basin (Colorado, New Mexico, Utah, and Wyoming) and the Lower Basin

[104] *See* PETER WILEY & ROBERT GOTTLIEB, EMPIRES IN THE SUN: THE RISE OF THE NEW AMERICAN WEST, 14 (1982).

[105] *See* MARTIN, *supra* note 51, at 23-24.

[106] *See* Arizona v. California, 373 U.S. 546, 555 (1963).

[107] *See*. REISNER, *supra* note 13, at 124.

[108] *See*. *id.*; Charles. Meyers, *The Colorado River*, 19 STAN. L. REV. 1, 11-12 (1967).

[109] Meyers, *supra* note 108, at 11.

[110] Sibley, *A Tale of Two Rivers*, *supra* note 87, at 13. "The first meeting was held in Wahington, D.C., in January 1922, with subsequent meetings in Phoenix, Los Angeles, Salt Lake City, Grand Junction (Colorado), Denver, Cheyenne and, finally Santa Fe. The future of much of the river might have been predicted from the location of those meetings—only the Grand Junction meeting was in the river's natural basin. The rest took place in Colorado River Basin states, but outside of the river's watershed." *Id.* Even though there were 26 million acres of Indian reservations in the Colorado River Basin, and the states were well aware of the potential of *Winters* rights to Colorado River water attaching to that land, the tribes were not included in any of the negotiations. *See* HUNDLEY, WATER AND THE WEST *supra* note 82, at 80.

[111] *See* Sibley, *A Tale of Two Rivers*, *supra* note 87, at 12.

(Arizona, California, and Nevada) would each get approximately half of the river's annual flow as measured at Lee's Ferry at the mouth of Glen Canyon.[112] Lee's Ferry would also serve as the dividing point between the two basins.[113]

The states based the Compact on the United States Geological Survey's estimate that the average annual flow of the Colorado River was 17.4 maf.[114] The estimate, however, was based on only twenty years of measurements[115] made hundreds of miles south of Lee's Ferry at Yuma, Arizona.[116] To be conservative, the parties allocated 7.5 maf to each of the basins, leaving on average 1.5 maf for a potential future treaty with Mexico and one million as surplus.

The delegates at the negotiations agreed to the Colorado River Compact[117] in November of 1922.[118] Specifically, the Compact limits[119] each basin's use to 7.5 maf per year,[120] but *prohibits* the Upper Basin from depleting the flow of the Colorado River at Lee's Ferry 75 maf over any ten year period.[121] The states

[112] *See, e.g.,* Arizona v. California. 373 U.S. 5-16, 557 (1963); REISNER, *supra* note 13, at 124-25. Lee's Ferry is alternatively referred to as Lee Ferry and Lees Ferry.

[113] *See* REISNER, *supra* note 13, at 125.

[114] *See* HUNDLEY, WATER AND THE WEST, *supra* note 82, at 184.

[115] *See* Sibley, *A Tale of Two Rivers*, *supra* note 87, at 12.

[116] *See* HUNDLEY, WATER AND THE WEST, *supra* note 82, at 184.

[117] The full text of the Compact was not printed in the *Statutes at Large* or *the United States Code*, but it is available in a number of sources. *See, e.g.,* 70 CONG. REC. 324 (1928): HUNDLEY, WATER AND THE WEST, *supra* note 82, at 337-43; U.S. DEP'T OF THE INTERIOR. DOCUMENTS ON THE USE AND CONTROL OF THE WATERS OF INTERSTATE AND INTERNATIONAL STREAMS 39 (1956); RAY LYMAN WILBUR & NORTHCUT ELY, THE HOOVER DAM DOCUMENTS 203 (2d ed. 1948). The Colorado Compact is hereinafter referred to as "the Compact. "

[118] *See* HUNDLEY, *supra* note 7, at 18. However, the Compact was not declared effective until 1929 and was not ratified by all of the states until 1944, when Arizona finally signed on. *See* Meyers, *supra* note 108, at 12.

[119] *See* Meyers, *supra* note 108, at 15.

[120] Article III(a) of the Compact provides: "There is hereby apportioned from the Colorado River system in perpetuity to the Upper Basin and to the Lower Basin, respectively, the exclusive beneficial consumptive use of 7,500,000 acre-feet of water per annum .... Under Article III(b), however, the Lower Basin is "given the right to increase its beneficial consumptive use of such waters by one million acre-feet per annum."

[121] Article III(d) of the Compact provides: "The States of the Upper Division will not cause the flow of the river at Lee Ferry to be depleted below all aggregate of 75,000,000 acre-feet for any period of ten consecutive years reckoned in continuing progressive series … ."

Generally, the Upper Basin is required to *deliver* to the Lower Basin 75 maf every ten years. This is not always the case, however. The Upper Basin has no obligation to deliver more water than is naturally in the River because the Compact *prohibits depletion* rather than *requiring delivery*. The Upper Basin's obligation under the Compact is also tempered by the fact that the Compact protects water rights perfected prior to 1922. Article VIII of the Compact provides, in part: "Present perfected rights to the beneficial use of waters of the Colorado River System are unimpaired by this compact."

within each basin would have to divide the 7.5 maf among themselves.

The Compact satisfied California because it meant that the state could start developing the Colorado River in earnest. The Upper Basin states were also satisfied "because Los Angeles, the thousand-pound gorilla," had been caged by the Compact. But the Compact put Arizona and Nevada in with the gorilla. Nevada was little more than a hangover from mining booms. Arizona, harboring its own California dreams, found itself in the cage with the gorilla and refused to endorse the agreement on the grounds that it would permit California to take all of the Lower Basin's allocation.[122] Arizona's fight against California over the Colorado River lasted at least forty-four years, taking the form of "five lawsuits in the United States Supreme Court, a filibuster in the Senate, a muster of troops by Arizona at the California border, and hundreds of thousands of words in congressional hearings and judicial proceedings."[123]

In 1928, the Boulder Canyon Project Act[124] overrode (at least initially) Arizona's objection to the Compact, providing that the Compact would be binding upon ratification by six of the seven basin states, effectively dividing the Lower Basin's 7.5 maf between the three Lower Basin states.[125] With the Upper Basin safe and Arizona pushed aside, California and the Bureau of Reclamation took center stage for the next twenty years.

B. *The Boulder Canyon Project Act and Hoover Dam*

While the Boulder Canyon Project Act allocated the Colorado among the Lower Basin states, its influence did not end there. The Act also began the Bureau of Reclamation's "great dam-building era"[126] that did not end until some $21.8 billion had been invested in 133 western water projects—including Glen Canyon Dam.[127] The Bureau inaugurated the era with the building of the All-Ameri-

[122] Sibley, *A Tale of Two Rivers*, *supra* note 87, at 13.

[123] Meyers, *supra* note 108, at 38 (citations omitted).

[124] Pub. L No. 70-642, 45 Stat. 1057 (1928) (codified as amended at 43 U.S.C. §617-617t (1994)).

[125] The Act effectively limited California's share of the 7.5 maf to 4.4 maf. *See* 43 U.S.C. § 617c(a) (1994). The implications of the Act's allocation of the Lower Basin's water was the subject of years of litigation, and was finally settled in Arizona v. California, where the court based its decision to allocate 2.8 maf to Arizona, 4.4 maf to California, and 0.3 maf to Nevada on the terms of the Boulder Canyon Project Act. *See* Arizona v. California. 373 U.S. 546, 564-65 (1963).

[126] FRADKIN, *supra* note 20, at 143.

[127] *See* WESTERN WATER POLICY REVIEW ADVISORY COMM'N. WATER IN THE WEST CHALLENGE FOR THE NEXT CENTURY 2-9 (1998) [hereinafter WATER IN THE WEST].

can Canal and giant Hoover Dam[128] -both built primarily for the benefit of Los Angeles and the Imperial Valley.

Hoover Dam, which stands in the Colorado River between Arizona and the southern tip of Nevada, was completed in 1935. At the time, it was the largest structure ever built.[129] Hoover's 4.4 million cubic yards of concrete—more than all fifty of the Bureau's previous dams combined[130]-—stood 726.4 feet high, arched 1244 feet, and spread 660 feet thick at its base. It generated more hydroelectric power than any installation on Earth and stored 28.5 maf of Colorado River water—more than two years worth of flow.[131] Even today Hoover remains the tallest concrete dam in the West Hemisphere, boasts the largest man-made lake in America and is considered one of America's "Seven Modern Engineering Wonders."[132]

The project was an immediate success. Completed more than two years ahead of schedule, the private contractors made more than a ten million dollar profit.[133] But the Hoover Dam project was about more than water and money. As President Franklin Delano Roosevelt said at the dam's dedication, it was about "altering the geography of a region."[134] Amidst the deepest days of the

[128] The All-American Canal was completed in 1940. *See* HUNDLEY, WATER AND THE WEST, *supra* note 82, at 296. Hoover Dam was originally named Boulder Dam for the canyon in which it had originally been sited. The dam temporarily held its original name even though it was built in Black Canyon. It was renamed in 1930 in honor of President Herbert Hoover, who had chaired the 1922 Compact negotiations as United States Secretary of Commerce.

[129] *See* MARTIN, *supra* note 51, at 35.

[130] *See id* at 37.

[131] *See* BUREAU OF RECLAMATION U.S. DEP'T OF THE INTERIOR, HOOVER DAM (1991) (tour pamphlet); Bureau of Reclamation, U.S. Dep't of the Interior *Dam Statistics* (visited July 6, 1999) <http://www.hooverdam.com/workings/damstats.htm>; Bureau of Reclamation, U.S. Dep't of the Interior, *The Story of Hoover Dam: How It All Works* (visited July 6 1999) <http://www.hooverdam.com/workings/htm>. From an engineering standpoint, Hoover Dam was "grossly overbuilt even without its pronounced upstream curve Donald C. Jackson, BUILDING THE ULTIMATE DAM: JOHN S. EASTWOOD AND THE CONTROL OF WATER IN THE WEST 247 (1995). This excessive construction of Hoover Dam foreshadowed the future development of the river. *See, e.g.*, HUNDLEY, WATER AND THE WEST, *supra* note *82*, at *335* (suggesting that "perhaps too many" dams were built on the Colorado River). Today, the Colorado's Upper Basin provides more storage per land area than any other place in the United States. *See id.* at 2-5.

[132] Bureau of Reclamation, *supra* note 131; BUREAU OF RECLAMATION, THE STORY OF HOOVER DAM, *supra* note 131. Lake Powell is the second largest man-made lake in the country.

[133] Wiley & Gottlieb *supra* note 104, at *19.*

[134] *President's Talk at Boulder Dam*, N.Y. TIMES, Oct. 1, 1935, at 2 (quoting President Roosevelt). At the dedication, Secretary of the Interior Harold Ickes explained to the crowd and the country over the radio that "gradually man has come to realize that in destroying nature he is destroying man himself." Charles W. Hurd, *President Asks Industry: Take the Responsibility of Speeding Employment—Speaks at Boulder Dam*, N.Y, TIMES Oct. 1, 1935, at 1. The Colorado River delta is one example of how Hoover Dam altered the geography of the region. While Hoover Dam was filling, virtually no water reached the delta. *See.* Glenn et al., *supra* note 39, at 1175, 1177; Daniel F. Luecke et al., *A Delta Once More: Restoring Riparian and Wetland Habitat in the*

Depression, it was also about national pride:

> It was America. It was moving mountains or rivers to achieve growth. It was what people during those depression years hoped would portend this nation's future—a tangible promise of prosperity rising Phoenix-like from the muck of a black canyon .... Never mind that a total of 110 men had died during its construction. It had been done. The river had been tamed, and now the water could be safely distributed below.[135]

Frank Waters described the dam as "a fabulous, unearthly dream. A visual symphony written in steel and concrete . . . [it] is inexpressibly beautiful of line and texture, magnificently original, strong, simple and majestic as the greatest works of art of all time and all peoples, and as eloquently expressive of our own as anything ever achieved."[136] Even Wallace Stegner could not help but appreciate the magnificence of Hoover Dam: "[N]obody can visit [Hoover] Dam itself without getting that World's Fair feeling. It is certainly one of the world's wonders … Everything about the darn is marked by the immense smooth efficient beauty that seems peculiarly American."[137]

The Bureau of Reclamation emerged from its Hoover Dam project one of the most revered and powerful agencies in the West,[138] and it only got bigger and more powerful. Less than ten years later, the Bureau completed Shasta Dam on the Sacramento River, a dam one-and-a-half times the size of Hoover.[139] Shortly after came Grand Coulee Dam on the Columbia River, hailed as "the greatest engineering feat ever undertaken."[140] It was built with

Colorado River Delta 2 (1999) (available at <http://www.edf.org/pubs/Reports/Delta/delta.pdf> [hereinafter Luecke et al., *A Delta Once More]*. The "ecologically devastating event" of Hoover Dam's construction "marks the beginning of the modern era toy the Colorado delta." *Id.*

[135] FRADKIN, *supra* note 20, at 239.

[136] Frank Waters, THE COLORADO 337 (1946)

[137] Wallace Stegner, *One Man's Rediscovery of America: Part Three*, SATURDAY REV. LITERATURE, Oct. 19, 1946, at 21, 21.

[138] *See* Marc Reisner & Sarah Bates, OVERTAPPED OASIS: REFORM OR REVOLUTION FOR WESTERN WATER 19 (1990).

[139] *See* MARTIN, *supra* note 51, at 48.

[140] WILKINSON, CROSSING THE NEXT MERIDIAN, *supra* note 68, at 196.

more concrete than Shasta and Hoover combined,"[141] and, for the first time in 3000 years, used more masonry than the largest Egyptian pyramid.[142]

The federally subsidized power and water provided by these dams cultivated avid supporters for the Bureau's darn building. It was easy to recruit the workers that built the dams, the engineering companies that grew rich off of the federal contracts, the irrigation farmers, and the urban millions who used the cheap hydropower. The catastrophic Mississippi River flood of 1928, the Dust Bowl of the 1930s, and the insatiable demand for war-time power in the 1940s convinced the few that were unsure to join in the Bureau's dam-building campaign.[143]

C. *The Colorado River Storage Project Act and Glen Canyon Dam*

While the Bureau was busy building dams, "the Upper Basin slumbered from the Compact signing through the Great Depression. Roosevelt's New Deal barely touched the Upper Basin, and even World War II bypassed it."[144] The Compact had given the Upper Basin the sense of security it had hoped for in signing it.

By the 1950s, however, the Bureau was at the zenith of its great dam-building era,[145] and it had big plans for the Upper Basin, where some of the few remaining big-dam sites could be found. As Reclamation Commissioner and potentate Floyd Dominy[146] reflected, "unregulated, the Colorado River wouldn't be worth a good God damn to anybody,"[147] and he and the Bureau were going to continue doing something about it. The Bureau had released in 1946 its well-known report, *The Colorado River A Natural Menace Becomes a National Resource*, which proposed spending nearly two billion dollars on 100 water projects on the upper Colorado River alone.[148]

[141] *See* MARTIN, *supra* note 51. at 48.

[142] *See* Jackson, *supra* note 131, at 247.

[143] *See* REISNER & Bates , *supra* note 138, at 17-21

[144] Sibley, *A Tale of Two Rivers*, *supra* note 87, at 14.

[145] *See* Michael Collier et al., *Dams and Rivers: Primer on the Downstream Effects of Dams*, U.S. GEOLOGICAL SURVEY CIR. 1126. at 4 (1996) (providing the. number of major dam closures per year between 1910 and 1980).

[146] As Floyd Dominy himself explains, "1 was a one-man Bureau of Reclamation. I stood up to whoever got in my way—including Stewart Udall." Tom Wolf, *"Mr. Dominy, Are You a Hero or a Villain?*", HIGH COUNTRY NEWS, Oct. 26, 1998, at 20.

[147] JOHN MCPHEE, ENCOUNTERS WITH THE ARCHDRUID 240 (1971)

[148] *See* WILEY & GOTTLIEB, *supra* note 104, at 43. *See* generally BUREAU OF RECLAMATION, U.S. DEP'T OF THE INTERIOR, THE COLORADO RIVER: "A NATURAL MENACE BECOMES A NATIONAL RESOURCE": A COMPREHENSIVE REPORT OF THE DEVELOPMENT OF WATER RESOURCES OF THE COLORADO RIVER BASIN FOR IRRIGATION, POWER PRODUCTION, AND OTHER BENEFICIAL USES IN ARIZONA, CALIFORNIA, COLORADO, NEVADA, NEW MEXICO, UTAH AND WYOMING (1946) ("The Blue Book").

At the same time, the Upper Basin's sense of security from the Compact was beginning to wear off. California was growing as fast as ever,[149] and now California controlled virtually all of the major developments on the river. By 1952, California was consuming 5.3 maf of Colorado River water each year[150]-nearly 1 maf more than it was allocated by the Boulder Canyon Project Act. To make matters worse, Arizona was also booming; Phoenix had nearly quadrupled its size in the thirty years since the Compact.[151] The entire region was looking to the Colorado Plateau and its central artery to satisfy its resource cravings. Unable to rid itself of prior-appropriation nightmares, the Upper Basin states feared that California, and now Arizona, would appropriate the Upper Basin's share of the Colorado regardless of the Compact.[152] The Upper Basin states needed at least one large dam upriver from Lee's Ferry to regain their sense of security.

A far more serious, although perhaps less potent, problem was also evident. The annual flow of the Colorado was nowhere near the 17.4 maf that the parties assumed was available when they negotiated the Compact. Since 1930, an annual average of only 11.7 maf had flowed past the gages at Lee's Ferry,[153] and the long-term average is about 13.5 maf, with historical droughts diminishing the river's average annual flows to less than 11 maf for up to two decades."[154]

This miscalculation was especially serious for the Upper Basin. The Compact was worded such that the Upper Basin is generally required to deliver the Lower Basin a minimum of 75 maf every ten years.[155] As a result, the weight of the mistake of fact sat squarely on

[149] Pushing two million residents, Los Angeles added nearly 500,000 to its population during the 1940s. *See* DODD, *supra* note 94, at 451.

[150] *See* REISNER, *supra* note 13, at 260.

[151] *See* Dodd *supra* note 94, at 455.

[152] *See* FRADKIN, *supra* note 20, at 191.

[153] *See* REISNER, *supra* note 13, at 262-63. 111 one Year, 1934, the Colorado flowed a measly total of 4.4 maf. *See Information Publicly Available*, *supra* note 71, at 2.

[154] *See* Meko et al., *supra* note 35, at 800. Other evidence confirms the tree-ring analyses *See* Steve Elliott, *Clam Shells Indicate Colorado Flow Was Once Slower*, PORTLAND OREGONIAN, Apr. 19, 1998, at A24. The average annual flow from 1906-1994 was 15.1 maf. *See* WATER IN THE WEST, *supra* note 127, at 2-3.

[155] Article III (d) of the Compact reads: "The States of the Upper Division will not cause the flow of' the river at Lee Ferry to be depleted below all aggregate of 75,000,000 acre-feet for any period of ten consecutive years reckoned in continuing progressive series…"

the Upper Basin's shoulders. "[T]he upper basin states had been inadvertently snookered,"[156] and they felt a desperate need for drought insurance. Some of the Upper Basin states also were beginning to have "California dreams" of their own and were concerned about future growth.

Moreover, the Upper Basin had other water commitments to consider. The United States had finally signed a treaty guaranteeing Mexico 1.5 maf of Colorado River water per year, half of which was to come out of the Upper Basin's share.[157] The Upper Basin, then, was prohibited from depleting the flow of the Colorado River at Lee's Ferry below 8.25 maf of water per year.[158] With the United States finally considering the 38,000 Native Americans in the Upper Basin and their potential Winters rights,[159] the Upper Basin's entitlement seemed to be shrinking rapidly. So the Upper Basin quickly refocused its attention on water. In 1948, the four states divided their share of the Colorado River under the Upper Colorado River Basin Compact.[160] That done, they approached the all-

[156] WILKINSON, CROSSING THE NEXT MERIDIAN, *supra* note 68, at 226.

[157] *See.* Treaty Respecting Utilization of Waters of the Colorado and Tijuana River s and of the Rio Grande, Feb. 3, 1944, U.S.-Mex., art. 10, 59 Stat. 1219, 1237 ("Of the waters of the Colorado River, from any and all sources, there are allotted to Mexico: (a) A guaranteed annual quantity of 1,500,000 acre-feet (1,850,234,000 cubic meters) . . .").

[158] In fact, the Upper Basin is generally required to deliver an average of 8.23 maf per year to Lee's Ferry. Article 111(d) prohibits the Upper Basin from depleting the flow of the Colorado below all average of 7.5 maf per year. The treaty with Mexico generally requires the Upper Basin to deliver one-half of the United States' 1.5 maf per year obligation, or 0.75 maf per year. However, the Upper Basin's total obligation is credited with the average annual flow of 20,000 acre-feet of the Paria River, which flows into the Colorado between Glen Canyon Dam and Lee's Ferry. *See* Larry L. MacDonell et al., *The Law of the Colorado River. Coping with Severe. Sustained Drought,* in 31 WATER RESOURCES BILL. 825, 829 (1995).

[159] *See* LLOYD BURTON, AMERICAN INDIAN WATER RIGHTS AND THE LIMITS OF LAW 23-24 (1991); MARTIN, *supra* note 5 1, at 55. In *Winters* v. *United States,* the Supreme Court held that a treaty between the United States and the Indians of the Fort Belknap Reservation impliedly reserved, with a priority date of that of the creation of the reservation, sufficient water to fulfill the purposes of the reservation, which was to facilitate the transformation of the Indians into a "pastoral and civilized people." 207 U.S. 564, 576 (1908). The doctrine announced in *Winters* was confirmed and clarified in *Arizona v. California,* where the Supreme Court held that five Indian reservations along the lower Colorado River were entitled to water from the mainstream of the river. 373 U.S. 546, 595-601 (1963). For more on *Winters* rights, *See* DAVID H. GETCHES ET AL., FEDERAL INDIAN LAW 796,859 (4th ed. 1998).

[160] 63 Stat. 31 (1949) (allocating Colorado 51.75%, Utah 23%, Wyoming 14%, New Mexico 11.25%, and Arizona 50,000 acre-feet of the Upper Basin's annual entitlement under the Compact).

too-willing Bureau of Reclamation to build more dams.

In response to the Upper Basin's pleas, in 1949 the Bureau proposed the gargantuan Colorado River Storage Project ("CRSP"), which contemplated the construction of four large dams on the Colorado: Bridge Canyon Dam just down river from Grand Canyon National Monument, Glen Canyon Dam just upriver from Lee's Ferry, Flaming Gorge on the Green River near the Wyoming-Utah border, and Echo Park Dam in Dinosaur National Monument.[161] The proposal was projected to cost $1.4 billion—"at least $10,000 in federal expenditures for every man, woman and child in the upper basin"-and would store nearly four years' worth of the Colorado River.[162]

D. *David Brower and the Fight Against Dams in the Upper Basin*

At the time of the CRSP proposal in 1949, the Sierra Club was a 6000 member regional organization.[163] The Club was founded in 1892, and through its first president and cofounder, John Muir, became one of the nation's leading advocates for national parks. Muir played a direct and significant role in the protection of Yosemite, the Grand Canyon, and the Petrified Forest in Arizona.[164] What effect his fireside advocacy had during a three-day trip in 1903 through the Sierra Nevada with Theodore Roosevelt[165]—who would set aside more than 200 million acres of federal lands as national forests, national monuments, and national wildlife refuges[166]no—is open to speculation. But Muir lost his greatest battle, a vigorous campaign against the construction of Hetch Hetchy Dam in Yosemite National Park. The dam was authorized in 1913, and Muir died in 1914 as the dam was being raised.[167]

Nevertheless, as Muir himself recognized just before his death, the Hetch Hetchy controversy had aroused "the conscience of the whole country … from sleep."[168] By seriously challenging the

[161] MARTIN, ***supra*** note 51, at 49-50.

[162] *See id.* at 54, 56.

[163] *See id* 50.

[164] *See* EDWIN WAY TEALE**,** *Introduction to* THE WILDERNESS WORLD OF JOHN MUIR, at xx (1954); *See* also NASH, *supra* note 63, at 138-40.

[165] *See* NASH, *supra* note 63, at 138-39.

[166] *See* GEORGE CAMERON COGGINS ET AL., FEDERAL PUBLIC LAND AND RESOURCES LAW 107. 122, 139, 306 (3d ed. 1993).

[167] *See* Nash 1, *supra* note 63, at 200.

[168] Letter from John Muir to Robert Underwood Johnson, Jan. 1, 1914, in Nash. *supra* note 63, at 180.

damming of Hetch Hetchy, Muir simultaneously elevated preservation, challenged wise-use conservation,[169] and deflated exploitation. Preservationists gained a national constituency and learned how to maneuver within the political arena. Just as importantly, "in Hetch Hetchy they had a symbol which ... would not easily be forgotten."[170]

By 1949, although the rest of the country had not forgotten Hetch Hetchy, it seemed that Muir's own Sierra Club had. At least seventeen conservation groups, including the lzaak Walton League and the Wilderness Society, opposed the Bureau's plans to build a dam in Dinosaur National Monument and to inundate Grand Canyon National Monument.[171] The Sierra Club, on the other hand, initially ignored the Echo Park proposal in Dinosaur National Monument and *endorsed* the Bridge Canyon proposal in the Grand Canyon.[172] Nevertheless, the Bridge Canyon proposal was successfully blocked in 1950, at least temporarily.[173]

In 1952, however, Sierra Club board member David Brower was promoted to executive director, making him the Club's first full-

[169] Muir can he credited with separating the Preservation Movement from the Progressive Conservation Movement. As a preservationist, Muir advocated protecting the environment in its natural state—wilderness. Progressive conservationists like Gifford Pinchot, on the other hand. advocated "the wise use or planned development of resources." NASH, *supra* note 63, at 129. *See generally* SAMUEL P. HAYES, CONSERVATION AND THE GOSPEL OF EFFICIENCY: THE PROGRESSIVE CONSERVATION MOVEMENT 1890-1920 (1980).

[170] NASH, *supra* note 63, at 180.

[171] The Grand Canyon was made a National Park in 1919. *See* Act of Feb. 26, 1919, 40 Stat. 1175 (codified as amended at 16 U.S.C. §§ 221-28 (1994)). Before that, it was a National Monument. *See* Proclamation No. 794, 35 Stat. 2175 (1908). The legislation creating Grand Canyon National Park provided that "whenever consistent with the primary purposes of said park, the Secretary of the Interior is authorized to permit the utilization of areas therein which may be necessary for the development and maintenance of a Government reclamation project." Act of Feb. 26, 1919, Pub. L. No. 65-277, ch. 44, § 7, 40 Stat. 1175, 1178 (1919) (codified as amended at 16 U.S.C. § 227 (1994)). The National Park Service also opposed the proposal to build a dam in Dinosaur National Park. The Bureau of Reclamation, used to getting its way within the Department of the Interior, failed to even notify its sister agency before floating its proposal. On reading of the reservoir site withdrawal in the Federal Register, 8 Fed. Reg. 10,370 (1943), Park Service Director Newton Drury suggested to the Secretary that there must have been a misunderstanding by the Bureau. There was none, however, and Secretary Chapman eventually approved the proposal. *See*, WILLIAM C. EVERHART, THE NATIONAL PARK SERVICE 153 (1972).

[172] *See Colorado River Basin Project: Hearings on H.R 3300, S. 20, and Similar Bills Before the Subcomm. on Irrigation and Reclamation of the House Comm. on Interior and Insular Affairs*, 90th Cong. 418 (1967) (statement of David Brower, Executive Director, Sierra Club) ("I was one of 15 directors of the Sierra Club who in 1949 ... voted unanimously to approve the building of Bridge Canyon Dam…."); MARTIN, *supra* note 51, at 51.

[173] *See infra* Part III.F.

time staff member.[174] Brower quickly realized the terrible precedent that a dam in Dinosaur National Monument would set. As a result, the Club changed its position on the Bureau's proposal. This change of position and heart quickly put the Sierra Club—and Brower—at the forefront of the effort to save Dinosaur from the Bureau.

Brower released a movie showcasing the monument's nearly untouched wilderness, which was shown hundreds of times across the country. He wrote inspiring articles and helped start a massive letter-writing campaign that resulted in thousands of letters piling up eighty-to-one against the dam.[175] The *New York Times* editorialized that the fight over Dinosaur would set a precedent for the entire national park system—if Dinosaur could be sacrificed, so could every other park in the country.[176]

Yet opponents of the Echo Park Dam faced a nearly impossible task. They would have to overcome the steam-rolling Bureau,[177] the desperate and paranoid Upper Basin states, and Wayne Aspinall, Colorado's powerful chairman of the House Subcommittee on Irrigation and Reclamation. They would have to break the bonds of the Iron Triangle of the Colorado River. The environmentalists were proposing to take the pistons out of Colorado River Storage Project's engine.[178] No one, David Brower included, even considered suggesting that the Upper Basin did not need the water that Echo Park would supply. Instead, the strategy was to store the water elsewhere, perhaps by simply raising the height of the dam scheduled for Glen Canyon.[179]

[174] *See* MARTIN, *supra* note 51, at 58; REISNER, *supra* note 13, at 283.

[175] *See* MARTIN, *supra* note 51, at 58-59; Nash, *supra* note 63, at 212.

[176] *See No Dam at Dinosaur*, N.Y. Times Dec. 22, 1953, at 30 (editorial) ("If the Administration and Congress are so ill-advised as to proceed with construction of Echo Park Dam in Dinosaur National Monument we might as well look ahead to another dam flooding out part of Glacier National Park, still another one wrecking a chunk of the Grand Canyon, and lumber companies moving in on Olympic National Park.").

[177] As Senator Milliken commented in the 1955 Senate CRSP hearings, "if y on are looking for someone to protect the United States as a Federal Agency, who would you find is a more experienced outfit than the Bureau of Reclamation?" *Colorado River Storage Project: Hearings on S. 500 Before the Subcomm. on Irrigation and Reclamation of the Senate Comm. On Interior and Insular Affairs*, 84th Cong. 642 (1955).

[178] *See Colorado River Storage Project Act: Hearings on H.R. 4449, H.R. 4443, and H.R. 4463 Before, the Subcomm. on Irrigation and Reclamation of the House Comm. on Interior and Insular Affairs*, 83d Cong. 24 (1954) (statement of Ralph A. Tudor, Under Secretary of the Interior).

[179] In the 1955 Senate hearings, Brower maintained that although the Sierra Club had -not recommended High Glen as an alternate," the), "would not have any objection to a Glen Canyon Dam, low or high, that was part of a sound project that did not threaten Rainbow Bridge National Monument." *Colorado River Storage Project: Hearings on S. 500 Before the Subcomm. on Irrigation and Reclamation of the Senate Comm. on Interior and Insular Affairs*, 84th Cong. 643 (1955).

To stem the growing tide of public opinion opposed to the Echo Park Dam, western congressmen of both houses decided to hold hearings. The House hearings began in January of 1954 with six days of testimony from the Bureau of Reclamation and other dam Supporters.[180] When it was finally Brower's turn, he began by reminding the congressmen of Muir's struggle against the dam that drowned Hetch Hetchy Valley, "[if] we heed the lesson learned from the tragedy of the misplaced dam in Hetch Hetchy, we can prevent a far more disastrous stumble in Dinosaur National Monument."[181] He brought the tragedy alive by showing a before-and-after film of Yosemite's Hetch Hetchy Valley.[182]

Brower went on to show that the Bureau, which proclaimed evaporation as the "fundamental issue," in rejecting the environmentalists' proposed alternative of heightening Glen Canyon Dam,[183] had made a miscalculation. Brower showed that, instead of increasing the annual losses by the 165,000 acre-feet the Bureau had mistakenly reported as a result of a subtraction error, the Glen Canyon proposal would actually save 2610 acre-feet in annual evaporative losses (while at the same time storing 700,000 acre-feet more water).[184] Brower concluded that Congress "would be making a great mistake to rely upon the figures presented by the Bureau of Reclamation when they cannot add, subtract, multiply, or divide."[185] The hearings had clearly backfired for the Colorado River delegation, and the Sierra Club continued its campaign against the dam. David Brower recruited Wallace Stegner, a long time Sierra

[180] *See generally Colorado River Storage. Project Act: Hearings on H.R. 4449, H.R. 4443, and H.R. 4463 Before, the Subcomm. on Irrigation and Reclamation of the House Comm. on Interior and Insular Affairs*, 83d Cong. (1954).

[181] *Colorado River Storage Project Act: Hearings on S. 1555 Before the Subcomm.* 071 Irrigation *and Reclamation of the Senate Comm. on Interior and Insular Affairs*, 83d Cong. 503 (1954)

[182] NASH, *supra* note 63, at 215.

[183] *Colorado River Storage Project Act: Hearings on H.R. 4449, H.R. 4443, and H.R. 4463 Before the Subcomm. on Irrigation and Reclamation of the House Comm. on Interior and Insular Affairs*, 83d Cong. 22 (1954) (statement of Ralph A. Tudor, Under Secretary of the Interior).

[184] *See id.* at 795.

[185] *Id. at* 824; *See also id.* at 795 (testifying that the Bureau of Reclamation "made three big errors and one little one in this one matter alone.... I submit that I know ninth-grade arithmetic. I shall be glad to do the arithmetic, if you wish, but for now will just mention the four errors that might have cost us our park….").

Club member who had recently published *Beyond the Hundredth Meridian,"*[186] to edit a picture book about Dinosaur. Stegner agreed, and the result, *This Is Dinosaur: Echo Park Country and Its Magic Rivers*, was the first of its kind. It was a popular piece of conservation advocacy, full of essays and breathtaking photographs, and a copy was left on the desk of every member of the Congress.[187] Stegner wrote, "[o]ur book attempts no more than to show—so far as words and pictures can show a region so varied and colorful—what the people would be giving up, what beautiful and instructive and satisfying things their children and their grandchildren and all other Americans from then on would never see.[188]

Stegner's book was a great success, but he was already tasting the bittersweet of the battle. Stegner had floated through the virtually unknown Glen Canyon twice in recent years and warned Brower, "[s]trictly between us, Dinosaur doesn't hold a candle to Glen."[189] As Stegner had written in the previous year, "Glen Canyon ... is completely different. As beautiful as any of the canyons, it is almost absolutely serene, an interlude for a pastoral flute .... Its walls are the monolithic Navajo sandstone, sometimes smooth and vertical, rounding off to domes at the rims, sometimes undercut by great arched caves, sometimes fantastically eroded by slit side canyons, alcoves, grottoes green with redbud and maidenhair and with springs of sweet water."[190]

The struggle over Echo Park lasted until April 11, 1956, when Congress passed the Colorado River Storage Project Act.[191] The Act's water projects would cost more than $1.6 billion,[192] but there would be no Echo Park Dam. The environmentalists had also obtained language protecting Rainbow Bridge National Monument

[186] *See* generally STEGNER, HUNDREDTH MERIDIAN, *supra* note 60.

[187] *See* WILKINSON, CROSSING THE NEXT MERIDIAN, *supra* note 68, at 275.

[188] Wallace Stegner, *Foreword to* THIS IS DINOSAUR: ECHO PARK COUNTRY AND ITS MAGIC RIVERS v, vi (Wallace Stegner ed., 1955).

[189] Brower, *supra* note 2, at 43.

[190] Stegner, Hundredth Meridian, *supra* note 60. at 88.

[191] *See* Pub. L No. 84-485, 70 Stat. 105 (1956) (codified at 43 U.S.C. § 620 (1994)).

[192] According to Marc Reisner, CRSP's subsidies to irrigators would be worth as much as $2 million per farm perhaps five times as much as the farms themselves were worth." Reisner, *supra* note 13, at 144. Such irrigation subsidies were not new in 1956 and have played an important role in the reclamation of the West. *See* GENERAL ACCOUNTING OFFICE BUREAU OF RECLAMATION: INFORMATION ON ALLOCATION AND REPAYMENT OF COSTS OF CONSTRUCTING WATER PROJECTS 23-30 (GAO/RCED-96-109, 1996). For a map of the CRSP facilities, see Western Area Power Administration, *Colorado River Storage Project: Storage Units and Participating Projects* (visited Sept20, 1999) <http://www.wapa.gov/crsp/info/crspmap.gif>.

from the reservoir that would be created by Glen Canyon Dam: "It is the intention of Congress that no dam or reservoir constructed under this Act shall be within any national park or monument."[193] The Act also required "adequate protective measures to preclude impairment of the Rainbow Bridge National Monument."[194] Although Brower was unhappy about Glen Canyon Dam, the Sierra Club withdrew its opposition to the Act.[195]

Roderick Nash felt that with the Echo Park victory, "the American wilderness movement had its finest hour to that date."[196] Brower, on the other hand, viewed the trade of Dinosaur for Glen Canyon as a defeat. He felt "partly responsible for [Glen Canyon's] needless death,"[197] and regarded the compromise as "the greatest sin I have ever committed."[198] However, like the defeat at Hetch Hetchy, forty years earlier, the battle had inspired a multitude to speak up for the environment and to protect wilderness for its own sake. The environmentalists had developed new ways to muster political support: books, movies, letter-writing campaigns, advertisements, lobbying, and thorough congressional and administrative oversight. Brower and the environmentalists had denied the almighty Iron Triangle, and they had "helped found the modern environmental movement."[199] Perhaps most importantly, as the opening of Brower's testimony confirmed, the environmentalists learned to successfully, profit from their earlier defeats. This time, however, they not only had a potent symbol of destruction in Glen Canyon, but they also had a potent symbol of salvation in Dinosaur.

[193] 43 U.S.C. § 620b (1994).
[194] Id, at § 620.
[195] *See* MARTIN, *supra* note 51, at 71, 73.
[196] NASH, *supra* note 63, at 219.
[197] David Brower, Foreword to ELIOT PORTER, THE PLACE NO ONE KNEW: GLEN CANYON ON THE COLORADO 8 (David Blower ed., 1988) (1963).
[198] MARTIN, *supra* note 51, at 328. 111 1967, Brower explained to a congressional subcommittee:

> Rather late in the game we saw that raising the height of Glen Canyon Dam was unnecessary, but it was too late at that point to find out about it. I, myself, was in a position early in the Echo Park battle of thinking that a reasonable alternative to the building of Echo Park Dam was building of a higher Glen Canyon Dam. That was the most disastrous mistake I ever made.
>
> I have learned a great deal more now. I came to that conclusion before I had seen the country and I am a lot more careful now about drawing conclusions before I have seen what my conclusions would damage.

Central Arizona Project. Hearings Before the Subcomm. on Water and Power Resources of the Senate Comm. on Interior and Insular Affairs. 90th Cong. 457 (1967).
[199] WILKINSON, CROSSING THE NEXT MERIDIAN, *supra* note 68, at 275.

E. *Glen Canyon Dam*

It was not long after Glen Canyon's fate was decided that the Bureau of Reclamation's geologists and engineers began poking around in the canyon and taking notes to bring back to their drawing boards. Other scientists—archaeologists, historians, geologists, and biologists—came to learn and salvage what they could before the canyon was buried under Lake Powell. The archaeologists' studies proved to be the most far-reaching. When they arrived, the canyon was still archaeological *terra incognita.*[200] By the end of the project, however, dozens of the over 2000 sites recorded had been excavated and a three-foot high stack of reports had been published.[201] Glen Canyon emerged "as the best known archeological area of comparable size and difficulty in the West. "[202] Among other significant contributions of the study, "[t]he Anasazi were found to be far more innovative about water control and agricultural strategies than previously suspected."[203]

David Brower also came to Glen Canyon, declaring 1962 to be "The Year of the Last Look," and pleading to Americans that they "owe[d] it ... to the future to know and to remember these things lost."[204] He and Eliot Porter floated through the canyon collecting thoughts and photographs that would relate the tragedy of Glen Canyon in *The Place No One Knew: Glen Canyon on the Colorado*.[205] Edward Abbey also floated down the "doomed" canyon, recalling it as "a voyage like no other in my life, a continuous dream of marvels wonders, splendors, that has haunted me ever since."[206]

[200] GEIB, *supra* note 11, at 1.
[201] *See id*.
[202] JENNINGS, *supra* note 51, at 68.
[203] GEIB, *supra* note 11, at 3.
[204] David Brower, *Glen Canyon: The Year of the Last Look,* SIERRA CLUB BULL., June 1962, at 7.
[205] *See generally* PORTER, *supra* note 197.
[206] MARTIN, *supra* note 51, at 176 (quoting Abbey). Abbey's trip through Glen Canyon led him to be the first on record to entertain the idea of removing Glen Canyon Darn. While the dam was still under construction, Abbey, speculated that someday an unknown hero with a rucksack full of dynamite strapped to his back will descend into the bowels of the dam; there he will hide his high explosives where they'll do the most good. Attach blasting caps to the lot and with angelic ingenuity link the caps to the official dam wiring system in such a way that when the time comes for the grand opening ceremony ... the button which the President pushes will ignite the loveliest explosion ever seen by man, reducing the great dam to a heap of rubble in the path of the river. EDWARD ABBEY, DESERT SOLITAIRE: A SEASON IN THE WILDERNESS 188 (1968) [hereinafter Abbey, Desert SOLITAIRE]. The idea became the theme of his classic, *The Monkey Wrench Gang* (1975). a story about a group of radicals set on destroying Glen Canyon Dam by filling houseboats on Lake Powell with explosives. Abbey later acknowledged, "I hoped it would stir people into action to do things I am too cowardly to do myself." As for blowing up Glen Canyon Dam, Abbey said, "I wouldn't actually push the plunger, but I'd hold the flashlight." JAMES BISHOP JR., EPITAPH

On October 15, 1956, at the signal of President Eisenhower, a huge slab of red rock was blasted off of Glen Canyon's west wall.[207] By 1960, the dam began crawling up the canyon walls,"[208] and by the beginning of 1962 it was nearly halfway to completion."[209] When the last bucket of concrete was poured in 1963, Glen Canyon Dam was, at 710 feet, the second highest dam in the Western Hemisphere. It arched 1560 feet between canyon walls, over 300 feet wider than Hoover. Eighteen people had died, 348 had been seriously injured, nearly $300 million had been invested, and 10 million cubic yards of materials had been consumed.[210] The dam would eventually generate 1.35 million kilowatts of cash-producing electricity, storing 27 maf of water in a reservoir named in honor (or dishonor, depending who you ask) of John Wesley Powell.[211]

The longest reservoir in the world, Lake Powell would eventually extend 186 miles upriver and create nearly 2000 miles of shoreline, an area roughly equivalent to the coastline of the entire eastern seaboard of the United States.[212]

At 2:00 p.m. on March 13, 1963, the outlet gates to Glen Canyon Dam were fully closed, with the exception of gate No. 2, which was soon lowered to a one-foot, ten-inch opening.[213] From David

FOR A DESERT ANARCHIST THE LIFE AND LEGACY OF EDWARD ABBEY 14 (1995) (quoting Abbey).

[207] *See* BUREAU OF RECLAMATION, U.S. DEP'T *OF* THE INTERIOR, GLEN CANYON DAM AND POWERPLANT; TECHNICAL RECORD OF DESIGN AND CONSTRUCTION *411 (1970)* [hereinafter POWERPLANT TECHNICAL RECORD].

[208] *See* FRADKIN, *supra* note *20*, at *196.*

[209] *See* POWERPLANT TECHNICAL RECORD *supra* note 207, at 446.

[210] *See.* MARTIN, *supra* note 51, at 94 (stating that the dam consumed "five million barrels of cement, ten million cubic yards of aggregate, three million board-feet of lumber. *130,000* tons of steel, 20,000 tons of aluminum, [and] 5,000 tons of copper."); *See* also FRADKIN, *supra*. note 20, at 196*;* POWERPLANT TECHNICAL RECORD, *supra* note 207, at 3.

[211] *Compare ABBEY,* DESERT SOLITAIRE, *supra* note 206, at 173 (asserting that the reservoir was named "supposedly to honor but actually to dishonor the memory, spirit and vision of Major John Wesley Powell"). *with* POWERPLANT TECHNICAL RECORD, *supra* note 207. at 3-4 (noting that the reservoir was "named Lake Powell in honor of Major John Wesley Powell, renowned explorer of the Colorado River and its tributaries").

[212] *See* FEIS, *supra* note *10,* at *1-59 (1960* miles of shoreline when full); Technical Record, *supra* note *207,* at *4* (reservoir extends 186 miles upstream); WILKINSON, CROSSING THE NEXT MERIDIAN, *supra* note 68, at 258 (the longest reservoir in the world): *See also* 1998 WORLD ALMANAC AND BOOK OF FACTS 451 (Atlantic coastline of the United States is 2069 miles).

[213] *See.* POWERPLANT TECHNICAL RECORD *supra* note 207*,* at 416. The dam was dedicated on Thursday, September 22, 1966. At the ceremonies, Lady Bird Johnson told the crowd of thousands, "As I look around at this incredibly beautiful and creative work, it occurs to me that this is a new kind of writing on the walls, a kind that says proudly and beautifully, 'Man was here.'... I am proud that man is here." MARTIN, *supra* note. 51, at 279. Also on hand was Arizona Governor John Williams, Utah Governor Calvin Rampton, Navajo Tribal Council Chairman Raymond Nakai, Commissioner Floyd Dominy, and, yes, David Brower. Introducing Brower to the crowd, Dominy explained that he and Brower were going to spend several days on Lake Powell, so I can convert him a little. Then we're going down the river, so he can convert me." MCPHEE, *supra* note 147, at 196. On their trip, Dominy admitted to Brower, "When we destroyed Glen Canyon, we destroyed something really beautiful. But we brought something else. Water. You can lament all you want what we covered up. What we got is beautiful, and it's accessible." *Id.* at 203.

Brower's perspective, "from that moment the canyon's life force ebbed quickly."[214] When the gates dropped, the flow of the Colorado was reduced to a trickling 1000 cfs, and the waters began to slowly rise behind the dam.[215] In spite of the crucial language mandating that Rainbow Bridge National Monument be protected from the reservoir,[216] the water would extend up into the monument, intruding right under the magnificent bridge itself.[217] Without appropriations from Congress for protective measures, Secretary of the Interior Stewart Udall was helpless; besides, he felt that a protective dam in lower Rainbow Bridge Canyon would do more harm than good.[218]

Betrayed, Brower sued.[219] District court Judge Willis Ritter recognized that Rainbow Bridge was not only the world's largest natural bridge, but was also "far and away the most spectacular in all nature."[220] He issued an injunction[221] limiting Lake Powell's storage to half its capacity,[222] telling reporters that "[i]t was pretty sneaky of Congress to pass a law and then ignore it completely."[223]

[214] Brower, *supra* note 197, at 8.

[215] Meanwhile, Martin Litton—a director of the Sierra Club—was rafting down the Grand Canyon. A government plane flying overhead dropped a bag on the riverbank. In the bag was a warning to Litton's party to abandon their dories and hike out of the canyon at Whitmore Wash—the Colorado River had been shut off. *See*. MARTIN, *supra* note 51, at 254-55. Nevertheless, Litton continued down the canyon safely. Some thirty-five years later, at the age of eighty and in stride, Litton became the oldest man to boat the Colorado through the Grand Canyon. *See* John Balzar, *The Old Man and the River*, L.A. Times, May 11, 1997, at A1.

[216] *See supra* note 179 and accompanying text.

[217] *See*, FRADKIN, *supra* note 20, at 197.

[218] *See* MARTIN, *supra* note 51, at 219.

[219] *See* Fr iends of the Earth v. Armstrong, 360 F. Supp. 165 (D. Utah 1973), *vacated*, 485 F.2d 4 (10th Cir. 1974), cert. *denied, Friends* of the Earth v. Stamm, 414 U.S. 1171 (1974), *reh'g denied, 416* U.S. 952 (1974).

[220] *Armstrong*, 360 F. Supp. at 169.

[221] *See id.* at 194.

[222] *See* FRADKIN, *supra* note 20, at 197.

[223] MARTIN, *supra* note 51, at 306.

The Tenth Circuit, however, reversed.[224] The appeals court held that Congress' failure to appropriate funds—and prohibiting the use of funds in one appropriation act—took precedence over the explicit language of the Act.[225] Of course, the court did not fail to note its assumption that a full Lake Powell was required "to provide basic storage necessary to fulfill the delivery requirements to the downstream states and Mexico," and was important for the Upper Basin to "develop the water allocated to them for irrigation and other projects."[226] The environmentalists appealed to the Supreme Court, but the justices refused to hear the case.[227]

F. *The Grand Canyon Dams*

Whether the Echo Park/Glen Canyon compromise was a "victory" for the environmentalists, the result at Rainbow Bridge certainly was not. Nevertheless, they successfully sold both to the public as great defeats,[228] and they would soon use that claim to counter continuing efforts to dam the Colorado River.

The Colorado River Storage Project Act might have marked the end of an era. It finally gave the Upper Basin its own "Hoover Dam," providing some sense of fairness after thirty-five years of federal catering to the Lower Basin. But instead of ending an era, the passage of the Act marked the beginning of a new era-what Charles Wilkinson has called "the Big Buildup of the Colorado Pla-

[224] *See* Friends of the Earth v. Armstrong, 485 F.2d 1, 12 (10th Cir. 1974).

[225] *See generally id.*

[226] *Id.* at 6.

[227] *See* Friends of tire Earth v. Armstrong, 414 U.S. 1171 (1974) (denying petition for certiorari); 416 U.S. 952 (1974) (denying petition for rehearing). Members of the Navajo Nation also sued unsuccessfully, alleging that the operation of Glen Canyon Darn and Rainbow Bridge National Monument violated NEPA and their First Amendment right to freely exercise their religion. *See* Badoni v. Higginson, 638 F.2d 172 (10th Cir. 1980).

[228] *See e.g.,* PORTER, *supra* note 197, at 8. A July, 1963, New York Times editorial pointed out that:

> Many who knew the glen say it was the gentlest, most intimate of the mighty canyons of the Colorado, indeed one of the outstanding natural scenic places anywhere in America ....
>
> The eradication of so beautiful a land presents a puzzling commentary on the values of our society. Glen Canyon could have been placed beside Yosemite or Yellowstone to inspire future generations with its unsurpassed natural beauty. Instead, the loss of Glen beneath the silty, waters of Lake Powell will surely become one of the tragedies of the conservation effort in the 20th century. Compounding the tragedy is the very real doubt that the dam is actually needed.

The Glen Canyon Dam: It's a "Dam" Shame, N.Y. TIMES, July 5, 1963, at 18, *reprinted in 109* Cong. Rec. A4248 (1963).

teau."[229] During the Big Buildup, which lasted for twenty years after the passage of the Act, Americans harvested the natural resources of the Plateau with unprecedented vigor to satisfy the exploding growth throughout the West. With its coal mines, power lines, and road signs, the Big Buildup transformed the Southwest, "eclips[ing] virtually every other industrial effort on earth."[230] Water would retain its role as the focus of the Southwest, and the Colorado River would provide the foundation for the effort.

Glen Canyon Dam, although the "colossus of the Big Buildup,[231] could not satisfy all of the Southwest's desires. Despite its oceanic storage and hefty power production, it still could not satiate Phoenix's exploding population or the thirsty Central Arizona farmers, not to mention Los Angeles, which was still begging for more of everything.[232] Further, Glen Canyon Dam actually decreased the amount of water in the Colorado—already four maf less than the Compact had planned on—because of seepage and evaporation. The Bureau's answer was to build dams in the Grand Canyon, one at Marble Canyon and one at Bridge Canyon.[233] With another "cash register" or two in the Grand Canyon[234]-the seven states could generate enough money to make the Colorado flow the 17.5 maf per year that it was supposed to—with the help of a pipeline from the Columbia River.[235] With David Brower's and the Sierra Club's 1949 endorsement of the Bridge Canyon proposal in hand, the proponents of the new dams went to work.

But so did the environmentalists. Sharp from the recent battle over Echo Park and Rainbow Bridge, the Sierra Club re-mobilized its forces in opposition. In many ways, the struggle would be a repeat performance of Echo Park. The Club mustered public support using coffee-table books, testimony at congressional hearings, movies, letter-writing campaigns, and direct oversight of the Bureau. It spent thousands of dollars on an ad campaign in major newspapers across the country.[236] "Should we also flood the Sistine Chapel so tourists can get nearer the ceiling?" asked one full-page

[229] WILKINSON, FIRE ON THE PLATEAU, *supra* note 12, at xii, 185.

[230] *Id.* at 185.

[231] lei, at 225.

[232] *See* FRADKIN, *supra* note 20, at 229.

[233] *Id.*

[234] *See,* REISNER & BATES, *supra* note 138, at 21. As Marc Reisner described the proposal, "The dams had one purpose—hydroelectric power—and a single objective: lots and lots of cash." REISNER, *supra* note 13, at 274.

[235] *See, e.g.,,* REISNER, *Supra* note 13, at 275-83.

[236] *See* FRADKIN, *supra* note 20, at 270-73.

ad in the *New York* Times.[237]

Testifying again in front of a congressional subcommittee, Brower defended the Sierra Club's reversal of policy by stating simply: "We do not believe on our side that because we were wrong once we have to stay wrong. We dug further for the facts, found them, reversed ourselves, and have been reassured of our wisdom . . . ."[238] "Ten years ago I was testifying in favor of a higher Glen Canyon Dam and I wish I had been struck dead at the time. We found out how wrong we had been. I would just stress that over these years our own thinking has evolved .... "[239]

Just as the environmentalists had felt that they could not get away with opposing the entire Colorado River Storage Project, they recognized the legitimate concerns addressed by the Grand Canyon proposal. The principal problem they faced was that Arizona's farmers, who had received virtually no water from all of the plumbing to date on the Colorado, had a real need. But it would take an enormous amount of electricity to pump water nearly 2900 vertical feet and 335 miles from the river to central Arizona.[240] If the Sierra Club were to object to the Grand Canyon dams, it would need to find an alternative source of power.

The Sierra Club would regret this proposal less than its last,[241] but it would regret it nevertheless. The Club proposed building a nuclear reactor or a giant coal-fired power plant.[242] Secretary of' the Interior Stewart Udall agreed. Although initially one of the foremost proponents of the Grand Canyon dams, which would have been gifts for his native state, Udall had a change of heart after floating the Grand Canyon. "There was a lot of pressure from my Arizona constituents and my brother and so forth—we had to

[237] *See id.* at *273.*

[238] *Colorado River Basin Project: Hearings on H.R. 3300, S. 20, and Similar Bills Before the Subcomm. on Irrigation and Reclamation of the, House Comm. on Interior and Insular Affairs,*90th Cong. 418 *(*1967*).*

[239] *Lower Colorado River Basin Project: Hearing Before the Subcomm. on Irrigation and Reclamation of Me House Comm. on Interior and Insular Affairs,* 89th Cong. 813 (1965): *See also* MARTIN, *supra* note 51, at 266.

[240] *See* David H. Getches, *Colorado River Governance: Sharing Federal Authority as an Incentive to Create a New Institution,* 68 U. Colo. L. Rev. 573,613 n.226 (1997) [hereinafter Getches, *Colorado River Governance*]*;* Robert Jerome Glennon, *Coattails of the Past: Using and Financing the Central Arizona Project,* 27 ARIZ.. S t. L.J. 677, 682 (1995).

[241] That is, when it endorsed Glen Canyon Dam as an alternative to building Echo Park Dam. *See supra* Part III.D.

[242] *See Central Arizona Project: Hearings Before the Subcomm. on Water and* 1'0111(7 *Resources of the Senate Comm. on Interior and Insular Affairs,* 90th Cong. 454 (1967); *See. also* FRADKIN, *supra* note 20, at *231.*

have a dam. But when I came off the river, I knew we were going to abandon the dams."[243] The coal-fired power plant idea was not only a viable alternative to the Grand Canyon dams, it also fit well with Udall's Native American policy. As a result, the Navajo and Hopi were deemed ready to expand the development of their massive coal deposits in Black Mesa.[244]

And so it was. There would be no Grand Canyon dams. Instead, Black Mesa coal would be shipped by train seventy-eight miles to the new Navajo Generating Station, which would provide the electricity to pump Colorado River water hundreds of miles through the massive Central Arizona Project to central Arizona farmers.[245] A slurry pipeline would carry Black Mesa coal to the new Mohave power plant, which would send even more power to Los Angeles.[246] In return for the coal-fired power, the Navajo would get much-needed jobs, the Hopi would get revenue, and the Colorado Plateau would get foul air.[247]

The Bureau's great dam-building era had indeed ended with Glen Canyon Dam. Proposed dams at Echo Park, Bridge Canyon, and Marble Canyon had been scrapped, and before long, four

[243] TIM PALMER, ENDANGERED RIVERS AND THE CONSERVATION MOVEMENT 85 (1986) (quoting Udall). In his 1963 book, *The Quiet Crisis,* Stewart Udall warned that "[w]e cannot afford an America where expedience tramples upon esthetics and development decisions are made with an eye only on the present." STEWART L. UDALL, THE QUIET CRISIS 190 (1963). In the same book, however, Udall hailed the Colorado River Storage Project as a model for change. *Id.* at 176. His words, perhaps incongruous to many today, illustrate a widely-held perception of the time that dams epitomized esthetics and foresight.

[244] For the Hopi at least, the development of Black Mesa coal was anything but simple. *See* Charles F. Wilkinson, *Home Dance, the Hopi, and Black Mesa Coal: Conquest and Endurance in the American Southwest, 1996* BYU L. REV. 449. *See generally* PHILIP RENO, MOTHER EARTH, FATHER SKY, AND ECONOMIC DEVELOPMENT: NAVAJO RESOURCES AND THEIR USE (1981).

[245] The Central Arizona Project ("CAP"), which was not substantially completed until 1994, diverts approximately 1.5 maf of Colorado River each year. *See* BUREAU OF RECLAMATION, U.S. DEP'T OF THE INTERIOR, CENTRAL ARIZONA PROJECT INTERIM FINAL COST ALLOCATION FOR STAGES I & II, DECEMBER 1996 (Revised September 1998) AND ESTIMATED REPAYMENT OBLIGATIONS OF PROJECT BENEFICIARIES 14 (1998). At $4.22 billion, the CAP is one of the most expensive public works projects in United States history. *See id.* at 31-32; us & SWCA, *supra* note 71, at 3. True to its history and the river, there is controversy over the allocation of the CAP's water and construction costs. *See, e.g.,* PONTIUS & SWCA, *supra* note 71, at 34-37; Grady Gammage Jr., *Interest in CAP Dispute Welcomed,* ARIZ. REP., Mai. 23, 1998, at B7. For more on the CAP, *See* FRANK WELSH, HOW TO CREATE A WATER CRISIS (1985)

[246] *See* FRADKIN, *supra* note 20, at 152.

[247] The Four Corners power plant, the first of four plants on the Plateau tied to Colorado River development to go on-line, polluted more air each day than did New York City. *See* WILEY & GOTTLEIB , *supra* note 104, at 46.

more Colorado River dams would appear among the seventeen dams targeted by President Carter's politically imprudent though prophetic "hit list."[248]

IV. THE MODERN ERA OF WESTERN WATER MANAGEMENT

A. *Renaissance of River Protection*

The successful opposition to Echo Park and the Grand Canyon dams raised the nation's appreciation for rivers as wilderness resources worthy of conservation. As Wayne Aspinall recognized early, on, "if we let them knock out Echo Park, we'll hand them a tool they'll use for the next hundred years."[249] Environmentalists did indeed use the techniques created and refined in the anti-dam campaigns of the 1950s and 1960s to protect rivers through legislative and judicial fora.

Still rolling from their success at preserving Dinosaur National Monument, environmentalists obtained passage of the Wilderness Act[250] amid the struggle to block the Grand Canyon dams. The movement to protect rivers came of age with the passage of the Wild and Scenic Rivers Act ("WSRA")[251] in 1968, just two days after the Grand Canyon dams were finally defeated.[252] The WSRA specifically aimed to prevent further construction of dams on America's rivers,[253] declaring that rivers possessing "outstandingly remarkable ... values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations. "[254] Today, the WSRA system protects over 10,900 miles of river.[255] In 1969, the National Environmental Policy Act

[248] Set, FRADKIN, *supra* note 20, at 5: REISNER, *supra* note 13, at 313-22.

[249] MARTIN, *supra* note 51, at 67.

[250] Wilderness Act. Pub. L. No. 88-577, 78 Stat. 890 (1964) (codified as amended at 16 U.S.C. §§ 1131-36 (1994)).

[251] National Wild and Scenic Rivers Act, Pill). L. No. 90-542, 82 Stat. 906 (1968) (codified as amended at 16 U.S.C. §§ 1271,97 (1994)).

[252] Set NASH, *supra* note 63. at 230.

[253] *See* WATER IN THE WEST, *supra* note 127, at 4-14.

[254] 16 U.S.C. § 1271 (1994)

[255] NATIONAL PARK SERVICE, U.S. DEP'T OF THE INTERIOR, RIVER MILEAGE CLASSIFICATIONS FOR COMPONENTS OF THE NATIONAL WILD AND SCENIC RIVER SYSTEM (1998). Ironically, not a single mile of the world's most scenic river (and historically one of its wildest) has been designated under the WSRA. *See id.* For every mile of river protected under the act, 60 miles are affected by dams. *See* WATER IN THE WEST, *supra* note 127, at 4-15. The extent of current development of America's rivers is also reflected by the fact that less than two percent of the river miles in the Lower 48 states possess sufficient natural or cultural attributes to even quality for protection under the Act. *See* NATIONAL PARK SERVICE, U.S. DEP'T OF THE INTERIOR THE NATIONWIDE RIVERS INVENTORY 5 (1982).

("NEPA")[256] ensured that never again would a federal dam be built without a thorough study of the consequences it would have on the environment.[257] Additionally, federal agencies are required under NEPA to "[u]se all practicable means, consistent with the requirements of the Act and other essential considerations of national policy, to restore . . . the quality of the human environment."[258] Finally, in 1973, Congress enacted the Endangered Species Act ("ESA").[259] The most environmentally protective legislation in history, the ESA protects endangered and threatened plants, animals, and insects, as well as the rivers they depend on for habitat.[260]

The environmentalists' success in Congress was mirrored in the Courts. In 1978, the Supreme Court enjoined the operation of Tellico Dam in perhaps the most important judicial decision in the modern environmental movement, TVA v. Hill.[261] In its decision, the Court agreed that the ESA prohibited the operation of Tellico Dam if it would jeopardize the endangered snail darter or destroy the fish's critical habitat.[262] Five years later, in *National Audubon Society v. Superior Court of Alpine County*,[263] the Supreme Court of California pushed the wave of environmentally friendly law even further, finding that the public trust doctrine limited Los Angeles' appropriative rights to divert water from Mono Lake tributaries."[264] In what "certainly must be ranked as, say, one of the five or ten leading environmental decisions by American courts,"[265] *National Audubon Society* affirmed "the duty of the state to protect the people's common heritage of streams, lakes, marshlands and tide lands," and directed the state to "reconsider the allocation of the

[256] National Environmental Policy Act, Pub. L. No. 91-190, 83 Stat. 852 (1970) (codified as amended at 42 U.S.C. §§ 4321-61 (1994)).

[257] *See* 42 U.S.C. §§ 4331-32 (1994).

[258] 40 C.F.R. § 1500.2(f) (1998).

[259] Endangered Species Act, Pub. L. No. 93-205, 87 Stat. 884 (1973) (codified as amended at 16 U.S.C. §§ 153143 (1994)).

[260] *See* 16 U.S.C. §§ 1531 (b), 1533 (b) (2), 1536(a) (2), 1538 (1994).

[261] 437 U.S. 153 (1978).

[262] Set, *id.* at 173.

[263] 658 P.2d 709 (Cal. 1983).

[264] So, *id.*

[265] Charles F. Wilkinson, *Introduction* to JIM STIMSON, MONO LAKE: EXPLORATIONS AND REFLECTIONS 1, 10 (1998). The story of Mono Lake stands with the stories of Echo Park and Hetch Hetchy as one of the most heroic struggles of the environmental movement. For more on the story of Mono Lake, *See* JOHN HART, STORM OVER MONO: THE MONO LAKE BATTLE AND THE CALIFORNIA WATER FUTURE. (1996).

waters" that Los Angeles had diverted "in apparent disregard for the resulting damage to the scenery, ecology, and human uses of Mono Lake."[266] In 1994, the California Board of Water and Power Commissioners issued its final decision on the plight of Mono Lake. The needs of Mono Lake would take precedence over the needs of mighty Los Angeles, even—in fact, especially—in years of drought.[267]

B. *Taking a Step Back: The New Era in Dam Administration and River Restoration*

Initially, environmentalists had objected to Glen Canyon Dam because it would destroy the natural and scenic wonders of Glen Canyon itself. No one predicted that the operation of the dam would have such far-reaching consequences for downstream habitat. As Secretary of the Interior Bruce Babbitt recently commented, "I was up here when this dam was built in the '50s, and at the time it didn't occur to anybody the relation between the dam and what would happen downstream."[268]

The disconnect in the understanding of the dam and its effects on the downstream environment is evident in the Colorado River Storage Project Act, which authorized Glen Canyon Dam. The Act declared that the dam was to be managed for

> regulating the flow of the Colorado River, storing water for beneficial consumptive use, making it possible for the States of the Upper Basin to utilize . . . the apportionments made to and among them in the Colorado River Compact and the Upper Colorado River Basin Compact, respectively, providing for the reclamation of arid and semiarid land, [and] for the control of floods.[269]

It also authorized the management of Glen Canyon for the generation of hydropower, but only as "an incident" to the other purposes.[270] At the same time, the Act instructed the Secretary to operate Glen Canyon in such a way "as to produce the greatest practicable amount of power and energy that can be sold at firm

[266] *National A udubon Soc'y* 658 P.2d. at 728, 729.

[267] *See* HART, *supra* note 265, a(171-75.

[268] Larry Warren, *Stirring Things Up On the Colorado River*, HIGH COUNTRY NEWS, Apr. 15, 1996, at 5; *See* also Collier et al., *supra* note 145, at 3 ("[D)ownstream effects of dams were of little concern during the design and construction of most dams in t he United States.").

[269] 43 U.S.C. §620 (1994).

[270] *Id.*

power and energy rates."[271] However, management for hydropower and reclamation were rarely in conflict because efficient hydropower generation requires an hourly and daily management regime that does not interfere with the seasonal and yearly regime necessary for efficient water delivery from Glen Canyon Dam.[272] As a result, the dam was managed to maximize both.

In 1968, the Colorado River Basin Project Act,[273] which authorized the giant Central Arizona Project, called for expanding the management purposes to include "improving navigation; . . . improving water quality; providing for basic public outdoor recreation facilities; [and] improving conditions for fish and wildlife."[274] Again, the 1968 Act listed the generation of hydropower as incidental.

Nevertheless, in order to meet fluctuations in power consumers' daily demands, releases from Lake Powell[275] varied by as much as 30,500 cfs in a single day.[276] The tidal-like waves produced by the daily increase and subsequent decrease in the amount of water released threatened both recreationists and the ecosystern in the Grand Canyon. In response, recreationists and environmentalists sued the Bureau, claiming violations of the National Environmental Policy Act. Their suits, however, were uniformly unsuccessful.[277] As it result, the operation of Glen Canyon Dam remained virtually unchanged despite the radical changes in both the politics and downstream environment that took place over the twenty years after the dam's gates were closed.[278]

However, in the early 1980s, Secretary of the Interior James Watt proposed to increase the generating capacity and peaking power of Glen Canyon's powerplant, which would require even greater daily fluctuations in releases from the dam.[279] In hopes of obtaining data that would show that a thorough environmental im-

[271] *Id.* § 620 (f)

[272] See NAT'L RESEARCH COUNCIL, *supra* note 26, at 14.

[273] Colorado River Basin Project Act, Pub. L. No. 90-537, 82 Stat. 885 (1968) (codified as amended at 43 U.S.C. §§ 1501-1556 (1994)).

[274] 43 U.S.C. § 1501 (1994).

[275] *See id.*

[276] *See* FEIS, *supra* note 10, at 70.

[277] *See, e.g.,*, Envtl. Defense Fund v. Higginson, 655 F.2d 1244 (D.C. Ch. 1981); Badoni v. Higginson, 638 F.2d 172 (10th Cir. 1980); Grand Canyon Dories v. Walker, 500 F.2d 588 (10th Cir. 1974).

[278] *See* NAT'L RESEARCH COUNCIL, *supra* note 26, at 14

[279] *Id.* at 16.

pact study of the proposal was not necessary,[280] the Department commissioned the fifty million dollar Glen Canyon Environmental Studies ("GCES") "to address the concerns of the public and federal and state agencies about possible negative effects of the operations of Glen Canyon Dam on downstream environmental and recreational resources."[281] Rather than obviate the need for further study, however, the Department's early studies confirmed that daily fluctuations in releases for hydropower caused the ecologically and recreationally important sandbars, and the river channel in general, in the Grand Canyon to deteriorate.[282] Moreover, the hydropower-determined releases permitted debris fans from tributaries to choke the main channel, making rapids more difficult for boaters to navigate.[283] Eventually, the Bureau began to prepare an environmental impact statement.[284]

When, after ten years, the Bureau still had not completed its EIS, Congress enacted the Grand Canyon Protection Act of 1992 ("GCPA")[285] to address the negative impacts documented by the Bureau's early studies.[286] The GCPA requires the Secretary of the Interior to manage Glen Canyon Dam "in such manner as to project [sic], mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreational Area were established."[287] It also requires the Secretary to develop and implement a long-term monitoring program, provide for public participation in Glen Canyon Dam decision-making, and comply with the 1922 Compact and other specified parts

[280] *Id.*

[281] *Summary and Principle Conclusions*, *in* U.S. DEP'T OF THE INTERIOR, GLEN CANYON ENVIRONMENTAL STUDIES FINAL REPORT (1988); *See also* NAT'L RESEARCH COUNCIL, *supra* note 26, at 2. *See generally* David L. Wegner, *A Brief History of the Glen Canyon Environmental Studies*, *in* COLORADO RIVER ECOLOGY, *supra* note 22, at 226.

[282] *See*, *e.g.*,, NAT'L RESEARCH COUNCIL, *supra* note 26, at 76 ("Wave action eventually would cause all bars to erode to the elevation of the water…")

[283] *See* Andrews, *supra* note 16, at 3.

[284] *See* NAT'L RESEARCH COUNCIL, *supra* note *26*, at 16; GETCHES, COLORADO RIVER GOVERNANCE, *supra* note *240*, at *598.* Secretary Lujan announced that an EIS would be prepared on July 27, 1989. *See* FEIS, *supra* note 10, at 11. In an effort to protect downstream resources during the preparation of the EIS, the Bureau implemented interim operating criteria on Nov. 1, 1991. *See id.* at 3.

[285] Grand Canyon Protection Act, Pub. L. No. 102-575, 106 Suit. 4600, 4669 (1992) [hereinafter GPCA]. For more on the GCPA, *See* Michael Conner, *Extracting the Monkey Wrench from Glen Canyon Dam: The Grand Canyon Protection Act—An Attempt at Balance*, 15 PUB. LAND L. REV. 135 *(1994).*

[286] *See* Getches, *Colorado River Governance*, *supra* note 240, at 600.

[287] GCPA § 1802(a).

of the Law of the River.[288] Finally, the GCPA required the Secretary to complete the EIS.[289]

Today, as a result of the GCPA and subsequent EIS, daily releases, from Lake Powell are not permitted to vary more than 5000 cfs in months of low flows and 8000 cfs in months of high flows, with strict limitations on rates of increase and decrease.[290] In addition, occasional releases of 30,000 to 40,000 cfs are contemplated to help maintain stream channels and restore sandbars.[291] In March and April of 1996, "the Bureau of Reclamation committed what agency veterans might consider blasphemy: it opened the valves and spilled stored water from Lake Powell, bypassing the turbines which make Glen Canyon Dam a virtual cash register. It created the very kind of flood dams are built to prevent."[292] Measuring 45,000 cfs for seven days during the peak of the simulated flood and 8000 cfs before and after the peak, the flood reestablished and fortified hundreds of sandbars in the Grand Canyon.[293]

Although it is too soon to know with certainty the ecological significance of the 1996 floods,[294] they clearly signify the beginning

[288] *See* GCPA §§ 1802(b), 1803(b), 1805. Section 1802(b) provides that [t]he Secretary shall implement this section in a manner fully consistent with and subject to the Colorado River Compact, the Upper Colorado River Basin Compact, the Water Treaty of 1944 with Mexico, the decree of the Supreme Court in Arizona *v.* California, and the provisions of the Colorado River Storage Project Act of 1956 and the Colorado River Basin Project Act of 1968 that govern allocation, appropriation, development, and exportation of the waters of the Colorado River Basin.

[289] *See* GCPA § *1*804(a). A final EIS was released in March of 1995. FEIS, *supra* note 10. A Record of Decision was signed in October 1996. SECRETARY OF THE INTERIOR, RECORD OF DECISION, OPERATION OF GLEN CANYON DAM FINAL ENVIRONMENTAL IMPACT STATEMENT. (1996). Revised Operating Criteria for the dam were adopted in 1997. Operating Criteria and 1997 Plan of Operations for Glen Canyon, 62 Fed. Reg. 9447 (1997).

[290] *See.* Operating Criteria and 1997 Plan of Operations for Glen Canyon, 62 Fed. Reg. 9447, 9448 (1997).

[291] *See id*

[292] Warren, *supra* note 268, at 5. In fact, revenues lost during the seven days of peak flooding amounted to $1.5 million. *See* Bernice Wuethrich, *Deliberate Flood Renews Habitats*, 272 SCIENCE 344, 345 (1996), 111 total, the test releases cost approximately $2.5 million. *See* DAVID A. HARTMAN, GLEN CANYON DAM BEACH/HABITAT-BUILDING TEST FLOW: AN EX POST ANALYSIS OF HYDROPOWER COST 23 (U.S. Bureau of Reclamation Rep. EC-97-01, 1997).

[293] Wuethrich, *supra* note 292, at 344-45; *See* DAVID M. GILLILAN & THOMAS C. BROWN, INSTREAM FLOW PROTECTION: SEEKING A BALANCE IN WESTERN WATER USE 24142 (1997).

[294] *See* Greg Hanscomb, *Reclaiming a Lost Canyon*, HIGH COUNTRY NEWS, Nov. 10, 1997, at 9 ("Within a year, more than 80 percent of the new beaches had washed back into the river."); *cf.* Leland R. Dexter & Brian L. Cluer, *Cyclic Erosional Instability of Sandbars Along the Colorado River, Grand Canyon, Arizona.* 89 ANNALS ASS'N AM. GEOGRAPHERS 238, 238 (1999) ("Success of the flood for sandbar regeneration was immediately apparent. Nevertheless, the longevity of the elevated sand deposits is still unknown, as is the "optimal" long-term dam-release strategy.").

of a new era in dam administration. The 1996 releases from Glen Canyon Dam represent the first time in history that a federal reclamation project was operated exclusively for the benefit of the environment. To be sure, the Law of the River still sets the limits within which Glen Canyon Dam is operated, but healthy ecosystems and mitigation are a new priority.[295] Seventy-five million dollars were spent on the Grand Canyon Studies, another $108 million studying and replacing power under the new operating criteria.[296] In total, the new era at Glen Canyon Dam's powerplant carries a price tag of somewhere between fifteen and forty-four million dollars a year.[297]

Millions more are spent each year in both the Upper and Lower Basins to protect and recover the endangered species and habitats impacted by development of the Colorado River. Two notable efforts are spearheaded by the United States Fish and Wildlife Service in cooperation with many stakeholders. In the Lower Basin, the Lower Colorado River Multi-Species Conservation Program ("LCR MSCP") aims to fulfill the requirements of NEPA, the ESA, and the California Environmental Quality Act.[298] The Program will work toward protecting and recovering over one hundred sensitive species and their habitats with efforts to restore the environmental health of the Lower Colorado River for the next fifty years. The Upper Colorado River Endangered Fish Recovery Program has similar, though less expansive, goals. The primary goal of' the Upper Colorado River Program is self-sustaining populations of Colorado pikeminnows, razorback suckers, and bonytail and humpback

[295] The Secretary of the Interior has significant discretion in operating Glen Canyon Dam. *See, e.g.*, Maricopa-Stanfield Irrigation & Drainage Dist. v. United States, 158 F.3d 428, 437-38 & 438 n.18 (9th Cir. 1998), *cert. denied*, 119 S.Ct. 1802 (1999) ("Out of respect for the Secretary's broad discretionary authority over the waters of the Colorado River, we assume that 'had Congress intended to fetter the Secretary's discretion [to allocate Colorado River water by passing the Colorado River Basin Project Act, it would have done so in clear and unequivocal terms'"); Arizona Power Auth. v. Morton, 549 F-2d 1231 (9th Cir. 1977).

[296] *See* GILLILAN & BROWN *supra* note 293, at 242-43.

[297] *See* FEIS, *supra* note 10, at 300.

[298] *See* BUREAU OF RECLAMATION, U.S. DEP'T OF THE INTERIOR, LOWER COLORADO RIVER MULTI-SPECIES CONSERVATION PROGRAM FACT SHEET AND PUBLIC PARTICIPATION BOOKLET 3 (1999).

chubs.[299]

For the first time in nearly a century, Colorado River water is not running uphill to money. According to Secretary Babbitt, "[t]he U.S. Department of the Interior, after helping supervise the most intensive flurry of dam-building in world history, is changing course."[300] "The Bureau of Reclamation is no longer the world's largest construction company, but it can and will be one of the world's great water resource management agencies."[301]

Evidence of the new era in dam administration is not limited to Glen Canyon Dam. The Platte River, like its larger and historically more unruly sister to the west, is one of the most highly developed rivers in the world.[302] As a result, the Platte has experienced significant alterations in its aquatic and riparian habitats, contributing to the decline of nine endangered species.[303] In 1997, interested parties entered into a cooperative agreement that will significantly modify the operation of water developments in the upper Platte River Basin in order to restore the river's natural habitat and, with it, populations of endangered species.[304]

If there was any question whether a new era had begun after the 1996 engineered flood in the Grand Canyon and the significant cooperative agreement on the Platte, then the explosion on the Clyde River in Vermont left no doubt.[305] For forty years, the

[299] *See* United States Fish and Wildlife. Service, *Upper Colorado River Endangered Fish Recovery Program* (visited Jul), 4, 1999) <http://www.r6.fws.gov/coloradoriver>.

[300] Bruce Babbitt, *That Ringing Sound: Sledgehammers on Concrete*, PEOPLE, LAND AND WATER, NOV./DEC. 1998, AT 9. Also available in Bruce Babbitt, *Making History with a Sledgehammer*, DENVER POST, Sept. 20, 1998, at H1.

[301] Tom Kenworthy, *A Leaner and Greener Bureau of Reclamation: Water Management Policies Being Redefined*, WASH. POST, Nov. 2, 1993, at A17 (quoting Babbitt).

[302] *See* Margot Zallen, *Integrating New Value with Old Uses in* ***the*** *Relicensing of Kingsley Dam and Related Facilities*, in DAMS, *supra* note 16, at 4; *See* also Getches & Meyers, *supra* note 19, at 51 (stating that the Colorado River is "the most intensively managed river of its size in the world").

[303] *See*, Zallen, *supra* note 302, at 8.

[304] *See generally* LEO EISEL & J. DAVID AIKEN, PLATTE RIVER BASIN STUDY (1997); Ray Ring, *Saving the Platte*, HIGH COUNTRY NEWS, Feb. 1, 1999, at 1.

[305] Former Commissioner of the Bureau of Reclamation, Dan Beard, recently observed that:

> [W]estern it water policy and the entire water industry, if you call it that, is poised on the edge of rather remarkable changes .... we are moving into a new water era. It is going to be an era that is going to be characterized by, [sic] greater deregulation, greater movement of water front one sector to another, increased prices, less capital intensive solutions like dams, and greater environmental sensitivity.

Daniel 1). Beard, *Speech to the Glen Canyon Institute* (Oct. 9, 1997) (visited May 11. 1998) <http://www.glencanyon.org/DOCS.HTM#Beard>.

Clyde River's once-famous landlocked salmon had been barricaded from their preferred upstream spawning habitat by the Newport No. 11 dam. In an effort to restore the dwindling salmon population, Newport No. 11 was dynamited on August 28, 1996.[306] It was the first time the Federal Energy Regulatory Commission ("FERC") recommended removing a dam as its preferred alternative, because of its impact on the environment.[307] But it would not be the last. Some two months later, the Western Canal Dam on a tributary of the Sacramento River in California was demolished in an effort to restore the salmon runs that had been blocked by the dam for seventy years.[308] Next it was the Quaker Neck Dam on North Carolina's Neuse River, and then the Sunbeam and Washington Power dams in Idaho.[309] On July 1, 1999, deconstruction began on the 162-year-old, 917-foot-wide, and 24-foot-high Edwards Dam on Maine's Kennebec River. This represented the first time that FERC ruled against renewing a dam operator's license because of fish, habitat, and their advocates.[310]

So far, the results have been impressive. Habitat, and fish populations with it, have dramatically and rapidly improved following removal of the dams.[311] As a result, most now agree that it is time to start taking down some of the big dams, including Elwha and Glines Canyon dams on the Elwha River in Washington and the Matilija Dam on California's Ventura River."[312]

[306] *See* Kelly L. Hartley, *In Fighting a Dam Disaster, They Helped Make History: Northeast Kingdom Chapter of Trout Unlimited Wins Effort to Return Vermont's Clyde River to Its Natural State,* NAT'L WILDLIFE, Dec. 10, 1997, at 66.

[307] *See American Rivers, Clyde River: Removal of Newport No. 11 Dam in Vermont (visited* Nov. 11, *1999) <http: / /www.amrivers.org/success-clyde.html>*.

[308] *See* Andrew Murr & Sharon Begley*; Dams Are Not Forever: Giant Water Projects of the '30s Lose Clout in the '90s—The Destruction and Removal of Dams Is Becoming a Viable Consideration,* NEWSWEEK, Nov. 17, 1997, at 70.

[309] *See The River Runs Free,* NEWS & OBSERVER, Dec. 20, 1997, at A20; *See also Balancing the Arguments Leads to One Conclusion: Breach the Dams Now,* IDAHO STATESMAN, Jan. 26, 1998. at 6A.

[310] *See, e.g.,* Murr & Begley, *supra note 308; Rethinking Dams,* N.Y. TIMES, July *6,* 1999. at A16.

[311] *See generally* Beth Wade, *Bringing Down the Dams: Many Environmental Engineers Recommend Removal of Dams,* 114, AM. CITY AND COUNTRY 20 (1999); Traci Watson, *Dam Removal May Help River Restoration: Demolitions So Far Getting Healthy Results* USA TODAY June 30. 1999, at 3A; American Rivers, *Dam Removal Success Stories: Restoring Rivers Through Selective Removal of Dams That Don't Make Sense* (visited Nov. 11, 1999) http://www.amrivers.org/success-intro.html>.

[312] *See* Gary Polakovic, *Removing Matilija Dam Top Priority, Babbitt Says,* L.A. TIMES. Oct. 9, 1999, at B1 (noting the "apparent unanimous support ... in Ventura County" for removing the 190-foot-tall, 620-foot-wide Matilija dam).

Today, river restoration is one of the most visible, widespread, and supported environmental issues in the country. A trio of river restoration projects, each of unprecedented magnitude, provide some of the evidence. In each case, removing concrete is not only a part of the ecological prescription, but is also a key source of public inspiration.

The plan to restore the Florida Everglades has been called "the largest environmental restoration project in the world."[313] It includes removing more than 240 miles of canals and levees in order to restore the natural flow of water through the River of Grass.[314] The federal and state governments have already spent over $3.5 billion on the effort, and there are plans to spend nearly eight billion more over the next twenty years.[315]

The effort to restore California's San Francisco Bay/Sacramento-San Joaquin Delta will rival the phenomenal plans for the Everglades. Billed as "the largest, most comprehensive, and most inclusive environmental restoration program in the United States,[316] the CALFED Bay-Delta Program aims "to develop a long term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system."[317] The fifteen federal and state agency members that make up CALFED have been collaborating with numerous stakeholders since 1995,[318] and have agreed to remove five dams on a tributary of the Sacramento River in order to restore the salmon runs.[319]

[313] Laura Parker, *Big Plan Seeks Everglades Revival,* USA TODAY, July 1, 1999, at 3A.

[314] *See* U.S. Army Corps of Engineers, *Rescuing an Endangered Ecosystem: The Plan to Restore America's Everglades, July* 1999, at 10 (available at <http://www/restudy.org/summfact.htm>.

[315] *See* Tom Kenworthy, *Pumping Billions into the Everglades,* WASH. POST, July 1, 1999, at A3; Karen Testa, *Supporters of Everglades Restoration Say Funding Will Be Found,* NAPLES DAILY NEWS, July 2, 1999 (available at <http://www.naplesnews.com/today/florida/d274408a.htm>); Matthew L. Wald, *White House To Present* $7.8 *Billion Plan for Everglades* N.Y. TIMES, July 1, 1999, at A14.

[316] CALFED BAY-DELTA PROGRAM, REVISED PHASE II REPORT: DRAFT PROGRAMMATIC EIS/EIR TECHNICAL APPENDIX 26 (1999).

[317] *See, e.g.,, id.* at 5-6. For more on the Program, *See* CALFED Bay-Delta Program, *CALFED Bay-Delta Program Homepage* (visited Nov. 9, 1999) <http://caIfed.ca.gov/>. Efforts to significantly alter the management of the Missouri River are also underway. *See, e.g.,* Pain Belluck, *Nature Ceded the Missouri to Man*: *Now Some Would Give It Back,* N.Y. TIMES, Jan. 1999, at Al.

[318] *See* CALFED BAY-DELTA PROGRAM, *supra* note 316, at 5.

[319] *See* GLEN MARTIN, Dams *Making Way for Salmon: Spawning Invited on Sacramento River Tributary,* S.F. CHRON., Nov. 9, 1999, at A3 (describing plan to restore wild salmon to Battle Creek, a tributary of' the Sacramento River, by removing five dams, altering other structures, and increasing instream flows).

The struggle to save the anadromous fish of the Columbia River Basin has also generated a claim to "the largest biological restoration program on the planet."[320] With billions of dollars of federal funding, there have been significant changes in the operation of the dams in the basin.[321] Although pressed by the dictates of the Endangered Species Act, the effort has been driven by the passion of the people of the Pacific Northwest and the country as a whole. Today, many are talking seriously about decommissioning the four massive dams on the Lower Snake River.[322]

The efforts to restore the Colorado, Platte arid Columbia rivers, and the Bay-Delta and Everglades represent a remarkable reversal of federal policy, arid Secretary Babbitt has led the charge: "During the New Deal, President Franklin Roosevelt and his Interior Secretary, Harold Ickes, toured the West dedicating dams before large, enthusiastic crowds. Now, at the end of the century, I am out touring the country with a different message—it is time to un-dedicate some of those dams by removing them and letting the

[320] Don B. Miller, *Of Dams and Salmon in the Columbia/Snake Basin: Did You Ever Have To Make Up Your Mind? in* DAMS, *supra* note 16, at 9. *See generally* JOHN M. VOLKMAN, A RIVER IN COMMON: THE COLUMBIA RIVER, THE SALMON ECOSYSTEM, AND WATER POLICY (Western Water Policy Review Advisory Comm'n, 1997).

[321] *See generally* VOLKMAN, *supra* note .320. To date, the efforts have not been a great success- *See* WILKINSON, CROSSING THE NEXT MERIDIAN, *supra* note 68, at 211-12.

[322] 322. The four dams considered for partial removal are Lower Granite, Little Goose. Lower Monumental, and Ice Harbor. The Corps of Engineers, which built the Snake River dams, is studying ways to decommission them. *See* Doug J. Swanson, *Going with the Flow: Dams May Fail to Save Salmon in the Northwest*, DALLAS MORNING NEWS, Mar. 2, 1997, at Al. On August 4, 1999, 107 members of Congress signed a letter to President Clinton urging him to insure the "that all scientifically credible options—including modified versions of present policies, partial removal of the four dams on die Lower Snake River, and any other alternative recommended by your agencies or developed within the region—be considered with equal rigor and seriousness, and be subjected to the same scientific scrutiny and economic mitigation studies." Letter from Thomas Petri et al. to President William Jefferson Clinton (Aug. 4, 1999) (on file with author, also available at <http://www.amrivers.org/clinton-letter.html>. *See also* MEYER RESOURCES, INC., TRIBAL CIRCUMSTANCES AND IMPACTS OF THE LOWER SNAKE RIVER PROJECT ON THE NEZ PERCE, YAKAMA, UMATILLA, WARM SPRINGS AND SHOSHONE BANNOCK TRIBES § 10.7 (Final Draft 1999) (prepared on behalf of the Columbia River Intertribal Fish Comm'n) (stating that breaching is the only alternative studied that has the potential to completely restore the salmon runs) Michael C. Blumm et al.. *Saving Snake River Water and Salmon Simultaneously: The Biological, Economic, and Legal Case for Breaching the Lower Snake River Dams, Lowering John Day Reservoir. and Restoring Natural River Flows*, 28 ENVTL., L. 997, 1000 (1998) ("Mounting biological evidence indicates that breaching the four lower Snake dams and drawing down John Day Reservoir (on the Columbia River) offers a far better likelihood of recovering Idaho's salmon.").

rivers run free.[323] The American people are listening to Babbitt's message. Virtually every major news magazine and paper recently has run a major story on dam removal.[324]

The American people are watching Babbitt as well. With some 75,000 dams to choose from,[325] he has had little trouble finding prime candidates for removal. "Four times in thirteen months now, I have swung ceremonial sledgehammers to celebrate...the destruction of environmentally-harmful dams."[326] Babbitt recently reflected, "[b]ut there can be no doubt that we have a long way to go toward a better balance."[327] "I want to be the first secretary to tear down a big dam."[328]

V. "THE WAY THINGS WERE WHEN THE WORLD WAS YOUNG: "[329] EVALUATION OF THE SIERRA CLUB'S PROPOSAL

A. *The Sierra Club's Proposal*

In light of both the Sierra Club's role in the compromise that led to the drowning of Glen Canyon and its participation in the sweeping movement to restore rivers through the removal and reoperation of dams, it was indeed "natural" for David Brower and the Sierra Club to propose adding Glen Canyon to the growing list of dams slated for decommissioning. Brower and the Club felt responsible for drowning Glen Canyon because of their ignorance of its value, their own power to protect it, and the extent of the negative impacts the dam would have. They felt double-crossed by Congress' refusal to protect Rainbow Bridge National Monument, and

[323] Bruce Babbitt, *A River Runs Against It: America's Evolving View of Dams*, OPEN SPACES, Fall 1998, at 8, 9 [hereinafter Babbitt, *A River Runs Against It*].

[324] *See, e.g.*,, *Dam Removal Issue Becomes a Hot Topic Across the Country*, SEATTLE POST INTELLIGENCER, Feb. 11, 1999, at B5 (citing a number of other articles on the subject).

[325] *See* UNITED STATES GEOLOGICAL SURVEY, U.S. DEP'T OF THE INTERIOR, STATUS AND TRENDS OF THE NATION'S BIOLOGICAL RESOURCES (1998).

> Today, all estimated 75,000 dams and an untold number of canals, levees, locks, power plants, and pipelines exist. The U.S. Army Corps of Engineers reported that in 1982, cacti of 2,654 large dams stored more than 6 million cubic Dieters of water [4,863.64 af.], 50,000 smaller dams stored 60,000 to 6 million cubic Dieters [48.64 af. to 4, 863.64 af], and more than 2 million small dams and farm ponds stored an undisclosed amount of water.

Id. (citations omitted).

[326] Babbitt, *supra* note 300, at 9.

[327] Babbitt, A *River Runs Against It*, *supra* note 323, at 13.

[328] Bruce Barcott, *Blow-Up*, Outside, Feb. 1999, at 3, 4 (quoting Babbitt)

[329] Wallace Stegner, *Backroads River* ; ATLANTIC MONTHLY, Jan. 1948, at 59, 64; *See* also STEGNER, MOUNTAIN WATER, *supra* note 9, at 120.

they felt empowered by the recent revolution in dam administration.

It was just as natural, however, that the proposal met considerable opposition and skepticism, especially in the West. In 1997. western members of the House of Representatives scheduled a hearing on the Club's proposal, drawing accusations from some that the purpose was to "embarrass" the Club and "ridicule" their proposal.[330] Like the previous hearings on Colorado River dam proposals, pro-dam stakeholders and government officials lined up to mock the proposal, emphasizing the potential adverse impact that draining Lake Powell would have on water management, power, recreation, and the environment.

At the hearings, Brower was again confronted by his apparent reversal of position regarding Glen Canyon.[331] But Brower and Sierra Club President Adam Werbach held their ground, countering the claims of economic and environmental catastrophe. As he had done in 1954 and 1967, Brower reminded the representatives of the history lying behind Glen Canyon Dam: "The *National Geographic's* superficial piece on the Grand Canyon calls me a 'dambuster' . . . . I've busted none, have helped block a few, and would like to retire Glen, Hetch Hetchy and maybe myself."[332] Like the 1954 Echo Park hearings and the 1967 Grand Canyon hearings, the 1997 Lake Powell hearings turned out to be a strategic mistake for the dam's defenders. Instead of doing away with the proposal. the hearings lent credibility to, and aroused public interest in, the proposal.

But is the proposal nevertheless credible? All parties agree that draining Lake Powell is technically feasible.[333] The debate, then, is

[330] Adrianne Flynn, *Idea to Drain Lake Powell Is Ridiculed,* ARIZ. REPUBLIC, Sept. 24. 1997, at A1 ("Committee insiders said the subcommittee chairman wanted the hearing specifically to call attention to the Sierra Club idea and expose it before it could become another Grand Staircase-Escalante National Monument."); *See* Murr & Begley, *supra* note 308, at 70; Daniel P. Beard, *Lake Powell Hearing Gives Credence to Dams Removal,* ARIZ. REPUBLIC Oct. 8, 1997, at B7. *But See Lake Powell Hearing, supra* note 1, at 2 (statement of James V. Hansen, Chairman, Subcomm. of Nat'l Parks and Public Lands) ("This hearing is designed to put all the facts on the table and analyze the potential impacts of such a proposal).

[331] *See Lake Powell Hearing, supra* note 1, at 2 (statement of James V. Hansen, Chairman, Subcomm. of Nat'l Parks and Public Lands) ("Mr. Brower played an important role in the policy to build Glen Canyon dam and I was hopeful we could hear some of that history today."). Brower was not in fact present at the hearings, although his statement was read to the committee. He was unable to attend due to illness in his family. *See id.* at 1.

[332] *Id.* at 88 (statement of David Ross Brower).

[333] *See Information Publicly Available, supra* note 71, at 2. Brower has suggested that perhaps the original diversion tunnels could be opened, thereby permitting 200,000 cfs to flow around the dam *See* Brower, *supra* note 2, at 42. Floyd Dominy, however, disagrees with Brower's strategy:

> I heard what Brower wants to do. Look, those tunnels are jammed with 300 feet of reinforced concrete. You'll never drill that out. What you need to do is drill new bypass tunnels. Go through the soft sandstone around and beneath the dam and line the tunnels with waterproof plates. It would be an expensive, difficult engineering feat. Nothing like this has ever been done before, but I've done a lot of thinking about it, and it will work. You can drain it.

Bruce Barcroft, *Beyond the Valley* of *the Doomed,* UTNE READER, May-June 1999, at 57 (intervening text omitted). *But cf. Lake Powell Hearing, supra* note 1, at 65 (statement of Larry E. Tarp, Chairman, Friends of Lake Powell) ("[D)raining the Lake and leaving the Dam ... is not possible.")

based on a general disagreement about the costs and benefits associated with decommissioning[334] the dam. In general, the water and power industries are presently opposed to the proposal, along with the local stakeholders such as the Navajo Nation and the residents of Page, Arizona. Recreationists and environmentalists are split. There is no question that the Bureau of Reclamation—one of the most successful and capable agencies in all of government—would expertly minimize the costs and maximize the benefits of decommissioning the dam. But the costs and benefits would nevertheless be profound.

The impacts of decommissioning Glen Canyon Dam—both positive and negative—logically fit into four general categories: water, power, recreation, and environment. Decommissioning Glen Canyon dam would significantly impact regulation of Colorado River water and would affect water availability throughout the Colorado River Basin. It would completely eliminate the substantial power that is produced at the dam and distributed across the Southwest. Recreation, both above and below the dam, would change dramatically, exchanging houseboaters for hikers, and trout fishermen for wilderness rafters. Just as dramatic and probably farther reaching would be the changes in the environment, including changes of stagnant water to natural flows, stable mud to volatile toxic sediment, and desert flats to delta estuaries.

Moreover, evaluating the proposal is difficult because many of the claimed costs and benefits are based on sheer speculation. Decommissioning Glen Canyon Dam would have far-reaching effects, and an analysis of its impacts requires expertise in a wide

[334] I have used the term "decommissioning" to describe the Sierra Club's proposal because it is conveniently vague. The term can encompass everything from completely or partially removing a dam, to completely or partially drawing down a dam's reservoir, to simply shutting down a dam's power operations. *See* Project Decommissioning at Relicensing: Policy Statement. 60 Fed. Reg. 339, 340 (Fed. Energy Regulatory Comm'n, 1995).

array of disciplines. At this early stage, experts have not only failed to study the proposal in-depth, but they also simply lack the tools necessary to evaluate with any precision some of the costs and benefits of decommissioning the dam.[335] Further, the effects of decommissioning the dam depend on how the benefits are used and the costs absorbed. Would water saved from evaporation be used for satisfying Los Angeles' growing domestic needs, or would it be used to restore the Colorado River Delta? Would Glen Canyon be dedicated to wilderness, off-road vehicles, or curio shops?

In the remainder of this Article, I will offer an analysis of the proposal—one that outlines and evaluates the most important costs and benefits associated with draining Lake Powell. By necessity, the analysis is fundamental and the evaluation is preliminary Nevertheless, I believe it shows that the Sierra Club's proposal is worthy of further study and sincere debate, an arguably radical though surprisingly logical conclusion.

B. *Sediment: Diminishing Returns*

An overarching issue is Lake Powell's usable life span and diminishing returns. The muddy Colorado River deposits a huge amount of sediment into Lake Powell. Some sixty-five million tons of sediment settle in the upper reaches of Lake Powell each year.[336] This sediment diminishes Lake Powell's storage capacity by at least fifty thousand acre-feet per year.[337] Thus, according to one estimate, the sediment has already claimed nearly a fifth of Lake Powell's total volume, decreasing the reservoirs total storage capacity from twenty-seven maf to twenty-three maf.[338] Eventually, unless sedimentation is somehow controlled, Lake Powell will become a 186-mile-long mud flat with an awesome 710-foot waterfall at one end. Researchers predict that this will take from 150 to 750 years to occur, with the most reasonable predictions in the 150 to 300 year range.[339]

[335] For a particularly insightful, non-technical evaluation of the proposal, *See* Jared Farmer, *West Questions* Its Big *Dams*, Oct. 13, 1999, IDAHO STATESMAN, at 711.

[336] *See* Andrews, *supra* note 16, at 1. 2; Collier et al., *supra* note 145, at 66; set, also LOREN D. POTTER AND CHARLES L. DRAKE, LAKE POWELL: VIRGIN FLOW TO DYNAMO 176-78 (1989). The amount of sediment in the Colorado can vary significantly from year to year.

[337] POTTER & DRAKE *supra* note 336, at 176-78; *cf. Lake Powell Hearing, supra* note 1. at 40 (statement of Rita P. Pearson, Director, Arizona Department of- Water Resources) ("The estimates are that between 65,000 and 100,000 cubic yards of sediment are annually gathered behind Glen Canyon Dam.").

[338] *See* Barcott, *supra* note 333, at 57.

[339] *See, e.g.,, Lake Powell Hearing, supra* note 1, at 22, 26 (statement of Eluid L. Martinez, Commissioner, Bureau of Reclamation) ("Different folks will give you different figures. It's my feeling that, or at least for the next three to four or 500 years, we will not have siltation unless the. climate of the world changes to a point where it causes chaotic problems."); Dave Wegner, *Environmental Integrity on the Colorado Plateau: Glen Canyon . . .The Center of the Restoration Storm* THE CANYON COUNTRY ZEPHYR**,** Apr.-May 1998, at 22 ("The timeline for when the filling of the reservoir basin will occur is variable and dependent on the regional climate, runoff, sediment availability and upstream conservation practices. The estimates range from 150 years to 700+ years."). Like much of the debate, these estimates are the subject of contention. According to Richard Ingebretsen of the Glen Canyon Institute, "To ask how long it will take the reservoir to silt ill is an exercise in futility. The 700-year figure quoted frequently by the Bureau of Reclamation, comes from a study backed by the National Science Foundation that measured actual siltation during the first decades of the reservoir. Other studies done by the government have the reservoir silting in closer to 250 or 300 years." Ingebretsen, *supra* note 1.

Additionally, a lot has been made of the possibility that Glen Canyon Dam itself will not last as long as Lake Powell. Critics of the dam point to the damage suffered by one of Glen Canyon Dam's spillway tunnels during the floods of' 1983 as evidence of the dam's frailty in relation to the mighty Colorado River, *See, e.g.,,* Dave Wegner, *Reclaiming the Canyon. The River Is Waiting*, Canyon Country Zephyr, Apr.-May 1998, at 9; *cf. Lake Powell Hearing, supra* note 1, at 21-22 (Statement of Eluid L. Martinez, Commissioner, Bureau of Reclamation).

As yearly accumulations of sediments steadily increase, some of Lake Powell's benefits will steadily decrease.[340] Recreation and storage are two examples. Other benefits, such as power, will not be affected for a long time, but would probably be eliminated at a certain level of accumulation.[341] At the same time, some of the costs of draining the lake increase as sediment accumulates.[342] For example, the longer that sediment is deposited in the lake, the longer it will take to restore Glen Canyon if the reservoir is drained. The accumulated sediments themselves and their adverse effects on the downstream environment will be much more difficult to deal with in 150 years than they would be in fifteen.

Sediment deposition is a factor that permeates nearly every cost and benefit. As a result, the diminishing returns of maintaining the dam must always be kept in mind when evaluating the pros and cons of decommissioning Glen Canyon Dam.

C. *Water: Letting the River Run Free*

Perhaps the most heated debate over the implications of draining Lake Powell concerns water use and administration. Because nearly every drop of water in the Colorado River is often con-

[340] *See infra* Parts V.C., V.E.

[341] That is, when sediment deposition accumulates to the level of the penstocks. *See infra* Part V.D,

[342] *See infra* Parts V.E., V.F.

sumed,[343] some water consumers and administrators are panicked by the notion of dedicating water to non-consumptive uses.[344] At the same time, however, an enormous amount of Colorado River water is wasted. The examples of inefficient and uneconomical irrigation practices are legion.[345] For example, according to the Bureau of Reclamation, in perpetually "thirsty" Southern California, the Imperial Irrigation District alone wastes 200,000 acre-feet of Colorado River water each year.[346] Simply put, the sense of panic is not always well founded.

In contrast to the speculation inherent in analyzing the impacts of the proposal on many of the other values, considerable light can be shed on the debate over water with a little further research.[347] The most important component of this debate is water storage. Draining Lake Powell would eliminate this most cherished benefit. It holds approximately twenty-four maf of Colorado River water, nearly two years' worth of the entire flow of the Colorado River, and over forty percent of all the storage in the basin.[348] This storage capacity is drought insurance for both the Upper and Lower Basins, an important part of the strategy to stabilize the river by extending wet cycles on the Colorado through the dry cycles.

I. *Losing precious water.*

Perhaps surprisingly, however, draining Lake Powell would probably have minimal effects on use[349] of Colorado River water. Moreover, most adverse effects related with eliminating the storage are purely of a legal and political, rather than physical, nature. It

[343] FRADKIN, *supra* note 20, at 30.

[344] The general resistance to instream flows in the West is one example. Another is the knee-jerk reaction by many opponents to the Sierra Club's proposal and the defensive stance taken when the words "Lake Powell- or "Glen Canyon Dam" are spoken. That sense of panic is generally limited to water users (e.g. irrigators) and administrators, and not shared by the general public, is evidenced by the continued growth of western cities like Los Angeles that are in fact "short" on water.

[345] *See generally* REISNER, *supra* note 1 .1; REISNER & BATES, *supra* note 138.

[346] *See* Rudy Yniguez, *BOR: IID Wastes Its Water:* IMPERIAL VALLEY PRESS, Dec. 9, 1998, at A1.

[347] For example, computer models of the Colorado River can be run without Lake Powell to assess the impact of draining the lake under a wide range of water availability scenarios. *See* Spreck Rosekrans, Economic Analyst, *The Effect of Draining Lake Powell on Water Supply and Electricity Production* (Environmental Defense Fund, Sept. 17, 1997) (unpublished manuscript on file with author). A number of' in-depth analyses can be expected in the future.

[348] *See* PONTIUS & SWCA, *supra* note 71, at 9.

[349] The term water "use" hereinafter generally refers to consumptive use, such as by irrigation, domestic, and industrial users.

may also be surprising that the idea of Lake Powell's minimal benefits as a water storage facility are neither new nor particularly radical. In 1959, Walter Langbein calculated that "[w]ater control by storage follows a law of diminishing returns .... The gain in regulation to be achieved by increasing the present 29 million acre-feet [of storage in the Colorado River Basin] to nearly 50 million acre-feet of capacity appears to be largely offset by a corresponding increase in evaporation."[350] Without Lake Powell, there would still be about thirty-seven maf of storage on the Colorado[351]-well within Langbein's calculated range of insignificant gains. Langbein's scholarship, now well accepted,[352] reveals that Lake Powell's value as a water storage facility is probably negligible.

A recent computer simulation of the effects of draining Lake Powell on water administration of the river confirms these results. The simulation showed that in average years, decommissioning Glen Canyon Dam would have no impact on water deliveries in the Upper Basin, would decrease the delivery of water to the Lower Basin by one percent (but only cutting into their use of "surpluses," not their Compact allocation), and would increase the total availability of water by approximately 500,000 acre-feet per year.[353]

Langbein's predictions are also supported by an evaluation of present conditions in the Colorado River Basin. Although estimates of evaporation from Lake Powell are the subject of some disagreement, they range from about 550,000 acre-feet to 1,000,000 acre-feet per year (when Lake Powell is full), with at least two au-

[350] WALTER LANGBEIN, WATER YIELD AND RESERVOIR STORAGE IN THE UNITED STATES 4 (U.S. Geological Survey Cir. 409,1959); *See* also William O. Douglas, My Wilderness: The Pacific West 64 (1960) ("Man and his great dams have frequently done more harm than good."); *The Glen Canyon Dam: It's a "Dam" Shame,* N.Y. TIMES, July *5,* 1963, at 18, *reprinted in* 109 CONG. REC. A4248 (1963) (stating that there is a "very real doubt that the [Glen Canyon] dam is actually needed"). Other costs of dams were also foreseen by some. *See generally* Elmer T. Peterson, BIG DAM FOOLISHNESS: THE PROBLEM OF MODERN FLOOD CONTROL AND WATER STORAGE (1954).

[351] *See* PONTIUS & SCWA, *supra* note 71, at 9; *See* also Edward W. Clyde, Institutional *Response to Prolonged Drought,* in NEW COURSES FOR THE COLORADO RIVER, *supra* note 7, at 109, 133 (giving the total storage provided by 24 reservoirs in the Colorado River Basin as 61.4 maf).

[352] *See e.g.,,* LINDA L. NASH AND P.H. GLEICK, U.S. ENVTL. PROTECTION AGENCY, THE COLORADO RIVER BASIN AND CLIMATIC CHANGE: THE SENSITIVITY OF STREAMFLOW AND WATER SUPPLY TO VARIATIONS IN TEMPERATURE AND PRECIPITATION 83 (U.S. Envtl. Protection Agency 230-R-93-009, 1993); Daniel F. Luecke, *Dams: Their Costs and Benefits, in* DAMS, *supra* note 16, at 4-5. Luecke suggests that Langbein's calculations "played a role in the rapid drop-off in large dam construction activity that was seen in the 1960s." *Id.* at 5.

[353] *See* Rosekrans, *supra* note 347. This study does not simulate the impact of the proposal in years of drought.

thors seriously questioning the accuracy of the lower figure.[354] Even using the lower estimate, however, the evaporative losses from a single Labor Day weekend could satisfy the water needs of 17,000 western homes for an entire year. Today, evaporation is the second largest consumptive use of Colorado River water in the Basin, ranking only behind irrigated agriculture.[355]

Evaporation from Lake Powell is more than just wasted water, however. As the storage capacity decreases as the reservoir fills with sediment, the amount of evaporation will decrease at a much slower rate. As a result, the value of Lake Powell as a storage facility, which was marginal to begin with, will decrease because of the relative increase in evaporation. Evaporation also plays a part in the significant problem of the unnaturally-high concentrations of salt in the Colorado River, also a problem with relative costs that will increase as the reservoir fills with sediment.[356] Draining Lake

[354] Compare BUREAU OF RECLAMATION, U.S. DEP'T OF THE INTERIOR, COLORADO RIVER SYSTEM CONSUMPTIVE USES AND LOSSES REPORT: 1986-1990, at 24 (1998) (estimating annual evaporation at 566,100 acre-feet front 1986-1990), *with* David *R.* Dawdy, *Hydrology of Glen Canyon and the Grand Canyon*, in COLORADO RIVER ECOLOGY, *supra* note 22, at 40, 45 (reporting the United States Weather Bureau's evaporation estimates of 650,000 to 730,000 acre-feet per year), and Trevor C. Hughes, *Reservoir Operations, in id.* at 207, 209 (calculating an adjusted evaporation figure of 756,400 acre-feet per year). According to the National Research Council, the differing calculations are explained by the fact that they are estimating two different things. The higher estimates are the simple total amount of evaporation from Lake Powell, and the Bureau's estimate is the simple total *minus* the amount of water that would have been lost from "the evapotranspiration from the land surface that was inundated by the reservoir (mostly from phreatophytes)." NAT'L RESEARCH COUNCIL, *supra* note 26, at 64. Therefore, while the Bureau's calculation "may provide a correct estimate of depletion caused by dam construction," it "is not, however, the total evaporation from the reservoir." *Id.*

[355] Based on the Bureau of Reclamation's allegedly low figures, the evaporative losses during the three-day Labor Day weekend in 1997 amounted to 8568 acre-feet. Data on file with author; *See* Shupe, *supra* note 19, at 188 n.6 (estimating that one acre-foot of water is sufficient to satisfy the annual domestic needs of two homes in the West); set, also BUREAU OF RECLAMATION, *supra* note 354, at 29.

Some of the water lost from Lake Powell to evaporation should not be counted as losses to the system for two reasons. First, some of the water is returned in the system in the form of precipitation on the west side of the continental divide. But *see* Ingebretsen, *supra* note I ("Water lost to evaporation is sent out of the basin entirely; most of- it winds up in the Midwest in the form of rain."). Secondly, if water levels in Lake Mead and other downstream reservoirs were increased to make up for lost storage in Lake Powell, the evaporation from each of those reservoirs would increase (due to increased surface area). See *Information Publicly Available, supra* note 71, at 2 ("[E]vaporation would increase by 9% (70,000 af) at Lake Mead . . . ."). Whether Lower Basin reservoirs in fact would be permitted to accumulate higher water levels, however, is questionable because of the countervailing consideration of flood control and structural limitations.

[356] About half of the nine million tons of salt that the Colorado River carries each year is caused by human development—mostly irrigation. *See* GETCHES, COLORADO RIVER GOVERNANCE, *supra* note 240, at 603. The salinity problem is already so significant that the Basin states have proposed addressing it with a plant that would produce desalinized Colorado River

Powell would ameliorate the current salinity problem by reducing the evaporation in the system.

Bank storage, the water lost to seepage into Glen Canyon's Navajo sandstone, is another significant cause of losses. Between 1964 and 1976, when Lake Powell was filling, approximately 600,000 acre-feet of water per year were lost to bank storage.[357] However, since Lake Powell reached capacity, the rate of bank storage probably has decreased to about 350,000 acre-feet per year.[358]

In total, then, draining Lake Powell would likely eliminate the loss of approximately one million acre-feet of water each year.[359]

2. Equity.

However, draining Lake Powell also has its costs. Evaluating these costs is

water at $515/af. *See* PONTIUS & SWCA, *supra* note 71, at 114. The relative costs will increase because the amount of storage provided by Lake Powell will decrease as it fills with sediment at a much faster rate than the amount of evaporation: The amount of evaporation from a shallow reservoir is the same as that from a deep reservoir.

[357] *See* POTTER & DRAKE *supra* note 336, at 214.

[358] *See Information Publicly Available, supra* note 71, at 4 (estimating the loss to bank storage in 1996 as 368,000 acre-feet):

[359] Estimates of bank storage are generally very tough simply because of the difficulty in assessing seepage in such a massive and convoluted reservoir. However, estimates of the combined losses to evaporation and bank storage are probably relatively accurate. This is because the total loss can be calculated, in its simplest form, by comparing the inflow to Lake Powell with the outflow from Glen Canyon Dam. The difference is roughly equivalent to the combined losses to evaporation and bank storage. As a result, most agree that the total annual losses average about one million acre-feet. *Compare Information Publicly Available, supra* note 71, at 4 (estimating combined losses to bank storage and evaporation in 1996 at 955,000 acre-feet), *with* Ingebretsen, *supra* note 1 ("The reservoir now wastes nearly 1,000,000 acre-feet per year, which is 8% of the river's flow.").

While it is clear that the water saved from evaporation and bank storage has value, it is difficult to quantify. In one sense, Colorado River water can be very valuable. For example, in a recent Proposal between San Diego County, the Imperial Irrigation District, and the Metropolitan Water District of Southern California, San Diego would pay approximately $300 pet acre-foot delivered. *See* SAN DIEGO WATER AUTHORITY WATER TRANSFER & EXCHANGE AGREEMENTS ("FACT SHEET") (1999); *See* David .J. Haves, *Quenching the West's Thirst*, San Diego Union-Trib., Oct. 31, 1999, atGl. In another sense, however, it is "free:" There is no fee paid to the federal or state government for the right to use the water. *See* WILKINSON, CROSSING THE NEXT MERIDIAN, *supra* note 68, at 289. But would the water saved from evaporation and bank storage be the water that San Diego buys, or the water that flows into the Sea of Cortez? Thus, valuing the water saved from Lake Powell depends on how much water is available in the system in any given year, users' ability to obtain it, and market opportunities for it.

complicated by the fact that these costs would not be shared equally by the two basins. Because the Upper Basin is generally responsible for delivering the Lower Basin's share of Colorado River water, the effect of losing Lake Powell on Lower Basin water use would probably be minimal, and in fact could be beneficial. Not only is the Lower Basin legally assured of receiving an average of 7.5 maf per year from the Upper Basin, but it would also reap the benefits of any over-deliveries from the Upper Basin resulting from the loss of Glen Canyon Dam's regulatory value. The Lower Basin's current storage of over twenty-eight maf—enough water to meet nearly four years' worth of allocations—provides plenty of drought insurance for its own needs.[360]

However, that does not account for the loss of the Lower Basin's upstream sediment trap: Lake Powell. Without Glen Canyon Dam, much of the sediment currently trapped by Lake Powell would wash downstream into Lake Mead, the Lower Basin's main source of storage. Instead of catching the relatively insignificant amounts of sediment presently scoured from the Grand Canyon, Lake Mead, as the first major reservoir on the Colorado Plateau, would catch virtually all of the sediment washed from the Plateau's countless sandstone canyons. The additional sediment would shorten the life span of Lake Mead, decreasing its storage capacity at a more rapid rate. On the other hand, if the elimination of Lake Powell slows the growth of water use in the Upper Basin (a debatable proposition), thereby prolonging current "surpluses" used by the Lower Basin, storage losses in Lake Mead could be more than offset for decades to come.[361]

An additional concern for the Lower Basin is the loss of flood control provided by Lake Powell. Without Lake Powell, Lake Mead would necessarily spill more often, presenting a risk of flood damage downstream.[362] However,

[360] Under the compact, even if the annual flow of the Colorado River were as low as 7.5 maf per year for ten years, the Lower Basin's allocation would hardly be affected.

[361] Although the Lower Basin currently exceeds its Compact allocation of Colorado River water, demand in the Lower Basin is expected to increase substantially in the future. *See* PONTIUS & SWCA, *supra* note 71, at 26. This demand likely will not be satisfied with Colorado River water, however. In fact, California's use of Colorado River water is expected to decrease in the future, as the state strives to bring its use within its 4.4 maf allocation. *See* IID/CVWD/DOI, MEMORANDUM OF UNDERSTANDING REGARDING QUANTIFICATION OF COLORADO RIVER WATER RIGHTS 2 (1998) (on file with author) (noting that "the State of California is endeavoring to reduce its use of Colorado River water to match the State's apportionment") [hereinafter MOU].

[362] This potential problem is due in significant part to the encroachment of homes on the edges of the river and reservoirs in the Lower Basin. While the Bureau has no legal obligation to avoid damage to these homes when making flood control releases, it nevertheless poses a practical problem that must be considered.

during its more than twenty years of operation at capacity before Glen Canyon Dam was constructed, Hoover Dam only spilled once, and the spill was a purposeful test.[363] Moreover, since Glen Canyon began filling, almost nine maf of storage has been added above Hoover Dam. Finally, if, as proposed, Glen Canyon Dam is not removed, it should be feasible to use the dam for emergency flood control. As a result, effective regulation of floodwater would likely be possible even in the absence of Glen Canyon Dam.

The Upper Basin's concerns are more complex and significant than those of the Lower. Most important to the Upper Basin is the dependability that Lake Powell provides. On a river that varies in annual flow from 4.4 to over 22 maf,[364] storage provides dependability plain and simple. Even though most of the reservoirs in the Colorado River Basin are in the Upper Basin, Lake Powell provides nearly three-quarters of its active storage.[365] The dam also provides the Upper Basin with the flexibility that the Compact severely limited. Because the Compact generally requires the Upper Basin to deliver seventy-five maf every ten years, the Upper Basin must shoulder most of the weight of drought.

Nevertheless, it is surprisingly clear that the Upper Basin would lose little for the foreseeable future. Presently, the Upper Basin uses only about four maf of water—just over one-half of its Compact allocation.[366] It is generally accepted that there is sufficient water stored in the system without Lake Powell to meet all present

To some degree at least, the Bureau would have to reduce this risk by evacuating some of the Lake's storage in preparation for spring runoff. However, while this reduces the risk of flood damage, it reduces the amount of viable storage capacity in Lake Mead, thereby increasing tire risk of shortages in times of drought.

[363] *See* Bureau of Reclamation, U.S. Dep't of the Interior, Hoover Dam 5, 7 (1985).

[364] *See* Getches & Meyers, *supra* note 19, at 55. Global warming and its associated climate change may have further implications on this variability, such as a decrease in average annual flows and an increase in the variability of seasonal flows. *See* KATHLEEN A. MILLER, CLIMATE VARIABILITY, CLIMATE CHANGE, AND WESTERN WATER 40 (1997).

[365] The Upper Basin's 19 major reservoirs actively store about 33.3 maf of Colorado River Water; Lake Powell's active storage is about 24.32 maf, S*ee* PONTIUS & SWCA, *supra* note 71, at 9. "Active storage" is "[r]eservoir capacity that can be used for power generation; at Glen Canyon Dam this is the receiver storage above the penstock openings at elevation 3490 feet." FEIS, *supra* note 10, at G-1.

[366] *Compare* PONTIUS & SWCA, *supra* note 71, at 13 (estimating Upper Basin use at 3.79 maf in 1996), *with Information Publicly Available*, *supra* note 71, at 6 (estimating present Upper Basin use at 4.2 maf/year). The Basins' "allocations" are determined by the 1922 Compact and the 1944 Treaty. The Basins' "entitlements" are limited by the Compact to "beneficial consumptive use." *See* Meyers, *supra* note 108, at 15.

obligations.[367] Accordingly, the absence of Lake Powell would most likely affect water use in the Upper Basin only if its water consumption increases. Under current projections, water use in the Upper Basin will increase to just over five maf per year by the year 2030.[368] Even then, the Upper Basin would not have to curtail its use in years with average or better flows for more than 100 years at that growth rate. But, as the reservoir capacity decreases with each year's sediment deposition, its benefits as a water storage facility diminish.[369] As a result, by the time use increases to the point that Lake Powell's present storage capacity might be beneficial, actual benefits may be nonexistent due to the accumulation of sediments.[370]

Moreover, the Upper Basin's projected increase in water use to five maf may be a significant overestimate. Nearly half of' the projected increase is attributable to growth in the state of Colorado,[371] but future rates of increase in Colorado River water use—in Colorado and elsewhere—may be significantly lower than expected. The new era has brought a halt to major water developments throughout the West.[372] Included are out-of-basin diversions like the scuttled Homestake 11 project that proposed taking water from a tributary of the Colorado River for Denver and Colorado Springs.[373] Thus, growth in Colorado River water use in the Upper Basin will likely take place on a local level, rather than the regional

[367] *See information Publicly Available, supra* note 71, at 6; *Lake Powell Hearing, supra* note 1, at 36 (statement of Adam Werbach, President, Sierra Club). The average flow of the Colorado River is 13.5 maf. *See supra* note 118 and accompanying text. Present use, as limited by Compact allocation, is approximately 13 maf. *See* PONTIUS & SWCA, *supra* note 71, at 13-14.

[368] *See* PONTIUS & SWCA, *supra* note 71, at 16-18. The Upper Basin's increase will likely be offset by decreases in California's use, which is presently about 0.8 rnaf more than its Compact allocation. *Id.* at *27.*

[369] *See supra* Part V.B.

[370] *See also* POTTER & DRAKE, *supra* note 336, at 178 ("[T]he utility of the reservoir would be seriously impaired well before it was totally filled with sediment.").

[371] *See* PONTIUS & SWCA, *supra* note 71. at 16.

[372] *See, e.g.,,* WAYNE B. SOLLEY, ESTIMATES OF WATER USE IN THE WESTERN UNITED STATES 1 (1997) ("The era of building large dams to meet water demand in the United States is drawing to a close .... Experts on the subject of water (supply and demand) agree that the western United States is in transition from an era of water-supply development to an era of water-demand management and conservation.").

[373] *See, e.g.,,* Geoffrey M. Craig, *House Bill 1041 and Transbasin Water Diversions: Equity to the Western Slope or Undue Power to Local Government?* 66 U. Colo. L. REV. 791, 798-99 (1995); *See also* Lawrence J. MacDonnell & David H. Getches, *Colorado River Basin, in 6* WATERS AND WATER RIGHTS 5, 50 (Robert E. Beck ed., 1991) (predicting that "substantial additional development in the Upper Basin is unlikely unless endangered species problems are successfully addressed.).

level as in the past. As a result, new uses of water might be fewer and farther between. Furthermore, predictions to the contrary, water use across the country is actually declining.[374] We use two-percent *less* water today in the West than in 1975, but this discussion begs the question of why we continue to try to make the Colorado River fit our growth, instead of the more rational approach of trying to make our growth fit into the Colorado River.[375]

During a severe short-term drought, Lake Powell's storage is largely irrelevant. Lake Powell generally does not provide the Upper Basin with storage for its use, but rather regulates its deliveries to the Lower Basin.[376] These deliveries under the Compact are measured over a ten-year period, "in continuing progressive series."[377] Thus, even if the Colorado stopped flowing for an entire year, the Upper Basin would only be obligated to deliver roughly 0.75 maf of water during that year to satisfy its half of the obligation to Mexico, leaving it free to use 7.5 of its remaining 8.25 maf of storage-its entire allocation.[378] The Lower Basin, with nearly thirty maf of its own storage[379] also would not be affected.

Thus, Lake Powell's benefits on water availability are generally manifested only during a sustained drought, followed or intervened by wet conditions.[380] For example, with a full Lake Powell, the. Upper Basin's allocation would be curtailed during a ten-year

[374] *See* William K. Stevens, *Expectation Aside, Water Use in U.S. Is Showing Decline,* N.Y. TIMES, Nov. 10, 1998, at A].

[375] *See* SOLLEY, *supra* note 372, at 14. This is despite the fact that the population in the West increased by 35 percent over the same period. *Id.*

[376] *See, e.g.,,* Meyers, *supra* note 108, at 9 ("Glen Canyon Dam ... provides enough storage capacity to enable the Upper Basin to meter its water deliveries to the Lower Basin rather precisely . . . .").

[377] Article III (d) of the Compact reads: "The States of the Upper Division will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years reckoned in continuing progressive series ...." The Upper Basin's obligations to Mexico under the 1944 Treaty, on the other hand, are based on yearly deliveries.

[378] *See* PONTIUS & SWCA, *supra* note 71, at 9 (listing storage capacity in Upper Basin). Even if the Upper Basin did have all annual obligation to deliver 8.25 maf of water to the Lower Basin, its allocation of water would only be diminished, if Lake Powell were drained, in any year that the flow of the Colorado River at Lee's Ferry was less than 15.75 maf—a rare event

[379] *See* Pontius & SWCA, *supra* note 71, at 9 (listing storage capacity in Lower Basin).

[380] U.S. ENVT'L. PROTECTION AGENCY *supra* note 352, at 83 ("Reservoirs serve solely to decrease seasonal and inter-annual variability (over a limited number of years); they do not increase the volume of water available on a long term basis. In fact, additional reservoirs in highly developed regions may actually decrease water supply over the long-term through evaporative and bank-storage losses.") (citations omitted).

period in which the Colorado's flow was less than 13.5 maf each year[381]—the usual scenario.[382] By way of comparison, without Lake Powell, the Upper Basin's allocation would be diminished during any ten-year period in which the Colorado's flow was less than 14.85 maf each year.[383] As a result, assuming that the sediment accumulation problems could be solved, and assuming that the Upper Basin will eventually consume its entire allocation—both questionable assumptions—the Upper Basin's use would have to be curtailed more often during droughts without Lake Powell's storage.[384]

Draining Lake Powell could, therefore, eventually have an effect on water availability in drought years, sometimes positive and sometimes negative. The negative effects would fall disproportionately on the Upper Basin, though even these effects would likely not be felt until Upper Basin water use increases significantly, which will take many decades. Practically speaking, the loss of

[381] As measured at Lee's Ferry.

[382] This estimate and those that follow are "rough" partially because the intricacies of' the Compact in such situations can be quite complicated. For example, the Upper Basin's obligation under the Compact is also tempered by the fact that the Compact protects water rights perfected prior to 1922. *See* Art. VIII of the Compact. Therefore the Upper Basin is entitled to deplete the flow by the amount necessary to satisfy Upper Basin rights perfected prior to 1922, which are relatively few, in order of priority within the entire Colorado River Basin not counting the first five maf of prior rights in the Lower Basin. which are to be satisfied by storage under Article VIII. These calculations are also rough because they are extremely simplistic, as a comparison to the computer models that simulate the Colorado River would make readily apparent. For example, they do not account for the significant changes in the amount of evaporation and bank storage as reservoir levels vary.

[383] Calculated by subtracting 9 maf—accounting for the complete depletion of the remaining storage in the Upper Basin—from the 157.5 maf necessary to satisfy the Upper Basin's allocation and obligations to the Lower Basin for ten years, and dividing by ten years.

[384] *See*, e.g COLORADO RIVER BASIN PROJECT, H.R. REP. NO. 89-1849, at 75-76 (1966).

> If there is no water storage in Lake Powell to make the required releases during periods of drought, it is possible that upper basin consumptive uses would have to be curtailed in order to discharge the compact obligations. The greater the storage in Lake Powell, the less the likelihood there will be of this happening.

Id. The actual management of the Upper Basin's storage facilities would also affect the frequency and severity of curtailments in the Upper Basin pursuant to drought. As discussed at *supra* Part III.A., the 1922 Compact is worked such that it prohibits the Upper Basin from depleting the flow of the Colorado below 75 maf for any ten year period, measured in continuing progressive series. Currently, however, the Upper Basin dams are operated to insure a release of 8.23 maf each year from Glen Canyon Dam. *See* Operating Criteria and 1997 Annual Plan of Operations for Glen Canyon Dam, 62 Fed. Reg. 9447. 9448 (1997). Thus. it is unclear whether Upper Basin dams would be operated to insure delivery of the Lower Basin's annual average allocation over the short-run, or operated to maximize availability of water over the long-run. Certainly, only the latter would be fair.

drought protection provided by Lake Powell would likely affect few people even if the Upper Basin eventually did significantly increase its rise of Colorado River water. Agriculture accounts for about eighty percent of Colorado River water consumption.[385] One study of water use in the West found that a seven percent reduction in agricultural use would double the amount of available water.[386] Another study estimated that Arizona irrigators alone could conserve up to 1.2 maf of Colorado river water each year through measures such as installing drip-irrigation systems and shifting cropping patterns.[387] Just that water would satisfy projected growth in Colorado River water use beyond 2030.[388] In short, in a region that has "some of the worst conservation practices in the world,"[389] "curtailment" means using brooms instead of hoses to clear leaves from our driveways, using drip instead of flood irrigation, and, if it really gets serious, turning off a few Las Vegas fountains.

3. *The Compact.*

Another issue related to water is the role of the Colorado River Compact in the absence of Glen Canyon Dam.[390] All Compact allo-

[385] *See* PONTIUS & SWCA, *supra* note 71, at 13.

[386] *See* WILKINSON, CROSSING THE NEXT MERIDIAN,. *supra* note 68, at 287. Residential water conservation could have similar results. Nearly half of all residential water is used to water lawns and gardens. *See* WATER IN THE WEST, *supra* note 127, at 2-27.

[387] *See* MORRISON ET AL., *supra* note 38, at 41. Another example of conservation is an arrangement in Southern California that has San Diego's metropolitan water users paying farmers to install conservation measures in exchange for the water conserved. It is expected that the metropolitan users will gain about 300,000 acre-feet of water in the deal. Tony Perry, *Interior Secretary Pulls Out of Water Dispute,* L.A. TIMES, Feb. 11, 1999, at A3: *See* MOU, *supra* note 361, at 2; *See also* WATER IN THE WEST, *supra* note 127, at 3-12 to -13 (describing potential benefits of reclaiming and recycling wastewater).

[388] The Upper Basin's projected increase in use amounts to about one maf between now and the year 2030, which may be an overestimate. *See supra* note 361 and accompanying text.

[389] WILKINSON, CROSSING THE NEXT MERIDIAN, *supra* note 68, at 260.

[390] Federal water contract delivery obligations should not impose substantial legal barriers to draining Lake Powell. Contracts for the delivery of water front the Bureau of Reclamation are generally limited by the amount of water available in accordance with priority of rise. As a result, any shortages resulting from decommissioning the dam would have no greater effect than present shortages in the system, which do not condemn vested rights. Water contracts for delivery from other federal dams could be incidentally affected, but they specifically provide that "the United States, its officers, agents, and employees shall not be liable for damages when, for any reason whatsoever, suspensions or reductions in of water occur." *See., e.g.,,* U.S. DEP'T OF THE INTERIOR, THE HOOVER DAM POWER AND WATER CONTRACTS AND RELATED DATA 302 (1933) (contract for the delivery of water to the Metropolitan Water District of Southern California); *See also* United States v. Winstar Corp.. 518 U.S. 839, 869 n.15 (1996) (indicating that the federal government will not be held contractually liable when the government explicitly reserves the Light to change requirements, legislatively or otherwise); Bowen v. Pub. Agencies Opposed to Soc. Sec.

cations would likely be satisfied in average or high flow years until at least the year 2030.[391] After 2030, and during droughts between now and then, however, the Upper Basin would likely bear the full burden of shortages. One way to address the apparent inequity imposed by the Compact would be to simply change the Compact to require sharing of the burden of drought between the two basins. The Compact was based on sizeable misconceptions of annual flow and was inadvertently worded in such a way as to give the Lower Basin a "higher priority" than the Upper.[392] If shortages were shared, draining Lake Powell would have greater benefits for overall water availability. Moreover, reexamining the Compact might be long overdue in any case.[393]

A similar result could be accomplished by changing the Upper Basin's delivery point from Lee's Ferry to the foot of Hoover Dam—thereby effectively giving the Upper Basin use of the storage in Lake Mead for delivery purposes. It is an important, though not new, concept, but it begs the question of why Glen Canyon Dam was built in the first place if its most significant benefit mattered only on paper. Steward Udall has offered an explanation, even if an unsatisfying one. When asked in 1974 whether moving the delivery point downstrearn from Lee's Ferry would have obviated the need for Glen Canyon Dam, Udall said, "Sure," but "Aspinall wanted dams. He said to not have dams would interfere with their

Entrapment, 477 *U.S.* 41, 52 (1986) (quoting Merrion v. Jicarilla Apache Tribe, 455 U.S' 130 (1982)) ("[C]ontractual arrangements, including those to which a sovereign itself is party, ‚remain subject to subsequent legislation' by the sovereign."); Maricopa-Stan field Irrigation Dist. v. United States, 158 F.3d 428, 438-39 (9th Cir. 1998), *cert. denied*, 119 S.Ct. 1802 (1999) (holding that a reallocation of excess CAP water did not result in a taking of private property in violation of the Fifth Amendment because "Congress did not foreclose the Secretary's discretion, and it did not relinquish its own legislative prerogative" in "'unmistakable terms'"); O'Neill v. United States, 50 F.3d 677, 684, 686 (9th Cir. 1995) ("Even if the water service contract did obligate the government to supply, without exception.... water.... the contract is not immune from subsequently enacted statutes,"). Further, all water contracts with the federal government can be canceled lot- a number of reasons, including non-use, waste, and, in some cases, discretionary renewal. For example, in the early 1980s, tire Department of the Interior exercised its discretionary authority to cancel contracts to farmers in Arizona who were refusing delivery and wasting water. *See* LLOYD BURTON, AMERICAN INDIAN WATER RIGHTS AND THE LIMITS OF LAW 134-35 (1991). Nevertheless, repayment provisions and contracts associated with diversions from Lake Powell pose complicated financial considerations.

[391] *See supra* notes 366-370 and accompanying text.

[392] MacDonnell et al., *supra* note 1.58, at 829.

[393] *See* Bloom, *supra* note 70, at 143 ("A fresh look should be taken at the interstate Compact as a vehicle for the resolution of Colorado River and analogous water resource problems.").

bookkeeping system.[394]

Bookkeeping or not, the obvious reply is simply that reexamining the Compact may not be politically feasible. In a region where water dependability is favored above all else, changing the Law of the River would clearly be difficult politically. While this reply may accurately reflect current reality, water policy and politics are rapidly changing.[395] People across the country are interested in Glen Canyon and the Colorado River. Thus, it is Congress as a whole, and not the Iron Triangle alone, that may steer Colorado River management in the future.[396] Moreover, for those who are open minded enough to objectively consider draining Lake Powell, altering a technical aspect of the Compact to provide for more efficient water use is probably a viable option. As a result, a reexamination of the Compact may be more acceptable in the future.

4. *Local implications.*

Finally, draining Lake Powell would eliminate its substantial value as a local diversion point. This could affect the Navajo Nation and, indirectly, the Central Arizona Project ("CAP"). The Navajo Nation hopes to divert water from Lake Powell to satisfy some of' its reserved water rights to Colorado River water, which amounts to perhaps 50,000 acre-feet or more.[397] Additionally, the Navajo Generating Station, which provides the electricity to pump water through the CAP, uses 34,000 acre-feet of Lake Powell water as coolant.[398] It would take a substantial amount of electricity to pump the cooling water 700 vertical feet from the riverbed, although the cost would still pale in comparison to the overall CAP power budget.[399]

In sum, the effects of draining Lake Powell on water availability are surprisingly minimal, though not absent. Politically speaking, however, effects on water use are the most difficult problem facing the Sierra Club's proposal. The Colorado is viewed by many as the

[394] BRUCE BERGER, THERE WAS A RIVER 10 (1979).

[395] *See* Beard, *supra* note 305

[396] *See* Arizona v. California, 373 U.S. 546,565 (1963) (Upholding Congress' constitutional power over apportionment of the Colorado River).

[397] *See Lake Powell Hearing*, *supra* note 1, at 114 (statement of Melvin F. Bautista, Executive Director, Division of Natural Resources of the Navajo Nation).

[398] *See* Fr iends of' Lake Powell, *The Place No One Knew Well Enough* (visited May 11, 1998) http://www.lakepowell.org/place.htm

[399] *See infra* Part V.D. Fifty times as much water is pumped nearly three times the vertical distance through the CAP.

lifeblood of the West. It is not surprising then that dependability has taken precedence over efficiency and environmental restoration. However, dependability has many costs, including a net loss in the amount of water in the system as a result of evaporation and seepage. Perhaps the most important issue is whether we are comfortable enough with our trans-mountain diversions and bottled water to sacrifice some of the dependability that seemed so crucial in the past.

D. *Power: Unharnessing the River*

Although power has always been formally relegated to an "incidental" purpose of Glen Canyon Dam, it was nevertheless one of the primary, purposes for its construction. Indeed, power singlehandedly ruled the daily operations of the dam until 1991, when the Department of the Interior implemented new operating criteria.[400]

I. *The costs of less power.*

The power-related costs of draining Lake Powell are relatively clear. Glen Canyon Dam produces approximately 5000 gigawatthours ("Gwh") of power each year—enough to supply 214,000 California users with electricity.[401] This electricity, and the revenues it generates, would be lost. Additionally, growth in future power demands, all of Glen Canyon's power will eventually have to be replaced, either through alternative sources of power or conservation.

In one sense, the lost power from Glen Canyon Dam could be easily replaced. Although Glen Canyon's raw generating capacity of 1300 megawatts ("MW") is impressive,[402] it is not irreplaceable. Its capacity is far exceeded by the Navajo Generating Station, which produces almost twice as much power.[403] Furthermore, there is currently a significant surplus of power in the Colorado Plateau region,[404] so there would likely be a significant amount of

[400] Operating Criteria and 1997 Plan of Operations for Glen Canyon, 62 Fed. Reg. 9447 (1997).

[401] NAT'L RESEARCH COUNCIL, *supra* note 26. at 167; *See* 1998 STATISTICAL ABSTRACT OF THE UNITED STATES 587, 590.

[402] *See* NAT'L RESEARCH COUNCIL, *supra* note 26, at 167.

[403] The Navajo Generating Station produces 2250 megawatts of electricity. See WESTERN AREA POWER ADMIN., 1998 ANNUAL REPORT: ST ATISTICAL APPENDIX 17 n.5 (1998).

[404] *See* HARPMAN, *supra* note 292, at 56 ("[I]n 1996 there is considerable excess capacity in the power system."); *See also* NAT'L RESEARCH COUNCIL, *supra* note 26, at 169.

time to find alternative sources of raw power.[405] By the time additional sources of power are needed, the life-span of Glen Canyon Dam's power-plant may be considerably reduced anyway. In a few hundred years, it is likely that accumulated sediments will completely eliminate power production from Glen Canyon Dam.[406]

0n the other hand, Glen Canyon Dam hydropower has not traditionally been valued as a source of raw power, but rather for its "peaking" or "load-following"—its capacity to respond to fluctuations in power demand. Glen Canyon Dam is optimal for load-following because water can be spilled through its generators almost instantaneously in order to supply an immediate demand for more electricity, and it can just as easily be cut off. A conventional thermal plant, on the other hand, may take minutes or hours to increase the supply of electricity.[407] As a result, conventional thermal plants like the Navajo and Mohave plants simply cannot replace the energy production traditionally supplied by Glen Canyon Dam. Moreover, load-following power is difficult to offset through conservation.[408]

However, Glen Canyon Dam's load-following capability has already been significantly diminished. Demand for its efficient and valuable load-following capability dictated its operations until the early 1990s, when new operating criteria were adopted to arrest the havoc that the highly variable flows associated with load-following were causing in the Grand Canyon.[409] The new operating criteria limit the releases at Glen Canyon to 4000 cfs per hour increases and 1500 cfs per hour decreases.[410] Consequently, both Glen Canyon Dam's capacity and load-following capability have already been significantly reduced.[411] As a result, the power revenues are esti-

[405] Interview with Bruce Driver, Executive Director, Land & Water Fund of the Rockies (Apr. 10, 1998).

[406] The penstocks are located 465 feet above the floor of Lake Powell-about two thirds of the way up the back of the dam, *See* POWERPLANT TECHNICAL RECORD, *supra* note 207, at 469.

[407] *See* NAT'L RESEARCH COUNCIL, *supra* note 26, at 168.

[408] *See Lake Powell Hearing*, *supra* note 1, at 135 (statement of Michael Hacskaylo, Administrator, Western Area Power Administration) ("(E]nergy conservation may be able to replace up to 20% of Glen Canyon Dam generation. The remainder of the lost generation would most likely come from fossil-fired powerplants."); *cf. id.* at 75 (statement of Joe Hunter, Executive Director, Colorado River Energy Distributors Association) ("([L]oad following potential is not something that can be offset through conservation.").

[409] *See supra* Part IV.B.

[410] *See* Operating Criteria and 1997 Plan of Operations for Glen Canyon, 62 Fed. Reg. 9447, 9448 (1997). An exception may be made in emergencies. *See id.*

[411] *See* FEIS, *supra* note 10, at 300, 308-09 (estimating a greater than 30% reduction in capacity and explaining reductions in load-following capability resulting from the new operations). Under the contract for Glen Canyon Dam power between the United States Department of the Interior and power distributors, the Secretary has considerable discretion to modify operations affecting power without incurring liability. All federal power contracts are contingent on available

mated to have decreased by about thirty million dollars per year.[412] Further, the lost pow *ENVIRONMENTAL* er can be replaced by building a gas- or oil-fired power plant, which would satisfy the region's need for load-following generation. Therefore, the direct financial losses associated with hydropower as a result of draining Lake Powell could be, roughly speaking, the cost of building and operating such a power plant. It is important to note, however, that the cost of operating a thermal power plant is much greater than the hydropower operating costs for Glen Canyon Dam, which are minimal.[413] A further disadvantage of replacing Glen Canyon hydropower with thermal power is the air pollution that results from burning oil or gas-a disadvantage that does not afflict Glen Canyon Dam's "clean" hydropower. Nevertheless, an oil-fired power plant, which would be the likely replacement, produces minimal air pollution.[414]

2. *The burdens of lost power.*

The cost of replacing Glen Canyon Dam's power is likely to be borne at least in part by the thirty percent of electricity consumers in a six-state region serviced by Glen Canyon Dam.[415] These approximately 1.7 million customers[416] would be directly affected by the decommissioning of the dam if they, were forced to beat the cost of replacing Glen Canyon's power. Of course, keeping the tradition, western members of Congress would likely seek to have the federal government absorb a significant amount of these costs. Nevertheless, a Bureau of Reclamation-commissioned report by the National Research Council and the National Academy of Sciences argues that "[i]f the beneficiaries of Glen Canyon Dam have traditionally been subsidized at the expense of taxpayers and the envi-

electricity and changes in applicable federal law, so decommissioning Glen Canyon Dam would not condemn vested rights in the form of power contracts. *See.* Western Area Power Administration, *General Power Contract Provisions* (visited Nov. 12, 1999) <http://www.wapa.gov/cso/power/gpcp.htm.> *See* generally Operating Criteria and 1997 Plan of' Operations for Glen Canyon, 62 Fed. Reg. 9447 (1997) (imposing operational changes with significant effects on power generation).

[412] *See* NAT'L RESEARCH COUNCIL, *supra* note 26, at 67.

[413] *See id.* at 168.

[414] *See* Driver, *supra* note 405.

[415] *See* NAT'L RESEARCH COUNCIL, *supra* note 26, at 169-70. The six states are Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming. *Id.* at 170.

[416] *Id.* at 169.

ronment, it is acceptable that they bear the costs of altered operations.[417] In effect, paying for replacement power would simply bring current users up to market rates.

Even so, the costs to each consumer would likely be minimal.[418] Glen Canyon Dam only produces about three percent of the electricity in the region.[419] Additionally, other utilities with present surpluses could benefit substantially from draining Lake Powell because they would have a market for their surplus power and because their electricity would be more valuable as a result of the decrease in supply of electricity in the region. As a result, the seventy percent of the consumers in the region who do not receive power from Glen Canyon Dam could see their power bills decrease if the darn were decommissioned.[420] Consequently, some of the economic costs of the lost hydropower would be offset. An additional source of offsetting value may be found at Hoover Dam, where much of the water that would have been "wasted" to seepage and evaporation from Lake Powell, can be run through the turbines. On the retail market, that would be worth about thirty-five million dollars per year.[421]

[417] NAT'L RESEARCH COUNCIL, *supra* note 26, at 171.

[418] *See* Richard Ingebretsen, *A Declaration of Independence for the Colorado River*, THE CANYON COUNTRY ZEPHYR, Apr.-May 1998, at 16 ("Increased costs would be on the order of 65 cents per person per year.").

[419] *See* Rosekrans, *supra* note 347. It is important to note, however, that while Glen Canyon only produces three percent of the region's power, a small number of utilities receive the majority of that power. As a result, the cost would not automatically be spread equally to utilities or consumers.

[420] *See* NAT'L RESEARCH COUNCIL, *supra* note 26, at 170; *See also* FEIS, *supra* note 10, at 304.

[421] Roughly speaking, at Hoover Dam, 55,000 cfs produces 2074 NMI of electricity. *See* Bureau of Reclamation, U.S. Dep't of the Interior, *Hoover Dam—How It All Works (vis*ited July 8, 1999) < http: / /www. hooverdam.com/workings/main.htm>; *See also* BRUCE C. DRIVER, WESTERN HYDROPOWER: CHANGING VALUES/NEW VISIONS 7 (1997); Telephone Interview with Ken Forman, Reclamation Guide, U.S. Bureau of Reclamation (July 7, 1999). The approximate retail value of the electricity produced at Hoover Dam can be approximated at $75 per MWhr. *See* Harpman, *supra* note 292, at 16, 43 (stating that the retail value of' power produced at Glen Canyon Dam, which is sold on the same distribution system as Hoover Dam is approximately $60 to $90 per MWhr). Using these figures, one maf of water would have a value of $34,221,000, though this estimate does not account for evaporation, water spilled, etc. It is also worth noting that, white this number reflects the approximate retail market value, the United States sells the power from Hoover Dam on the wholesale market for approximately $12 per MWhr. *See* WESTERN AREA POWER ADMIN., *supra* note. 403, at 62 (listing the annual composite rate as 8.51 mills/kWh and the additional Lower Colorado River Basin Development Fund charge as 4.5 mills/kWh in Arizona and 2.5 mills/kWh in California and Nevada); *See also* FEIS, *supra* note 10, at 170 (stating that "applicable law makes it clear that the United States markets power to serve the public interest, not to make a profit"). At that rate, the one maf Would be worth approximately $5.5 million per year.

Finally, revenues from Glen Canyon Dam that are available for ecosystem protection and endangered species recovery in the Grand Canyon would be lost. It was Glen Canyon Dam hydropower revenues that funded the $100 million Glen Canyon Environmental Studies that resulted in the 1996 engineered floods and the dam's new operating criteria.[422] Nevertheless, these funds have not been regularly dedicated to mitigating the dam's environmental impacts in the past, and there is legitimate concern that similar contributions will be rare in the future.[423] More importantly, the tradeoff may be a good one, since natural flows will likely prove to be a more efficient and effective way to address these environmental problems.

As far as power is concerned, then, draining Lake Powell would have few benefits. Although the power-related losses associated with decommissioning Glen Canyon Dam and Lake Powell would take place immediately upon drawdown of the reservoir, many costs would not take place until some time in the future. For the present, decommissioning the dam would raise electricity prices for some consumers and decrease the emergency power reserve. In the future, the power would likely have to be replaced, and minimally higher electricity rates and levels of air pollution could result.

E. *Recreation: Draining "The Great Recreational Resource* "[424]

Recreation provides the greatest direct financial benefits associated with Glen Canyon Dam. These benefits have not been overlooked by Congress. Even before Lake Powell filled, the program implemented by the Colorado River Basin Project Act provided for "basic public outdoor recreation facilities.[425] Glen Canyon National Recreation Area was established in order to "provide for public outdoor recreation use and enjoyment of Lake Powell and lands adjacent thereto in the States of Arizona and Utah and to preserve the scenic, scientific, and historic features contributing to

[422] *See Lake Powell Hearing, supra* note 1, at 136 (statement of Michael Hacskaylo. Administrator, western Area Power Administration).

[423] *See* Luna B. Leopold, *Closing Remarks, in* COLORADO RIVER ECOLOGY, *supra* note 22, at 255, 256.

[424] Stegner, MOUN TAIN WATER, *supra* note 9, at 121.

[425] 43 U.S.C. § 1501(a) (1994).

public enjoyment of the area."[426]

The legislation encouraging recreation has clearly been successful. In 1889, the peak of the historical occupation of Glen Canyon, there were some 1000 miners living in the canyon.[427] In 1963, the canyon attracted some 44,000 people anxious to take a last look.[428] Today, Lake Powell attracts two million overnight visitors each year[429]-second only to Yosemite National Park.[430] Lake Powell offers spectacular flat-water recreation, a rare commodity in the and West. As Art Greene, one of the first entrepreneurs to take advantage of the new era in recreation at Glen Canyon, envisioned in 1964, "Now a whole new breed of people can come out and be adventurers in safety.[431]

Those adventurers buy gas and supplies in Page, Arizona, rent boats at one of Lake Powell's five marinas, hire fishing guides, and take pictures that will be developed at the local drugstores. According to the National Park Service, tourists visiting Lake Powell contribute more than $400 million to the regional economy.[432] One survey estimated the value of Lake Powell boats alone to be $191 million.[433]

The growth of recreation downstream in the Grand Canyon is similarly spectacular. Some of its supporters worry that natural flows will have an adverse impact on their businesses and fun. The regulated flows from Glen Canyon Dam make rafting through the Grand Canyon a sport of seasons, rather than months. The cool, clear waters released from Glen Canyon Dam have created one of the great trout fisheries in the Southwest.

The direct value of rafting the Grand Canyon alone surpasses the revenues from hydropower.[434] In 1869, John Wesley Powell was the first person to float through the Grand Canyon. Ninety years

[426] Pub. L No. *92-593 (1972).*

[427] *See* MARTIN, *supra* note 51, at 127.

[428] *See* Jared Farmer, *Field Notes: Glen Canyon and the Persistence of Wilderness,* W. HIST. Q. 211, 218 (1996).

[429] *See* FEIS. *supra* note 10, at 159*;* Denis M. Searles, *Loving a River to Death: Recreation a Huge Industry, but at What Cost?—Recreation Poses Problems Along Colorado,* SALT LAKE TRIB., May 26, 1997, at Al.

[430] *See Lake Powell Hearing, supra* note *1,* at *22, 32* (statement of Denis Galvin, Acting Deputy Director. National Park Service).

[431] Ralph Gray, *From Sun-clad Sea to Shining Mountains, 125* Nat'l Geographic 542, 564 *(*1964*).*

[432] *See Lake Powell Hearing, supra* note *1,* at *17* (statement *of* Eluid L. Martinez, Commissioner, Bureau *of* Reclamation).

[433] *See* Searles, *supra* note 429.

[434] *See* Andrews, *supra* note 16, at 3.

later, when the construction of Glen Canyon Dam began, only 500 more had made the trip—an average of less than six per year.[435] But by 1960, two hundred people per year were rafting the Grand Canyon.[436] By 1970, the number had soared to 16,436.[437] Today, the Colorado River through the Grand Canyon annually supports over 20,000 anglers, 15,000 to 20,000 white-water boaters, and 33,000 day-trip rafters[438]-over 190,000 visitor-days per year, and more would come but for limited permits.[439]

Little analysis has been completed on the economic impacts of draining Lake Powell on recreation. Still less analysis has been undertaken to value the non-economic impacts. Nevertheless, it is obvious that the current value of Glen and Grand Canyon recreation is immense. Draining Lake Powell would destroy some recreational activities, but others might not be affected at all, and some new recreational opportunities would emerge.

1. *Recreation losses.*

Among the recreational opportunities that would be eliminated by the Sierra Club's proposal is surface recreation on Lake Powell. Lake Powell supports 1.5 million boater nights each year[440] Some, though certainly not all, of these displaced boaters would find solace in other western reservoirs. Another recreational opportunity that would be adversely affected is the trout fishing immediately below Glen Canyon Dam. The trout thrive on the clear and cold flows that spill from the dam, but they have a low tolerance for the highly variable temperatures and flows, and the high concentrations of sediments that would characterize the restored Colorado River.[441] If the trout fishery were eliminated, the yearly economic losses to the region would total approximately $1.8 Million.[442]

2. *Recreation gains.*

However, the recreational costs of draining Lake Powell would be offset by some clear recreational benefits. Wallace Stegner described the recreational and esthetic value of the pristine Glen Canyon:

> Once the river ran through Glen's two hundred miles in a twisting, many-branched stone trough eight hundred to twelve hundred feet deep, just deep enough to be impressive without being overwhelming. Awe was never Glen Canyon's province. That is for the Grand Canyon. Glen Canyon was for delight. The river that used to run here cooperated with the scenery by flowing swift and smooth, without a major rapid. Any ordinary boatman could take anyone through it. Boy Scouts made annual pilgrimages on rubber rafts. In 1947 we went through with a party that contained an old lady of seventy and a girl of ten. There was superlative camping anywhere, on sandbars furred with tamarisk and willow, under cliffs that whispered with the sound of flowing water.[443]

If river recreation in the Grand Canyon is any indication, the economic value of such a recreational experience would be enormous—certainly tens of millions of dollars. In any case, the event of draining Lake Powell and restoring Glen Canyon would likely draw more recreationists to the area than it could possibly accommodate (I know that I would be in line with my raft and hiking boots).[444]

Many have objected that the esthetic values of Glen Canyon would not be restored for centuries. For example, Arizona's Director of Water Resources, Rita Pearson, stated at the 1997 hearing that "draining the he reservoir will leave about 250 square miles of rock formations that have been bleached through the leaching of mineral and millions of cubic yards of sand and silt deposits trapped behind the dam."[445] Others fear the muddy sediments and trash that would be left behind on what is now the floor of the reservoir.[446]

[435] *See id.*
[436] *See* FEIS, *supra* note *10,* at *152, 161.*
[437] *See id.*
[438] *See* NAT'L RESEARCH COUNCIL, *supra* note *26,* at *120.*
[439] *See* FEIS, *supra* note *10,* at *153.*
[440] *See id, at 159;* Searles, *supra note 429.*
[441] *See* FEIS, *supra note 10, at 215, 216.*
[442] *See id.* at 164. Here again, however, if native fish populations were restored, it least some of this loss would be offset.

[443] Stegner, MOUNTAIN WATER, *supra* note 9, at 121-22.
[444] This phenomenon can be seen in the nearby Grand Staircase-Escalante National Monument, proclaimed by President Clinton in 1996. Visits to the area have increased nearly 50% since the proclamation. *See* Lisa Church, *Fun Hogs to Replace Cows in a Utah Monument,* HIGH COUNTRY NEWS, Feb. 1, 1999, at 4.
[445] *Lake Powell Hearing, supra* note 1, at 96 (prepared statement of Rita P. Pearson, Director, Arizona Department of Water Resources); *See. also id.* at 121 (prepared statement of Larry E. Tarp. Chairman, Friends of Lake Powell) ("[T]here would be nothing left but the biggest white hole on Earth. Perhaps in a thousand centuries there will have been enough sun, rain and wind erosion to partially restore some of the canyons walls.").
[446] *See, e.g.,,* Tim Cornwell, *Environment: The Vanishing Lake That Could Leave a Tourist Industry High and Dry* . INDEP., Sept. 29,1997, at 9 ("Draining the lake now, locals say, would leave a massive salt rim. and thick silt and mud, along with piles of rotting fish, that would take years to clean up.").

However, restoration may well take place more rapidly than some fear. According to Dave Wegner of the Glen Canyon Institute, "Evidence already gathered from...water level variations in side canyons, indicate[s] that within a year or two the side canyons will flush themselves clean of sediment and the white 'bathtub ring' will be gone within a 5 to 10 year period of time."[447] His statement seems to be supported by the fact that a significant natural reservoir existed in Lake Canyon for years until its earthen dam was breached by heavy. rains in 1915. Although it was inundated again by Lake Powell a mere 50 years later,[448] I am aware of no complaints that the canyon remained a white-washed mud pit when it was later explored.[449]

The effects that draining Lake Powell would have on other recreational activities is less clear. An example is Grand Canyon rafting, which contributes approximately $21.3 million to the regional economy.[450] As one Grand Canyon rafter testified at the 1997 hearing, the negative impact of draining Lake Powell "comes in the sediments and water temperature .... There would be lots of flies, no way to get clean, and no cold water to help our perishable foods make it through the canyon for two weeks.[451]

[447] *See* Wegner, *supra* note 281, at 226, Edward Abbey predicted the following effects of draining the reservoir:

> This will no doubt expose a drear and hideous scene: immense mud flats and whole plateaus of sodden garbage strewn with dead trees, sunken boars, the skeletons of cattle and long-forgotten, decomposing water-skiers. But to those who find the prospect too appalling I say, give nature a little time. In five years, at most in ten, the sun and wind and storms will cleanse and sterilize the repellent mess. The inevitable floods will soon remove all that does not belong within the canyons. Fresh green willow and tamarisk, box elder and redbud will reappear: and the ancient drowned cottonwoods (noble monuments to themselves) will be replaced by young of their own kind. With the renewal of plant life will come the insects, the birds, the lizards and snakes, the mammals. Within a generation—thirty years—I predict the river and canyons will bear a decent resemblance to their former selves. Within the lifetime of our children Glen Canyon and the living river, heart of the canyonlands, will be restored to us. The wilderness will again belong to God and the people.

EDWARD ABBEY & PHILIP HYDE, SLICKROCK 69 (1971).

[448] *See* MARTIN, *supra* note 51, at 18.

[449] *See* generally JENNINGS, *supra* note 51.

[450] *See* FEIS, *supra* note 10, at 164.

[451] *Lake Powell Hearing*, *supra* note 1 (statement of Robert Elliott, America Outdoors and Arizona Raft Adventures) (available at 1997 WL 14151305). One might argue, on the other hand, that the type of adventurers the Grand Canyon does, and would, attract are not so sterile as to fear getting muddied by silty water, so incompetent as to be incapable of packing food so as to last two weeks, and so testy as to allow some flies to ruin a raft-trip through the most spectacular canyon in the world.

On the other hand, one study concluded that if water were released from Glen Canyon Dam on a schedule that roughly mimics natural flows, the direct economic value of Grand Canyon river running would increase by about four million dollars per year.[452] With a greater diversity of flows, there will be a greater range in the difficulty, and type of white water recreation. Moreover, "[o]ne of the attributes of an excellent river trip most often identified by river runners is a wilderness experience."[453] While the economic value of a "wilderness experience" is probably significant, the noneconomic value may be incalculable.

It is difficult, then, to evaluate the overall impact of draining Lake Powell on recreational values. Some long for the Glen Canyon of John Wesley Powell. To them, "[i]n gaining the lovely and the usable, we have given up the incomparable.[454] Others long for the uncrowded and serene Lake Powell of the 1960s. For them, the arrival of millions of recreationists was "the end of our Lake Powell, which was a place for exploration, and its conversion into pure recreation."[455] Still others find the Lake Powell of today priceless. For them, "Happiness Is…A Houseboat on Lake Powell."[456]

Perhaps the most fundamental question concerning recreation, however, is how much recreation do we really want on Lake Powell and in the Grand Canyon? The most common species of recreationist on the Colorado Plateau, as Edward Abbey observed, is *"Slobivius americanus.*[457] The 2.5 million visitors to Lake Powell leave an extraordinary amount of trash on the beaches and in the lake.[458] Along Lake Powell's 2000 miles of coastline there are only forty-six restrooms. Fouled by human waste, beaches along the lake are periodically closed.[459] Visitors consume about five million gallons of gas on their Lake Powell vacations each year[460] and, according to David Brower, the "jetskiers and power boaters ... de-

[452] *See*. FEIS, *supra* note 10, at 32-33, 292 tbl. IV-18 (giving the net increase in economic value, subtracting angling, as 54.25). This study was based on dam releases, not natural flows. Therefore, it does not adequately consider some impacts.

[453] NAT'L RESEARCH COUNCIL, *supra note 26, at 123.*

[454] Stegner, MOUNTAIN WATER *supra note 9, at 128*

[455] BRUCE BERGER, THERE WAS A RIVER *2 (1994).*

[456] Ernie Cowan, *Happiness Is A Houseboat on Lake PoweII,* DESERT, May 1974, at 24.

[457] Abbey, DESERT SOLITAIRE, *supra note 206, at 215.*

[458] *See* POTTER & DRAKE, *supra note 336, at 287.*

[459] *See* Searles, *supra note* 429.

[460] *See* Farmer, *supra note* 428, at 219.

posit the equivalent of an Exxon Valdez oil spill into 'Lake' Powell every 2.5 years."[461]

Perhaps present recreation should he limited in any case. Doing so might also limit any costs of draining Lake Powell.

F. *Environment: Restoring Ecosystems and Endangered Species*

Probably the most uninformed and speculative argument in the debate over draining Lake Powell involves environmental impacts. Telling evidence of this is the statement of Rob Elliott, representing Grand Canyon white-water outfitters, at the congressional hearings:

> With the draining of Lake Powell and the freeing of Glen Canyon from beneath megatons of potentially toxic sediments, restoration would begin immediately and take perhaps a millennium for nature to restore Glen Canyon to, to what? We don't know. We know very little about the environmental consequences of draining Lake Powell . . . . 462[462]

Perhaps even more telling of the scientific level of the debate is the fact that Elliot was one of the few who even ventured to make a guess on the subject at the congressional hearings. Dave Wegner, the only biologist who testified, did not. Instead, he encouraged further study.463[463]

Nevertheless, it is possible to suggest what the important considerations in the environmental debate will be, namely endangered species, pollution, and ecosystem recovery. Unfortunately, the evaluation of some of the environmental impacts involves consideration of our present and future engineering capabilities, which makes the evaluation both more complex and more speculative.

1. *Endangered species.*

The survival of native fishes is a focus of the environmental debate. Historically, there were only eight species of fishes native to the Colorado River in Glen and Grand Canyons.464[464] Today, five of

[461] David R. Brower, *Preface to* ELIOT PORTER, THE PLACE NO ONE KNEW: GLEN CANYON ON THE COLORADO *(forthcoming 1999).* The 2.5 year figure is a calculation that has been updated since the 1997 hearings. *See Lake Powell Hearing, supra* note 1, at 88 (statement of David Ross Brower).

[462] *See Lake Powell Hearing, supra* note 1, at 73 (statement of Robert Elliott, America Outdoors and Arizona Raft Adventures).

[463] *See id.* at 78-79 (statement of David Wegner, Vice-President, and Richard Ingebretsen, President, Glen Canyon Institute).

[464] *See* FEIS. *supra* note 10, at 109, 114; Minckley, *supra* note 22, at 131. Six of the eight native species were endemic to the Plateau region of the river. *See supra* Part 11.

the eight native species are endangered or have been extirpated, and of these five, only one species exists as a naturally reproducing species.[465] The exact causes of the severe declines in the native fishes are unclear, but certainly include the introduction of exotic species, the physical obstruction of spawning migrations by Glen Canyon and Hoover dams, the destruction of habitat, and the alteration of the Colorado's water quality, quantity, and temperature.[466]

The most important factor in the decline of native fishes in the Grand Canyon is likely the water temperature.[467] The Grand Canyon's native fishes are unable to spawn in the cold water that is released from Glen Canyon Dam. As a result, they are largely limited to the Colorado River tributaries with natural water temperatures.[468]

Another important factor in the decline of the native species in the Grand Canyon is the introduction of exotic species.[469] Twenty species of exotic fish have established themselves in the Grand Canyon.[470] Some of these species thrive on the clear, cold, and steady artificial flows provided by Glen Canyon Dam, especially in the sixteen miles between the dam and the Paria River.471[471] Native Species, on the other hand, are highly adapted to relatively extreme variations in the aquatic environment—variations that no longer exist.472[472] As a result, native species are at a competitive disadvantage in the now crowded Colorado River.

[465] Set, Minckley, *supra* note 22, at 131-32; *See also* FEIS, *supra* note 10, at 114. The populations of bonytail chub, Colorado pikeminnow, roundtail club, and razorback sucker are either extinct or "exceedingly rare." The humpback chub persists as a threatened, but viable population. The speckled dace, flannelmouth sucker, and bluehead sucker remain relatively common. *Id.*

[466] *See* Minckley, *supra* note 22, at 141-42; *See also* WATER IN THE WEST, *supra* note 127, at 2-13 to -14 ("[I]nstream flows in the Rio Grande, Upper Colorado, and Lower Colorado water resource regions are insufficient to meet current needs for wildlife and fish habitat, much less allow any additional offstream use.") (citations omitted).

[467] *See* Minckley, *supra* note 22, at 142 ("Water temperature too low for reproduction or larval development clearly results in loss of populations and is the culprit excluding natives from Marble/Grand Canyons..."); *See also* Bureau of Reclamation, U.S. Dep't of the Interior, *Glen Canyon Dam Modifications To Control Downstream Temperatures: Plan and Draft Environmental Assessment,* at 33 (1999) (visited Feb. 13, 1999) <http://www.uc.usbr.gov> [hereinafter *Modification DEA].*

[468] *See* FEIS, *supra* note 10, at 211.

[469] "Exotic" species, also called "alien" or "non-native" species, are those that exist outside of then- native range. *See* HUNTER, *supra* note 29, at 215.

[470] *See* Minckley, *supra* note 22, at 132; *See also* WATER IN THE WEST, *supra* note 127, at 2-13 ("The proportion of non-native [or exotic] fish is greatest in the Color ado River basin, where there are nearly twice as many introduced species (60) as native species (32).").

[471] *See* NAT'L RESEARCH COUNCIL, *supra* note 26, at 97.

[472] *See id.*; FEIS, *supra* note 10, at 213.

In an effort to mitigate the adverse impacts of the dam on native fishes, the Bureau of Reclamation has proposed a fifteen million dollar modification to Glen Canyon Dam.[473] The modification would provide for the release of warm water from the top of Lake Powell, instead of the cold water from lower in the water column that is currently released through Glen Canyon Dam's penstocks. While certainly a worthwhile experiment, whether the modification will prove beneficial to the native fishes remains to be seen. The plan only provides for releases of warm water thirty days per year.[474]Some of the exotic fishes may also respond favorably to the warmer releases from Glen Canyon Dam.[475]If they do, they may expand their range into the native fishes' last strongholds,[476] further threatening the endangered native fishes.

Other negative impacts of the dam have not been addressed. One such impact is the barrier effect of the dam. By restricting the natural spawning migrations of many of the native fishes, the dam further limits the population that is now trapped between Glen Canyon Dam and Lake Mead. Finally, Lake Powell itself has destroyed much of the native fishes' prime habitat.[477] Draining Lake Powell would clearly benefit the native fishes by restoring their natural habitat, provided that the lake could initially be drained in such a way as not to destroy existing populations. Native fishes would gain from the expanded habitat, the higher and more variable water temperatures, and the increased variability of water flows and silt-loads. But as with the Bureau's proposed modifications to the dam, decommissioning the dam altogether raises the concern that exotic species will move into the new habitat more successfully than would the natives, thereby aggravating threats posed by competition.

There is also a heated debate about the numerous other exotic species that have moved into the Grand Canyon as a result of the downstream habitat alterations caused by Glen Canyon Dam. As a

[473] *See* Steve Yozwiak, Warning the Colorado: $15 Mil Plan To Raise Temperature Reflects US. Desire To Protect Fish, ARIZ. REPUBLIC , Jan. 26, 1999, at Al. *See generally Modification DEA*, *supra* note 467.

[474] Michelle Nijhuis *Not Such a Cold Fish*, HIGH COUNTRY NEWS, Mar. 1. 1999, at 4.

[475] *See* Minckley, *supra* note 22. at 124, 146, 149; Barry Burkhart, Warm-Water Debate Rages on Colorado: Raising Temperature Could Have Drawbacks, ARIZ. REPUBLIC, Feb. 11, 1999, at C12.

[476] *See*, Minckley, *supra* note 22, at 146.

[477] *See id* at 150-64.

result of the traditional fluctuations associated with hydropower releases from Glen Canyon Dam, sandbars have degraded over time.[478] Coincident with the changes in sandbars have been changes in riparian vegetation,[479] which in turn have resulted in changes in the terrestrial fauna that occupy the Grand Canyon.[480]

The exotic species that moved in to fill the niches opened by habitat changes include a number of endangered species. For example, bald eagles, which were virtually absent from the Grand Canyon before the installation of Glen Canyon Dam, largely prey on cold-water trout that are dependent on the insects that thrive in the unnaturally cold water.[481] Similarly, peregrine falcons in the Grand Canyon, which likely existed in substantially reduced numbers historically, prey on the unnaturally abundant smaller birds that prey, on these insects.[482]

As one raft-guide commented, "I and my customers rather like the river environment and the species diversity which has evolved downstream from the clam the way it is today.[483] Natural flows through the canyon would build sandbars and reduce riparian vegetation, thereby likely decreasing the species diversity. Bald eagles and peregrine falcons populations would likely decline.[484] At the same time, some of these effects are likely to occur under the present operation of Glen Canyon Dam, which is intended to restore habitat, including sandbars. Moreover, if the maintenance of global or national biological diversity is of primary concern, then natural flows would have to be favored because of the relative risk of extinction of the species affected.

2. *Pollution.*

Pollution is also a critical issue in evaluating the Sierra Club's

[478] *See supra* Part IV.B

[479] *See* R. Roy Johnson *Historic Changes in Vegetation Along the Colorado Rivet in the Grand Canyon*, in COLORADO RIVER ECOLOGY, *supra* note 22, at 178, 187. Johnson relates that "the aquatic ecosystem in the Grand Canyon is an exotic ecosystem, an ecosystem that has been so extensively modified that it consists of a humanly created environment in which native processes have been interrupted non-native species abound, and native species have been extirpated." *Id.* at 181.

[480] *See id.* at 196-97; FEIS, *supra* note 10, at 231, 244-45.

[481] *See* FEIS, *supra* note 10, at 137-38.

[482] *See id.* at 138.

[483] *Lake Powell Hearing*, *supra* note 1 (statement of Robert Elliott, America Outdoors and Arizona Raft Adventures) (available at 1997 WL 14151305).

[484] *See* FEIS, *supra* note 10, at 137-38.

proposal. As mentioned previously,[485] replacing the hydropower lost by decommissioning Glen Canyon Dam will eventually cause increased air pollution in the region.[486] On the other hand, draining Lake Powell will eliminate the massive amounts of pollution associated with surface recreation on the Lake.[487]

Another pollution concern involves the toxic sediments that have accumulated on the bottom of Lake Powell.[488] The impact of the toxic metals in Lake Powell can cut either way, however, depending on whether an engineering solution can be developed. If the toxic sediments were washed downstream in large quantities, serious harm to plants and animals could result. On the other hand, the toxic sediments will have to be dealt with someday; in the meantime, the predicament is only getting worse as toxic sediment deposition in the reservoir continues.

Restoring the Colorado River delta has also become a focus of the environmental debate. The dams and diversions on the Colorado River have effectively prevented most of the Colorado's rich waters from reaching the delta and the Sea of Cortez beyond. The river was first cut off from the delta in 1905, when it was accidentally diverted into the Salton Sink.[489] Though most of the river again returned to the delta within two years,[490] it was again dry when Hoover Dam filled during the mid-to-late-1930s.[491] It was dry once more while Glen Canyon filled from 1963 to 1980.[492] By 1981, much of the delta was non-existent—nothing but mud flats.[493] Along with the wetlands, many of the birds, fish, and plants disappeared.[494] So too did Aldo Leopold's "despot of the delta,

[485] *See supra* Part V.D.

[486] Some have speculated that the accumulated sediments in the drained canyon would contribute to significant amounts of pollution as they dry and become airborne. *See, e.g.,,* Lake *Powell* Hearing, *supra* note 1, at 96 (statement of Rita P. Pearson, Director, Arizona Department of Water Resources).

[487] *See supra* Part V.E.

[488] *See, e.g.,,* POTTER & DRAKE, *supra* note 336, at 215-30.

[489] *See* Glenn et al., *supra* note 39, at 1177

[490] *See id.*

[491] *See* Bureau of Reclamation, U.S. Dep't of the Interior, The *Chronology* (visited Mar. 7, 1999) <http://www.hooverdam.com/History/chrono.htm> (reporting that Hoover Dam began to fill on February 1, 1935, the first generators began operations in 1936, and the spillways were tested in 1941; *See also* Luecke et al., *A Delta Once More, supra* note 134, at 2 ("For six years, as Lake Mead filled behind the [Hoover] dam, virtually no freshwater reached the delta.").

[492] *See* Glenn et al., *supra* note 39, at 1177.

[493] *See* FRADKIN, *supra* note 20, at 338-41; MORRISON ET AL., *supra* note 38, at 22-23.

[494] *See* Glenn et al., *supra* note 39, at 1177; Luecke et al., *A Delta Once More, Supra* note 134, at 24; *See also* MORRISON ET AL, *supra* note 38, at 22-23.

the great jaguar, *el tigre*.[495]

Since 1981, however, wet years in the Colorado Basin have provided the delta with water once again, rejuvenating remnants of the delta.[496] Although the delta has been reduced to a mere five percent of its historical size,[497] it provides crucial habitat for many species. Some waterfowl have returned to winter in the delta, and it provides a key stopover for some of the migratory birds on the Pacific Flyway.[498] It is home to the largest populations of the Yuma clapper rail and desert pupfish,[499] both of which are listed as endangered under the Endangered Species Act.[500]

However, these remnants of the delta and its wildlife remain entirely dependent on the recent largesse of the fickle Colorado River. With current consumptive uses of Colorado River water, much of the delta[501] will again go dry when the river slows to its

[495] Aldo Leopold, A SAND COUNTY ALMANAC, WITH ESSAYS ON CONSERVATION FROM ROUND RIVER 151 (Ballantine Books 1970).

[496] *See* Luecke et al., *A Delta Once More, supra* note 134, at 1, 7, 13. "From 1940 to 1998, total water releases to the delta have amounted to an estimated 20 percent of the Colorado's total flows over the same period." *Id.* at 1. "From 1980 to 1993, average annual flood flows across the border (cross border flows minus Mexico's treaty allotment) were 3.9 maf in 1997-1998, flows exceeding 1.5 maf were released to the delta . *Id. a*t 13.

[497] *See id.* at 4.

[498] *See* Glenn et al., *supra* note 39, at 1176; Luecke et al., *A Delta Once More, supra* note 134, at 6, 17. "Although not extensively studied, the delta's significance for migratory birds is indisputable, as it is the principle freshwater marsh in the region. From 1980 to 1985, some 45,000 ducks and 200 geese wintered in the delta. A 1992 winter survey found more than 160,000 birds in the delta…" *Id.* at 17 (citations omitted).

[499] *See* Glenn et al., *supra* note 39, at 1176.

[500] *See* 50 C.F.R. § 17.11 (1997) (desert pupfish, *Cyprinodon macularius*, and Yuma clapper rail, *Rallus longirostris yumanensis).*

[501] Colorado River water would likely continue to flow into the Cienega de Santa Clara wetland even if the mainstem flow dropped below 13.5 rnaf. The Cienega de Santa Clara is fed by the salty water that is drained from the Wellton-Mohawk Irrigation District in Arizona through the Wellton-Mollawk Main Outlet Drain Extension ("M.O.D.E.") canal. *See* Edward P. Glenn et al., *Cienaga de Santa Clara: Endangered Wetland in the Colorado River Delta, Sonora, Mexico,* 32 NAT. RESOURCES J. 817, 818-19 (1992). This water was originally intended to supply the infamous Yuma Desalting Plant ("YDP"), which was slated to clean the water and then deliver it as part of the United States' 1.5 maf treaty obligation to Mexico. See Luecke et al., *.A Delta Once More, supra* note 134, a t 15-16. However, the plant remains idle and the wastewater continues to sustain the Cienega de Santa Clara. *See id.*

Today, the Cienega de Santa Clara is one of the central remnants of the delta's wetlands, making the continued flows of wastewater an important environmental issue. *See generally* Glenn et al., *supra* note 39, at 817; Luecke et al., *A Delta Once More, supra* note 134, at 40; *See also* PONTIUS & SWCA, *supra* note 71, at 113-14 ("Operation of the YDP is not the most cost-effective way to meet the Mexican Treaty obligation and in fact is an extremely expensive alternative .... It is time for the federal government and the states to decide whether the YDP should ever be operated.").

normal 13.5 maf.[502] As a result, the delta was listed as America's sixth most endangered waterway by American Rivers in 1998.[503]

Along with the delta, the totoaba and vaquita can be listed as two of America's most endangered.[504] Both are literally going extinct before our eyes. The vaquita, which was not even formally described until 1958,[505] numbers only a couple hundred today.[506] The totoaba is likely even worse off.[507] While the fate of each has largely been determined by overfishing in the Sea of Cortez, it is likely that the damming of the Colorado River has played some role in its threatened demise.[508]

The endangered status of the delta, the Upper Sea of Cortez. and its species have generated considerable interest in both the United States and Mexico,[509] and some are looking to the proposal

[502] The Lower Basin is currently using almost eight maf, and the Upper is currently using approximately four maf. *See* PONTIUS & S*WCA, supra* note 71, at 13-14 (reporting estimated 1996 use in the Lower Basin as 8 maf per year and in the Upper Basin as 3.79 maf per year); *See also* BUREAU OF RECLAMATION, U.S. DEP'T OF THE INTERIOR, COMPILATION OF RECORDS IN ACCORDANCE WITH ARTICLE V. OF THE DECREE OF THE SUPREME COURT OF THE UNITED STATED IN *ARIZONA V. CALIFORNIA* DATED MARCH 19, 1964: CALENDAR YEAR 1998, at 1(1999) (reporting total Lower Basin consumptive use at about 7.9 maf). Mexico uses all of its 1.5 maf annual allocation. Luecke et al., *A Delta Once More, supra* note 134, at 12.

[503] *See* American Rivers, *America's 20 Mast Endangered Rivers* of 1998 (visited Nov 1, 1999) <http://www.amrivers.org/98endangered.htrm#intro>; *See also* Steve Yozwiak. Low *Flows Threaten River Delta: State-U.S. Panel Refuses To Study Impact in Mexico,* ARIZ. REPUBLIC Nov. 12, 1998, at Al.

[504] Both species are listed as endangered under the Endangered Species Act. *See* 50 C.F.R. § 17.11 (1997).

[505] *See* K. S. Norris & W. N. McFarland, *A New Porpoise of the Genus Phocoena in the Gulf of California,* 39 J. Mammology 22 (1958). The vaquita "is one of the most recently described large mammals." Hohn et al., *supra* note 42, at 235.

[506] *See* Jay Barlow et al., *First Estimates of Vaquita Abundance,* 13 MARINE MAMMAL SCIENCE 44, 44, 52 (1997).

[507] *See* Luecke et al., *A Delta Once More, supra* note 134, at 17 (stating that the totoaba is "now virtually extinct"); Guevara, a, *supra* note 4 1, at 201 ("The longer-term preservation and enhancement of the remaining totoaba gene pool depends on whether or not the fish can be reared in captivity.").

[508] *See* Guevara, *supra* note 41. at 201 Diversion of the Colorado River has converted the formerly brackish-water habitat in the extreme northern Gulf of California into a hypersaline environment, drastically altering the nursery grounds of the totoaba"); Cisneros-Mata et al., *supra* note 41, at 811-12 ("[W]e cannot disregard the possibility that control of the Colorado River resulted in a negative impact on totoaba.); *See also* Ramirez *supra* note 36, at 9 (Reduced freshwater flow into the Upper Gulf of California may have contributed to alteration of vaquita habitat.").

[509] *See* PONTIUS & SWCA, *supra* note 71, at 57-59; Getches, *Colorado River Governance supra* note 240, at 605-07. *See generally* Morrison et. al., *supra* note 38 Luecke et al., *A Delta Once More, supra* note 134; Frank S. Wilson, A *Fish Out of Water: A Proposal for International Instream Flow Rights in the Lower Colorado River,* 5 COLO. J. INT'L L. & POL'Y 249 (1994).

to drain Lake Powell as the delta's savior.[510] Draining Lake Powell likely would result in more water reaching the delta. With less storage in the United States, Colorado River dams would spill more frequently, resulting in larger deliveries to Mexico. At least some of the water saved from evaporation and bank storage would make its way into the delta and out to the Sea of Cortez.

However, for at least some people the only suggestion more heretical than draining Lake Powell is "wasting" America's water by letting it flow into Mexico's Sea of Cortez. Moreover, not even decommissioning Glen Canyon Dam would ensure the ultimate restoration of the delta. Once the Colorado's prized waters breach the Mexican border, there is no guarantee they will end tip in the delta and the Sea of Cortez, instead of Tijuana or yet another irrigation canal. Therefore, successful restoration of the delta and the Sea of Cortez would require international agreement—perhaps even amending the 1944 Treaty—to provide assurances for instream flows and protection of the delta and the Sea's resources.[511]

3. *Contingent environmental concerns.*

There are less tangible environmental impacts of decommissioning Glen Canyon Dam to consider as well. In a very important sense, development of the Colorado River arguably has been an environmentally protective factor in the growth of the West. The 1922 Compact assured the Upper Basin that it would not have to race to develop the Colorado in order to secure water for the future.[512] As a result, the Upper Basin states had the flexibility to focus on other priorities. Similarly, Glen Canyon has given the entire basin a sense of security, permitting the flexibility to take measures to protect the environment. Without Glen Canyon Dam, an agreement to restore the Platte River may never have been reached. Similarly, the restoration of Mono Lake and Owens Valley, may have never been considered. Consequently, the environ-

[510] *See, e.g.,, Lake Powell Hearing, supra* note 1, at 89 (statement of David Ross Brower).

[511] *See generally* Luecke et al., *A Delta Once More, supra* note 134; Wilson, *supra* note *509.*

[512] *See* Sibley, *A Tale of Two Rivers, supra* note 87, at 15 ("Without the compact, the Upper Basin would have been forced to appropriate water as fast as possible. Development would have been even more reckless and destructive than it has been. Must probably, the surrounding cities would have rushed to drain the Colorado River before California could appropriate the water.")

mental costs of draining Lake Powell could reach far beyond the Colorado Plateau.

Without Lake Powell, many water managers in the West would be more anxious about the water supply for future growth. Whether such fears are rational is, in one sense, irrelevant: Lake Powell has allayed some of those fears, thereby facilitating the dedication of some water to the environment. Nevertheless, many of these fears are ungrounded, at least for the foreseeable future. Water supply has not limited growth in the West, and will not for a long time to come unless, of course, growth is defined as more fountains, man-made lakes, and rolling lawns in Las Vegas. Accordingly, costs associated with indirect threats to environmental protection should be part of the calculus only if we refuse to update western water law and management.

In sum, environmental costs and benefits associated with draining Lake Powell are presently unclear. Here, perhaps more than any other issue, our current knowledge is severely insufficient to accurately evaluate the consequences. At the same time, the Plateau's native fishes, the Sea of Cortez's vaquita and totoaba, and the delta itself may not wait for decades of study.

VI. CONCLUSION

Glen Canyon Dam was built on the assumption that it was necessary–period. Backing-up the presumed necessities were many benefits, including boating, trout fishing, river regulation, and power. But no consideration was given to the potential costs of creating Glen Canyon Dam. No environmental impact studies were conducted,[513] no consideration was given to the impacts the dam would have on the downstream ecosystem in the Grand Canyon, no consideration was given to the Native Americans on the Plateau or the Mexicans to the south, and no consideration was given to The Place No One Knew. But the costs have become obvious–at least some of them–and they are farther-reaching than anyone had imagined.

[513] The Glen Canyon Institute proposes to undertake a "Citizens Environmental Assessment," modeled on NEPA, to evaluate the impacts of decommissioning Glen Canyon Dam. As of October 1997, the Institute had raised $100,000 for the project, one-quarter of the estimated cost of the Assessment. *See Lake Powell Hearing, supra* note I (statement of David Wegner, Vice President, and Richard Ingebretsen, President, Glen Canyon Institute) (available at 1997 WL 14151303); *See also* Brent Israelsen, *Pull Lake Powell Plug? Residents in West Get To Say if Proposal Really Holds Water* SALT LAKE TRIB. Oct. 27, 1997, at D1.

The Glen Canyon Environmental Studies revealed much. They revealed that the operations of Glen Canyon Dam could be altered to mitigate some of its costs. In a commendable effort, we have, and these efforts continue today.

Nevertheless, it is possible that nothing short of draining Lake Powell will save the endangered fish, birds, and mammals of the Colorado River, its delta, and the Sea of Cortez. The beaches that are so important to both wildlife and recreationists may continue to disappear unless sediment is permitted to flow through Glen Canyon. The water that is so precious to the people and the environment of the southwest will continue to evaporate. The toxic sediment, oil, and trash in submerged Glen Canyon will continue to accumulate.

Draining Lake Powell clearly would have its costs as well: flood control, power, recreation, and storage. But the economic costs and benefits of the dam are so indeterminate that hundreds of millions–probably billions–of dollars could be thrown on either side of the equation. And the impacts, both positive arid negative, range from the Platte River to the Sea of Cortez and beyond.

Even if the direct economic costs of decommissioning the dam do outweigh the direct economic benefits, a price tag in the billions of dollars for habitat restoration is not unprecedented. Just look to the Florida Everglades, where the federal and state governments have already spent $3.5 billion and plan to dedicate nearly $8 billion more to habitat restoration,[514] or the Columbia River where $3 billion already has been spent trying save and restore the salmon and steelhead.[515]

This preliminary analysis of water, power, recreation, and the environment reveals that some of the common assumptions about the importance of Glen Canyon Dam and Lake Powell may not be accurate. Even so, analysis has its limitations. There are values involved that simply cannot be balanced with dollars or any other economic valuation.

As we enter the new millennium, we are amidst the most vital changes in Colorado River management in many, decades, with Bruce Babbitt and the Bureau of Reclamation leading the way. Formal surplus guidelines will be promulgated for the first time;[516]

[514] *See supra* note 316 and accompanying text.

[515] William K. Stevens, *Will Dam Busting Save Salmon? Maybe Not*, N.Y. TIMES, Oct5, 1999, at Fl: *See also supra* note 120 and accompanying text.

[516] *See* Public Meetings on the Development of Surplus Criteria for Management of the Colorado River and To Initiate National Environmental Policy Act (NEPA) Process. 64 Fed. Reg. 29,068 (1999); Bruce Babbitt, *Remarks to the Colorado Water Users Association, Las Vegas, December 17, 1998* (visited Mar. 9, 1999) <http://www.doi.gov/secretary/ cowater.htm

California has committed to reducing its use of Colorado River water, aiming to comply with its legal obligation to bring its use within its 4.4 maf annual allocation;[517] the Bureau has adopted a new rule that permits off-stream storage and interstate transfers of Colorado River water;[518] and the Imperial Irrigation District and the City of San Diego have penned a historic transfer of conserved irrigation water.[519] We have an obligation to consider the future of Glen Canyon during this dynamic debate over the fate of the Colorado River in the twenty-first century and beyond.

Many, perhaps most, feel that Echo Park was a bad compromise. In 1983, Stewart Udall said, "If I could switch it, I'd have Glen Canyon be the national park and build the dam at Echo Park.[520] Martin Litton said, "Looking back, I'd say Echo Park was less valuable than Glen Canyon.[521] Former Senator Barry Goldwater acknowledged his vote for Glen Canyon dam as the one he most regrets.[522] Just a decade after the gates of Glen Canyon Dam were closed, Frank Waters—the same man who had described Hoover Dam as "inexpressibly beautiful" and "a fabulous, unearthly dream" in 1946–wrote:

> So precious is this spiritual heartland of America, it seems to me now, that it would not have been inappropriate had we with better foresight preserved it as a refreshing oasis, a sacred shrine, for millions of people desperately needing to regain touch with their earth and their inner selves. Who can say that its aesthetic and spiritual values would not in the future have outweighed its monetary values?[523]

His foresight begs the next question: If Glen Canyon Dam would not have been built had we known then what we know today, then doesn't the proposal deserve careful consideration?

Yet some would prevent any consideration at all. Three years after David Brower shared his vision of the future of the canyons of the Colorado River, immediately catching peoples' attention and sparking their imaginations, western members of Congress worriedly inserted a rider to the 1999 appropriations bill in an attempt to slow the proposal's momentum. The rider was inserted again in the 2000 appropriations act, prohibiting the Department of the Interior from using any appropriated funds "to study or implement any plan to drain Lake Powell or to reduce the water level of the lake below the range of water levels required for the operation of the Glen Canyon Dam."[524] While Congress certainly should—and indeed must—have its say as to whether the plan should be implemented, the provision raises the obvious question "What is Congress trying to hide by prohibiting study of the proposal?"

Draining Lake Powell may or may not be in our best interests or even in the best interests of our grandchildren. But we should have the integrity and sensibility to reexamine decisions that we have made in the past. If we take a close look at the proposal, we may find the assumed benefits are illusory, that the unpredicted costs are greater than we realize, or that our changed values require a new equation. We may also find that there is flexibility still hidden in the rigid Law of the River.[525] We owe it to ourselves, future generations, and the lands of the Colorado River to finally evaluate the costs and benefits objectively.

[517] *See* MOU, *supra* note 361, at 2 ("the State of California is endeavoring to reduce its use of Colorado River water to match the State's apportionment"). The California Limitation Act of March 4, 1929, provides that:

> the State of California. . . agrees irrevocably and unconditionally with the Untied States and for the benefit of the states of Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming as an express covenant and in consideration of the passage of the said "Boulder Canyon Project Act" that the aggregate annual consumptive use (diversions less returns to the river) of water of and from the Colorado river ... shall not exceed four million four hundred thousand acre-feet ... plus not more than one-half of any excess or surplus waters unapportioned by said Compact ....

1929 Cal. Stat. 38-9, *available in* RAY LYMAN WILBUR & NORTHCUT ELY, THE HOOVER DAM DOCUMENTS A231-32 (1948); *See also* Tony Perry, *Agencies Reach Truce in Feud Over River Water*, L.A. TIMES, Aug. 5, 1995, at A].

[518] *See* Offstream Storage of Colorado River Water and Development and Release of Intentionally Created Unused Apportionment ill the Lower Division States, 64 Fed. Reg. 58,986 (1999) (effective Dec. 1, 1999).

[519] *See* David J. Hayes, *Quenching the West's Thirst*, SAN DIEGO UNION-TRIB., Oct. 31. 1999, at G1; Babbitt, *supra* note 516.

[520] PALMER, *supra* note 243, at 79.

[521] *Id.*

[522] *See* Babbitt, A *River Runs Against It*, *supra* note 323, at 8, 11.

[523] WATERS, *supra* note 136, at 337.

[524] Pub. L. No. 106-113, § 1000(a)(3) (1999) (incorporating by reference H.R. 3423, 106th Cong. § 135

[525] *See* MacDonnell & Getches, *supra* note 373, at 5, 4546 ("It now seems clear that all inflexible reliance on the Law of the River will not address the panoply of issues being raised and could actually result in calls for broader reforms, even fundamental revision of basic allocations.").

Babbitt may or may not be correct in his assessment of his own challenge to tear out dams across the country:

> Does it mean all 75,000? No, of course not. Does it mean Hoover Dam? No, of course not. Does it mean Glen Canyon Dam? Not in my lifetime. Not until the entire Colorado River Compact is reexamined, and that is not going to happen in my lifetime—nor should it.[526]

But he certainly has it right that "we should challenge dam owners everywhere—including the U.S. Bureau of Reclamation, the Army Corps of Engineers and other federal agencies—to defend themselves, to demonstrate by hard facts, not sentiment and myth, that continued operation of a dam is in the public interest."[527] This is especially true of Glen Canyon Dam, a dam built on assumptions of necessity and with a blind eye to the environment and our changing values.

The Sierra Club's proposal has sparked the imagination of many Americans.[528] Now, the experts are starting to ask, "Is it now time to do the study that we never took the time to do during the Big Buildup?[529] Former Commissioner of Reclamation Dan Beard has said that the Sierra Club's proposal "may just be the cheapest and easiest solution to our river restoration problems," and has urged the advocates of fair study not to give up.[530]

As Sierra Club President Adam Werbach has suggested, "[r]egardless of where you stand on this issue, it shouldn't hurt to at least look at the information."[531] Looking at the information, in fact just gathering the information, is long overdue, and time is getting shorter as our many plans move ahead, the sediment accumulates, and the species decline.

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[526] Secretary, Bruce Babbitt, Address at the Natural Resources Law Center Conference, University of Colorado School of Law, Strategies in Western Water Law and Policy: Courts, Coercion and Collaboration (June 8, 1999).

[527] Babbitt, *supra* note 300, at 9.

[528] A reflection of some of the interest in David Brower's proposal is the number of books that have been published on "predambrian" Glen Canyon since David Brower floated the idea to the Sierra Club's Board of Directors. *See, e.g.*, JARED FARMER, GLEN CANYON DAMMED: INVENTING LAKE POWELL AND THE CANYON COUNTRY (1999); STEVEN HANNON GLEN CANYON: A NOVEL (1997); KATIE LEE, ALL MY MEMORIES ARE GONE: A JOURNEY OF DISCOVERY THROUGH GLEN CANYON (1998); TAD NICHOLS, GLEN CANYON IMAGES OF A LOST WORLD (1999).

[529] WILKINSON, FIRE ON THE PLATEAU *supra* note 12, at 227.

[530] Beard, *supra* note 6*; See also* Beard, *supra* note *305*.

[531] *See Lake Powell Hearing*, *supra* note 1, at 1,10 (statement of Adam Werbach, President Sierra Club*)*. The 404-page 1995 EIS devotes all of one paragraph to evaluating the idea of decommissioning the dam.