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Colorado River Basin Study: Report to the Western Water Policy Review Advisory Commission

Dale Pontius

Colorado River Basin Study

Final Report

Dale Pontius,
Principal Investigator

Inconjunction with

SWCA, Inc.
Environmental Consultants
Tucson, Arizona

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August 1997

The Western Water Policy Review Advisory Commission

Under the Western Water Policy Review Act of 1992 (P.L. 102-575, Title XXX), Congress directed the President to undertake a comprehensive review of Federal activities in the 19 Western States that directly or indirectly affect the allocation and use of water resources, whether surface or subsurface, and to submit a report of findings to the congressional committees having jurisdiction over Federal Water Programs.

As directed by the statute, the President appointed the Western Water Policy Review Advisory Commission. The Commission was composed of 22 members, 10 appointed by the President, including the Secretary of the Interior and the Secretary of the Army, and 12 members of Congress serving *ex-officio* by virtue of being the chair or ranking minority member of the 6 congressional committees and subcommittees with jurisdiction over the appropriations and programs of water resources agencies. A complete roster is provided below.

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This is an Independent Report to the Commission

The report published herein was prepared for the Commission as part of its information gathering activity. The views, conclusions, and recommendations are those of the author(s) and are not intended to represent the views of the Commission, the Administration, or Members of Congress serving on the Commission. Publication by the Commission does not imply endorsement of the author's findings or recommendations.

This report is published to share with the public the information and ideas gathered and considered by the Commission in its deliberations. The Commission's views, conclusions, and recommendations will be set forth in the Commission's own report.

Additional copies of this publication may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia, 22161; phone 703-487-4650.

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Executive Summary

This report cannot possibly cover all the issues of concern in the Colorado River basin. The basin is vast and diverse geographically, ethnically, and politically. Conflicts over water are part of its history, as water has been the defining resource in the settlement and development of the Colorado River basin. A complex set of laws, a treaty, court decrees, contracts, agreements, regulations and traditions of use have evolved over this past century which have governed water policy and management decisions. Over the last few decades, new social values have emerged in the basin and across the country which reflect an appreciation of the important functions of river systems along with a desire to preserve this natural heritage for succeeding generations. In addition, the residents of the basin states, and those who visit, take advantage of the natural beauty of the Colorado River basin to recreate in increasing numbers, rafting, hiking, fishing, and boating on or near the lakes, rivers and streams that make up the watersheds of the basin. Today, recreation and tourism are major elements of the economy of every basin state.

The growing constituencies for recreation, tourism, and conservation values conflict on occasion with the traditional view that the first prioirty must be to store and deliver water for people, to grow food, produce electricity and for other commercial uses. The incredible growth that is continuing in the basin means more water must be found for these uses from an uncertain and limited supply. Someday, new technology and the economics of water development may free up new supplies by cost-effective desalinization or other technological breakthroughs, but these are not yet on the horizon. Yet decisions need to be made in the coming years as to how existing water supplies and apportionments can be utilized in a more efficient and equitable way to meet these growing needs within the sustainable limits of the ecosystem.

As we enter the 21st century, these conflicting values also must be reconciled with those held by Native Americans, who have lived the longest in the basin and hold the most senior rights to water in most cases. The *Winters* decision by the Supreme Court was issued almost 90 years ago -- in 1908 -- but today most of the Indian communities and reservations in the basin hold only paper rights or claims to their share of the basin's water resources. The next generation of leaders in the basin and in Washington must make substantial progress toward meeting these legal and equitable obligations. Settling these claims, which is a national obligation, and sharing the wealth that water brings to the basin with its Native American citizens must become a reality. Water management decisions must involve tribes as equal partners and institutions developed that effectuate this partnership.

At the outset of this report, it is stated that there should be goals and objectives against which water policy and management decisions should be measured. Whether efficiency, equity, and sustainability accurately reflect the basin's current goals is problematic; what *is* important is that a vision be developed that does reflect

the basin's values and objectives for the next century. This report suggests some recommendations that might be starting points. They are:

- The basin states and Secretary of the Interior should agree on and formalize a cooperative management structure for the basin to address and resolve major water management issues affecting the public interest and which defers to state implementation and management wherever possible.

- The federal government should undertake a thorough review with the basin states and tribes over the next several years to determine how the various agencies could be reorganized to provide more efficient, cost-effective service in administering their programs without sacrificing the national interest or trust responsibilities. In addition, whenever feasible, federal agencies with water management programs and responsibilities should be organized along watershed or sub-basin boundaries.

- A centralized and integrated data center for the Colorado River basin should be established to collect and provide a comprehensive, reliable, scientific and economic database that is electronically available to all who need it.

- The Secretary, basin states and Indian tribes, with input from other interests, should agree on a plan for reservoir operation and surplus and shortage criteria that is equitable to all interests and meets federal statutory obligations and treaty obligations to Mexico.

- An interstate water bank should be established in the Lower Basin along the lines proposed by Arizona, with maximum flexibility for marketing and banking water, including tribal water.

- The basin states and local water managers need to develop stronger conservation programs to maximize conservation and reuse potential and more clearly define and regulate reasonable beneficial use. In the lower Colorado River basin, the Bureau of Reclamation and the states, working together, need to more clearly define and regulate reasonable beneficial use.

- Recovery plans for endangered fish in the Colorado River basin should be consolidated in one multi-species recovery plan and recovery goals more clearly defined. In addition, the three different recovery implementation programs in the basin should be coordinated.

- The Secretary should establish a policy which allows for more public input into the development of reasonable and prudent alternatives under Section 7 of the Endangered Species Act. The FWS should develop policies that provide water development interests with more clearly defined, realistic mitigation requirements that will provide the maximum possible certainty for existing and planned water development projects.

- An environmental trust fund should be established with dedicated funding for endangered species recovery, habitat restoration, and environmental enhancement in the basin.

- A Binational Commission should be established to review and make recommendations on the potential for restoration of the Colorado River delta and the environmental and economic benefits and costs of such restoration.

- The Secretary should commission a comprehensive study of alternatives to operation of the Yuma Desalting Plant and what should be done with this facility if it is determined not to be in the long-term interest to operate the Plant.

- Future salinity control programs should emphasize on-farm irrigation management, reuse and conservation, fallowing agreements, and retirement of marginal lands.

- The federal government should develop a more effective strategy and establish priorities for settling and implementing Indian water rights claims in the basin.
- The basin states and tribes should agree on a plan for integrating tribal water use, banking, and leasing of tribal water in state and interstate water marketing systems.

Introduction

The Western Water Policy Review Advisory Commission (Commission) requested that this study include background information on the Colorado River and its geology, geography, and hydrology; a description and analysis of the most critical issues facing the basin in the near future and efforts being made to address these problems; and also provide specific recommendations to the Commission including the proper role for the federal government in basin water management and governance over the next twenty years. The opinions expressed in the recommendations are my own and reflect, of course, my own view of the history, law and politics of the Colorado River Basin and the current issues. I did my best to provide an objective discussion of the issues and to recommend changes needed to improve water management in the basin in the 21st century.

In addition, the report was to include a case study of a specific watershed and a discussion of how water management problems are and can be dealt with at the watershed level. The Dolores River Watershed, located in southwestern Colorado, was chosen for this case study.

I would like to acknowledge the able assistance of David Gold, John Thomas, Peter Livingston, and Dorothy House of SWCA, Inc., all of whom contributed to the development of the draft report, along with Mary Wallace, a senior research specialist with the Water Resources Research Center in Tucson, Arizona, who contributed research and writing on a number of issues. I am especially grateful to the extraordinary work done by David Gold to produce this report; his research, editing and production of the graphics included were invaluable and the task would have been impossible to accomplish without him. I would also like to thank Frank Gregg, Helen Ingram**,** Gary Hansen, and Steve Carothers, who served as an informal advisory committee, for their comments and advice on the study.

In finalizing the report, I have reviewed and analyzed well over 800 specific suggestions for changes and comments, both pro and con, that were sent to the Commission by over 40 entities and individuals before the comment deadline. In the vast majority of cases, the comments were constructive, corrected factual or technical points, or helped clarify the discussion and were incorporated in the final report. In some cases, commenters simply disagreed with the text, my emphasis, analysis, or the recommendations. I want to thank all those who took the time to comment on the draft and hope they will again take the time to read the final report, which has been improved in my mind considerably as a result of their comments.

Writing about the Colorado River is an awesome challenge given the body of scholarly work and commentary that has been done over the years on the Colorado River. I have mined some but not of all this material in the limited time allotted for this report and have included a representative but by no means complete bibliography of the voluminous literature that exists on the subject.

Background Information

The Colorado is one of the great rivers of the American West. It has a dramatic history going back millions of years; within its watershed are located some of the most majestic geologic features in North America, including the Grand Canyon. Today, it is considered the lifeline of the Southwest, providing water for nearly 25 million people, three million acres of irrigated land, and 11.5 billion kilowatt-hours of hydroelectric power. Its water yield is only eight percent of the annual flow of the Columbia and three percent of the Mississippi, yet it is arguably the most regulated river in the country, and has spawned the most litigation and controversy. The river has been the source of disputes between states, between the United States and Mexico, between cities and farms, between power users and conservationists, and between Indian tribes and non-Indian water users. To provide context for the current issues in the Colorado River basin, the geography, hydrology, water development, and water uses in the basin are described below.

Geography

The Colorado River basin, depicted in Figure 1, covers almost a quarter of a million square miles and includes portions of seven states, part of Mexico, and 34 Indian reservations. Reservation lands in the basin are depicted in Figure 2. The federal government owns 56 percent of the land within the basin, Indian reservations occupy 16.5 percent, states 8.5 percent, and
19 percent is privately owned land (Weatherford and Brown, 1986). Approximately two percent of the basin is in Mexico. The Salton Sea was filled when the Colorado River broke its channel in 1905 and flowed into the Imperial Valley for three years before it was contained. It is now replenished primarily by return flows from the Imperial Irrigation District and other discharges of waste water into the New River. Additional areas outside the natural drainage area, including the Imperial and Coachella valleys and

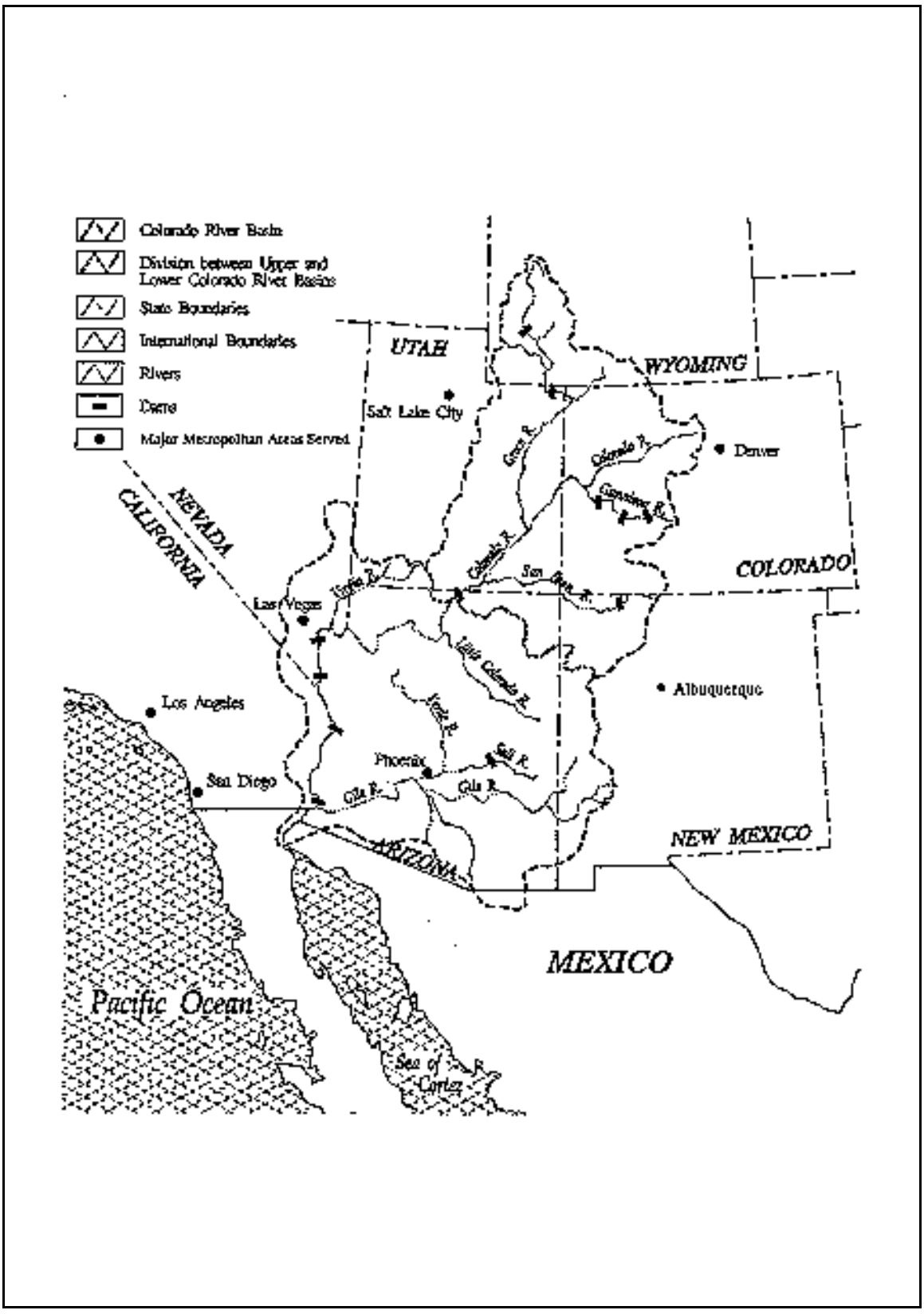


Figure 1.—Colorado River Basin.

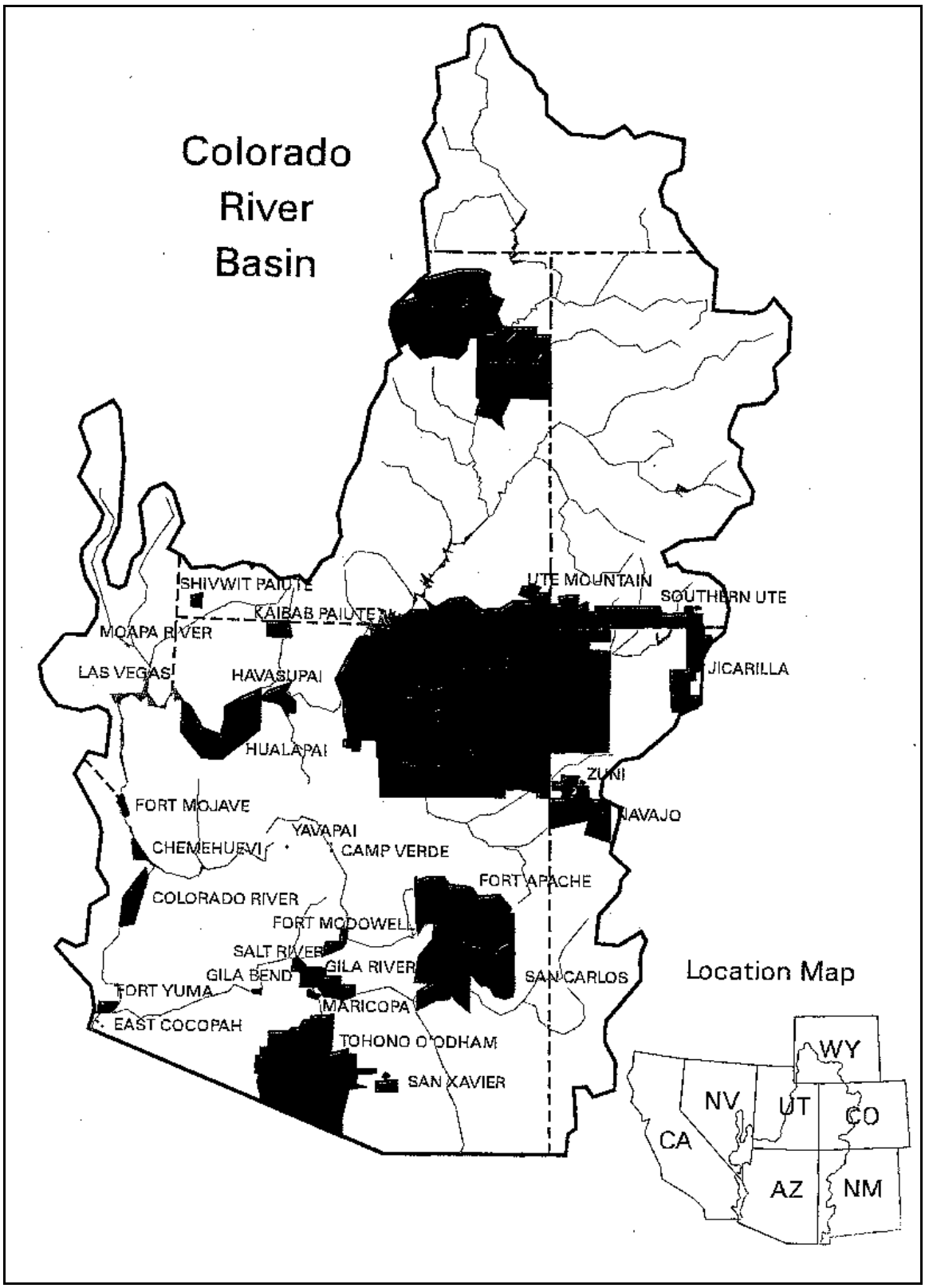


Figure 2.—Reservation lands in the Colorado River Basin. (Source: USBR, 1996).

other portions of southern California, are considered part of the Lower Colorado River Basin for the purposes of determining priorities to the use of Colorado River water in California.[1]

From its headwaters in the Rocky Mountains of Colorado and Wyoming, the Colorado River flows 1,450 miles to the Gulf of California, dropping more than 10,000 feet in elevation along the way. It flows southwest through Utah into Arizona, where it winds west through the Grand Canyon and turns south to form Arizona's western border with Nevada, California, and Mexico. The river crosses then into Mexico and empties into the Sea of Cortez. Much of the river runs a steep course through narrow canyons, sometimes hidden from sight in thousand-foot-deep chasms, carved over some five million years. The river runs through the hottest, driest regions of the United States and contains some of its most spectacular scenery.

The Colorado River Compact of 1922, negotiated by the seven basin states and the U.S. government, divided use of Colorado River water between the Upper Basin and the Lower Basin. Lee Ferry in Arizona is the division point between the Upper and Lower Basins. The Upper Basin includes portions of Arizona, Colorado, New Mexico, Utah, and Wyoming and the Lower Basin includes portions of Arizona, California, Nevada, Utah and New Mexico.

Hydrology

The Colorado River was named by a Spanish explorer for the reddish color of its waters, which comes from sediments contributed by colorful sandstones and other rocks along its course. Historically, the river's sediment load was high due to the low volume of vegetation in the arid Colorado Plateau and the force of the river coursing down its steep gradient. Sediments moved downstream with spring floods, forming marginal sand bars and terraces and a vast delta at its mouth in the Gulf of California, known in Mexico as the Sea of Cortez. These sediments provided substrate for riparian vegetation habitat and for wildlife. Today, dams trap much of the vast quantity of sediment that once flowed through the river. Historically, the average annual basin-wide sediment discharge was approximately 85 millions tons. The construction of dams and reservoirs, and the diversions in the Lower Basin and Mexico preclude the river from flowing to the gulf in most years.

Principal tributaries to the Colorado River upstream of Glen Canyon Dam include the Green, San Juan, Escalante, Gunnison, and Dolores rivers. Principal tributaries

[1] Section 7, Seven Party Water Agreement, August 18, 1931.

between Glen Canyon and Hoover Dams include the Paria, Virgin, and Little Colorado rivers. Downstream of Hoover Dam are the Bill Williams and Gila rivers. Major tributaries to the Colorado River are depicted in Figure 3.

Historically, the flow of the Colorado River, measured at Lee Ferry, fluctuated widely from year to year, season to season, and over long periods of time. Annual flows in excess of 24.0 million acre-feet (maf) and less than 6.0 maf have been calculated (Harding *et al.*, 1995). The long-term historical average measured is 14.95 maf but tree-ring studies covering hundreds of years suggest a long-term average annual flow of about 13.5 maf (Stockton and Jacoby, 1976). Most of the flow for the Colorado originates in the Upper Basin, which encompasses some 109,800 square miles. About 86 percent of the annual runoff originates within only 15 percent of the area, in the high mountains of Colorado (Stockton *et al.*, 1991).

The natural flow of the Colorado followed a distinct seasonal pattern, with more than 70 percent occurring in the months of May, June, and July (Harding *et al.*, 1995). Historically, floods of May and June peaked at greater than 86,000 cfs (Collier *et al.*, 1996). Since flows are now regulated by several major dams, peak flows are significantly lower. Over the last 20 years (with Glen Canyon Dam in place), peak daily discharges at Lee Ferry averaged 20,005 cfs in May and 25,735 cfs in June (USGS, 1996).

Over the past century, the bulk of the highest flows occurred in a "wet" period from 1896 to 1930, when the average annual natural flow during this period at Lee Ferry was about 17 maf/yr. By contrast, the average flow from 1930 to 1996 was about 13.9 maf/yr (Merritt, 1997). In the early 1980s, heavier than anticipated runoff led to releases from Lake Powell of over 90,000 cfs[2] and the emergency installation of flashboards on top of the spillway gates and Hoover Dam spilled for the first time since 1941. Flood control releases totaling over 50 maf led to substantial flooding and damages along the lower river. The wettest 10-year period on record (1914 to 1923) saw an average annual flow of 18.8 maf. This period is especially significant

[2] According to Dave Wegner, releases peaked at 97,300 cfs on June 23, 1983 (Wegner, 1997).

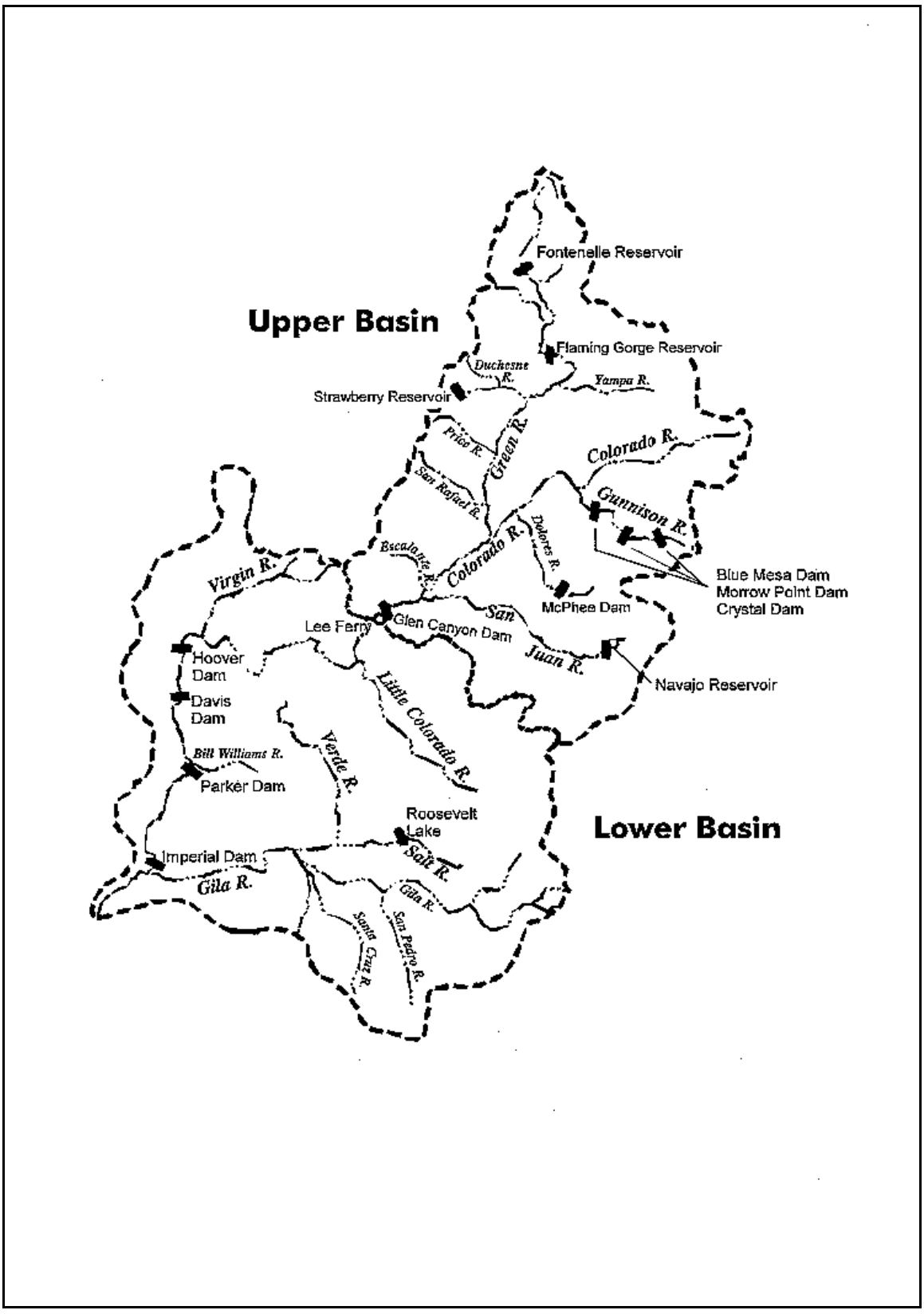


Figure 3.—Major tributaries and water developments in the Colorado River Basin.

because the Colorado River Compact, which allocated the river's water, was negotiated in 1922. Since 1922, estimates of the river's average flow have been consistently revised downward.

Water Development

While most river basins in North America have less than two times the annual water supply in reservoir storage, reservoirs on the Colorado River have a total live capacity more than *four* times the average annual flow. As shown in Table 1, the total live storage capacity of major reservoirs in the basin is more than 60 maf. The capacity of the two principal reservoirs, Lake Mead and Lake Powell, is greater than 50 maf.

The unusually large storage capacity has diminished impacts of drought within the basin, at least in the short term. Growing demands on the river, however, may reduce the ability of these reservoirs to provide a buffer against drought. Most of the reservoir storage is located too far downstream for direct use in the Upper Basin, and most of the water in storage in the Upper Basin is used to satisfy Compact guarantees to the Lower Basin and for Mexico's entitlement.

Evaporative losses from the Colorado River reservoirs are especially high due to the arid climate of the region. As shown in Table 2, the average annual evaporative loss from reservoirs in the basin is more than 2.0 maf. It has been reported that the optimum level of storage in the basin, beyond which there is no net increase in usable supply due to evaporative losses, has been surpassed (Langbein, 1959; Hardison, 1972).

Diversions

Colorado River water is diverted for use both in and out of the basin at hundreds of diversion points. There are considerably more diversions in the Upper Basin, but Lower Basin diversions are much larger. Representative water development projects in the Upper Basin are shown in Figure 4. On an annual basis, more than a third of the river's supply is exported from the basin, including diversions to such cities as Denver, Colorado Springs, Salt Lake City, Albuquerque, Los Angeles, and San Diego. These service areas, in combination with the actual Colorado River basin, have been referred to as

Table 1.—Major storage reservoirs in the Colorado River Basin

Reservoir	Active capacity(maf)	Basin	State
Lake Mead	25.88	Lower	AZ, NV
Lake Powell	24.32	Upper	AZ, UT
Flaming Gorge	3.75	Upper	WY
Mohave	1.81	Lower	AZ, NV
Navajo	1.7	Upper	NM
Strawberry	1.1	Upper	UT
Blue Mesa	0.83	Upper	CO
Havasu	0.62	Lower	AZ, CA
McPhee	0.38	Upper	CO
Fontenelle	0.35	Upper	WY
Starvation	0.26	Upper	UT
Morrow Point	0.12	Upper	CO
Taylor Park	0.11	Upper	CO
Scofield	0.07	Upper	UT
Ridgway	0.06	Upper	CO
Joes Valley	0.06	Upper	UT
Quail Creek	0.04	Upper	UT
Steinaker	0.04	Upper	UT
Moon Lake	0.04	Upper	UT
Upper Stillwater	0.03	Upper	UT
Red Fleet	0.03	Upper	UT
Crystal	0.02	Upper	CO
Total	61.62		

Sources: Anderson, 1997; Carson, 1997; Lindon, 1997; Ryan, 1997; BOR, 1996; Harding *et al.*, 1995.

Table 2.—Estimated evaporative losses (1,000 acre-feet) from the Colorado River Basin (1981-1985). These are the most recent estimates available from BOR

	Year					
State	1981	1982	1983	1984	1985	Average
Main stem[1]	1,598.4	1,402.9	1,896.2	1,197.1	1,782.9	1,575.5
Arizona	279.7	212.1	280.4	274.5	266.2	262.6
California	0.0	0.0	0.0	0.0	0.0	0.0
Colorado	82.7	78.4	82.3	84.2	86.3	82.8
Nevada	4.2	3.9	4.6	5.1	4.7	4.5
New Mexico	44.3	42.3	39.0	44.9	38.4	41.8
Utah	65.0	59.4	63.0	64.7	69.0	64.2
Wyoming	41.6	39.2	36.7	34.5	30.5	36.5
Total	2,115.9	1,838.2	2,402.2	1,705.0	2,278.0	2,067.9

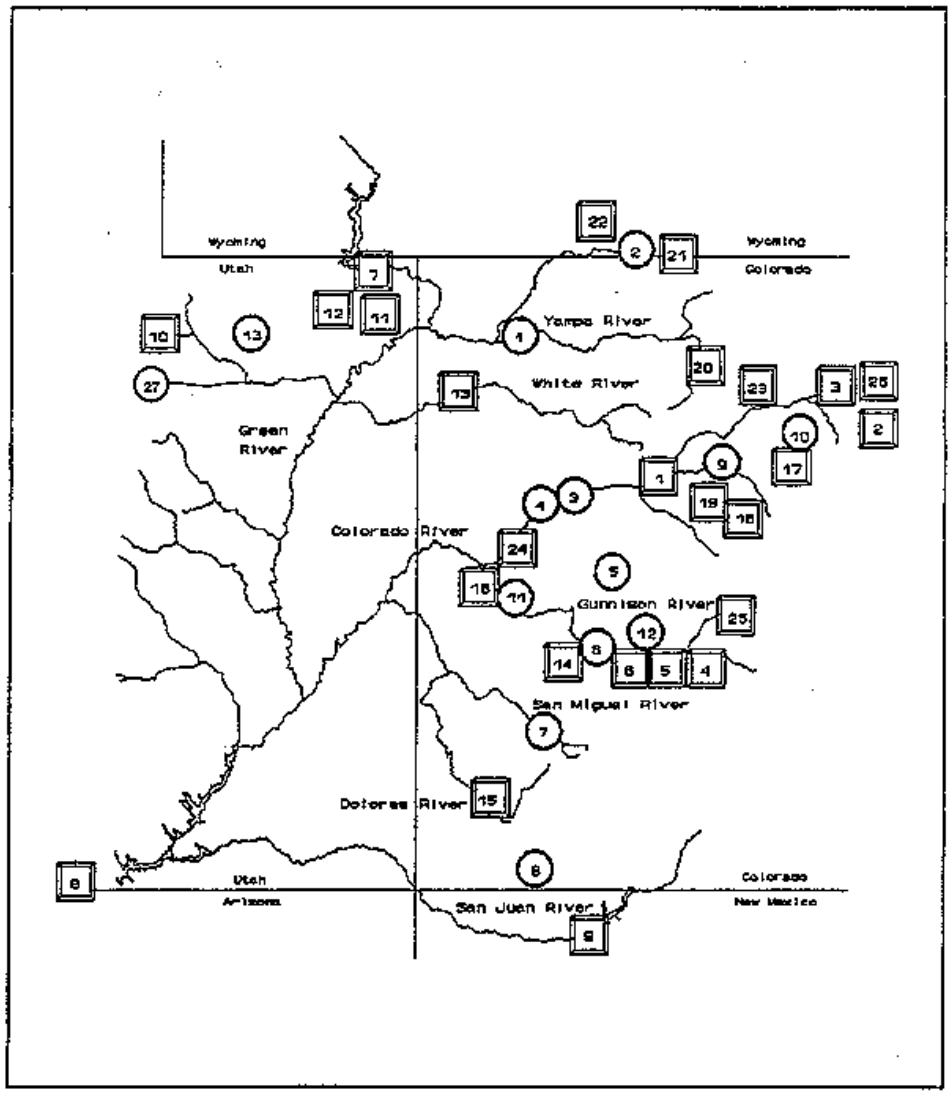
[1] Main stem reservoir evaporation in Upper and Lower Basins and main stem channel losses for Lower Basin.
Source: BOR, 1991.

the Colorado "hydrocommons" (Weatherford, 1994) and the total population served is nearly 25 million people (Water Education Foundation, 1995). Major out-of-basin diversions are depicted in Figure 5.

Major Water Use And Allocation

The Colorado River Compact of 1922 apportioned the use of 7.5 maf/year each to the Upper Basin and Lower Basin, with an additional 1 maf allocated to the Lower Basin.[3] The 1944 Mexican Water Treaty guarantees delivery of 1.5 maf to Mexico, but provides for a *pro rata* reduction in times of shortages. Under current conditions, demands on the river are much greater in the Lower Basin. In 1996, the Lower Basin exceeded 7.5 maf of beneficial use

[3] Article III(D) of the Compact requires that deliveries to the Lower Basin at Lee Ferry for the current year plus the immediately preceding nine years (the ten-year moving average) total no less than 75 maf.



KEY

EXISTING PROJECTS (Squares)

1. Shoshone Dam
2. Green Mountain Dam
3. Williams Fork Dam
4. Blue Mesa Dam -- Aspinall Unit
5. Morrow Point Dam -- Aspinall Unit
6. Crystal Dam -- Aspinall Unit
7. Flaming Gorge Dam
8. Glen Canyon Dam
9. Navajo Dam
10. Strawberry Reservoir and Collection System
11. Jensen Unit -- Central Utah Project
12. Vernal Unit -- Central Utah Project
13. Taylor Draw Dam
14. Dallas Creek Project
15. McPhee Dam/Dolores Project
16. Redlands Dam
17. Dillon Reservoir
18. Homestake Reservoir
19. Fryingpan-Arkansas Project (Ruedi Reservoir)
20. Stagecoach Reservoir
21. Sandstone Dam
22. Cheyenne Stage II Water Diversion
23. Wolford/Muddy Creek (Ritchard Project)
24. Grand Valley Project
25. Taylor Park Reservoir -- Uncompahgre Valley Project
26. Colorado-Big Thompson Project
27. Bonneville Unit -- Central Utah Project

PROPOSED PROJECTS (Circles)

1. Juniper/Cross Mountain Project
2. Savery Pothook Project
3. West Divide Project
4. Una Dam and Reservoir
5. Grand Mesa Project
6. Tri-County Reservoir
7. San Miguel Project
8. Animas-La Plata Project
9. Eagle-Colorado Project
10. Green Mountain Exchange
11. Dominguez Dam and Reservoir
12. Fruitland Mesa Project
13. Upalco Unit -- Central Utah Project

Figure 4.—Representative water developments in the Upper Colorado River Basin.

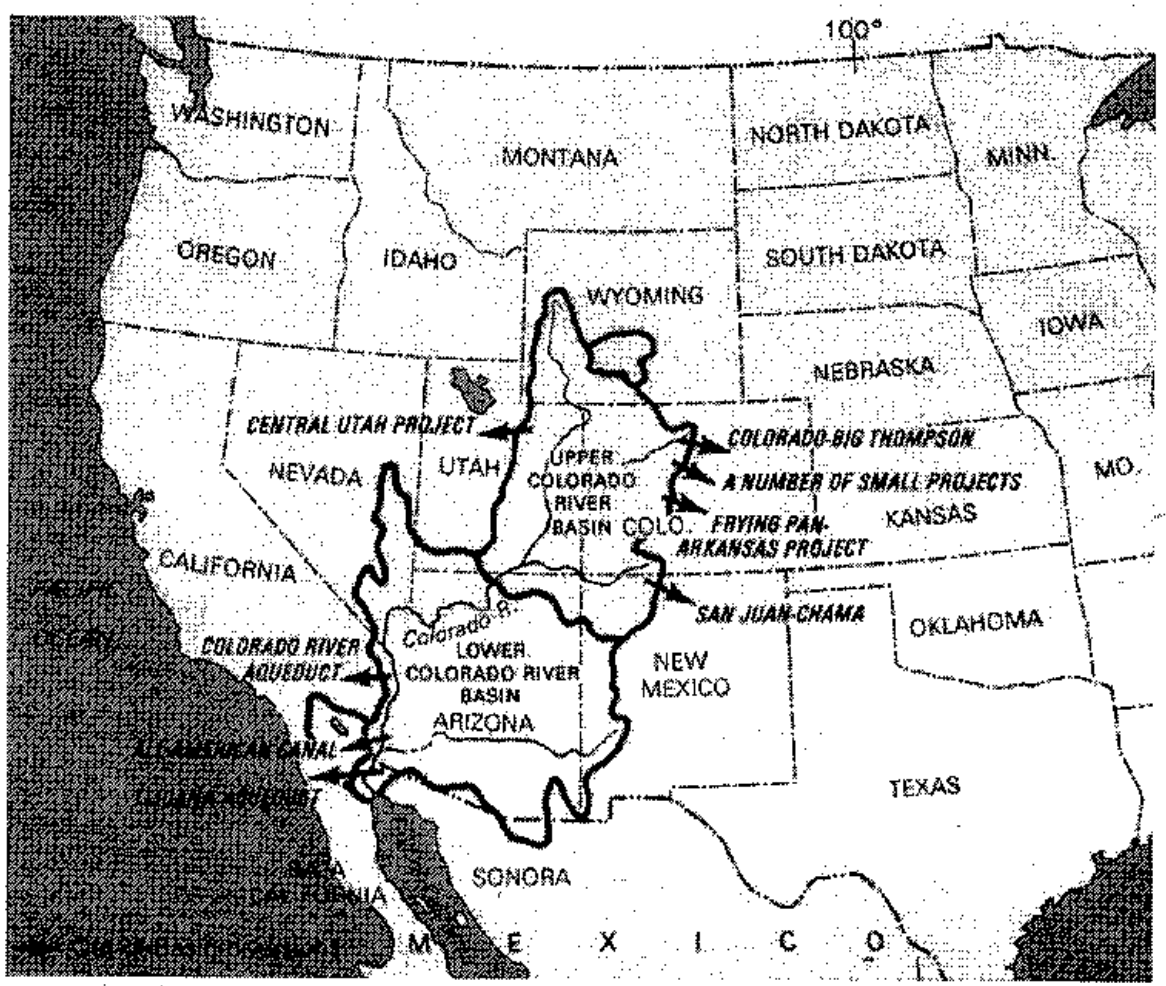


Figure 5.—Major out-of-basin diversions in the Colorado River Basin (Fradkin, 1981).

(Table 3). California diverts and uses well over its 4.4 maf apportionment, Nevada is approaching its 300,000 af apportionment, and Arizona is in the process of diverting its entire 2.8 maf apportionment. The Upper Basin, which has been slower to develop, is using approximately 60 percent of its entitlement (Table 4) and projections vary as to when full development will occur. In 1996, Lower Basin water use is estimated to be 8.00 maf, compared to 3.79 maf in the Upper Basin.[4]

Table 3.—Annual water use (1,000 af) in the Lower Basin, 1990-1996

State	Apportionment	Year						
		1990	1991	1992	1993	1994	1995	1996
Arizona	2,800	2,260	1,864	1,906	2,246	2,152	2,221	2,704
California	4,400	5,220	5,006	4,546	4,835	5,234	4,925	5,316
Nevada	300	178	180	178	204	228	217	249
Unmeasured returns		(233)	(214)	(202)	(221)	(254)	(283)	(266)
Total	7,500	7,425	6,836	6,428	7,064	7,360	7,081	8,003

[1] *Arizona v. California* (1963).

[2] Preliminary estimates (Source: Harkins, 1997).

Approximately 80 percent of the river's supply is used for agriculture. The largest user of agricultural water is the Imperial Irrigation District (IID) in southern California, which alone accounts for approximately 2.87 maf annually (1964-96 average), or almost 20 percent of the river's average annual flow. Other major agricultural users include the Palo Verde Irrigation District and the Coachella Valley Water District, which are also in southern California, the Central Arizona Project, the Central Utah Project and various other water districts in the Upper Basin. Municipal and

[4] Harkins, 1997.

Industrial (M&I) water from the Colorado River water is provided by Denver Water, the Central Utah Water Conservancy District (CUWCD), the Metropolitan Water District of Southern California (MWD), the San Diego

Table 4.—Annual water use (1,000 af) in the Upper Basin, 1981-1985, 1990

State	Apportionment[1]	1981-1985 average[2]	1990
Arizona	50	42	42[3]
Colorado	3,079	1,994	2,206[4]
New Mexico	669	377	445[4]
Utah	1,369	657	737[4]
Wyoming	833	332	422[4]
Total	6,000	3,402	3,852

[1] For planning purposes this assumes the total Upper Basin entitlement is 6.0 maf, of which 50,000 af is the Upper Basin allocation to Arizona.
[2] Source: BOR, 1991
[3] Source: Trueman, 1996.
[4] Source: Cook, 1997.

County Water Authority (SDCWA), the Southern Nevada Water Authority (SNWA), Central Arizona Water Conservation District (CAWCD), the City of Phoenix and various other municipalities.

Depending on which flow estimates are used, the river has been over allocated by 20 to 30 percent. As shown in Table 5, a total of 17.5 maf has been allocated to the seven basin states and Mexico. While the Upper Basin is not close to fully utilizing its legal entitlement and uses 6.0 maf as the number for planning purposes, there is increased concern in the Upper Basin about future demands on Colorado River water. (Projected use to 2030 in the Upper Basin is depicted by state in Figures 6 to 10). Water use estimates were compiled in 1995 and projections were made to the year 2060 by the U.S. Bureau of Reclamation (BOR) in consultation with individual states within the Colorado River Basin and the Upper Colorado River Commission.

Tribal uses and claims will be discussed below in the “Indian Water Rights” section, but it should be noted that the general consensus is that these uses and claims to

reserved rights are considered within each state's apportion-ment under the "Law of the River."[5]

Table 5.—Water allocations in the Colorado River Basin

Entity	Apportionment (maf/year)	Authority
Upper Basin	7.5	1922 Colorado River Compact. (The Upper Basin has the right to use 7.5 maf only if that quantity is available after it has satisfied its delivery requirements of 7.5 maf/year to Lower Basin plus the amount required to satisfy the Mexican Treaty obligation.)
Arizona	0.05	1948 Upper Colorado River Basin Compact
Colorado	3.86	1948 Upper Colorado River Basin Compact. (Colorado is apportioned 51.75% of the remaining flows after the Upper Basin's delivery requirements have been met.)
New Mexico	0.84	1948 Upper Colorado River Basin Compact (New Mexico is apportioned 11.25% of the remaining flows after the Upper Basin's delivery requirements have been met.)
Utah	1.71	1948 Upper Colorado River Basin Compact (Utah is apportioned 23% of the remaining flows after the Upper Basin's delivery requirements have been met.)
Wyoming	1.04	1948 Upper Colorado River Basin Compact (Wyoming is apportioned 14% of the remaining flows after the Upper Basin's delivery requirements have been met.)
Lower Basin	8.5	1922 Colorado River Compact
Arizona[1]	2.8	1963 U.S. Supreme Court decision *Arizona v. California*
California[2]	4.4	1963 U.S. Supreme Court decision *Arizona v. California*
Nevada[3]	0.3	1963 U.S. Supreme Court decision *Arizona v. California*
Additional	1.0	Article III(b) of 1922 Colorado River Compact

[5] The Navajo Nation objects to the characterization that tribal water rights are considered as a part of a states entitlement (Letter from Stanley Pollack, Special Counsel For Water Rights, Navajo Nation, April 4, 1997).

Mexico	1.5	Mexican Water Treaty of 1944
Total	17.5	

[1] Plus 46% of the surplus water available, as determined by the Secretary.
[2] Plus 50% of the surplus water available, as determined by the Secretary.
[3] Plus 4% of the surplus water available, as determined by the Secretary.

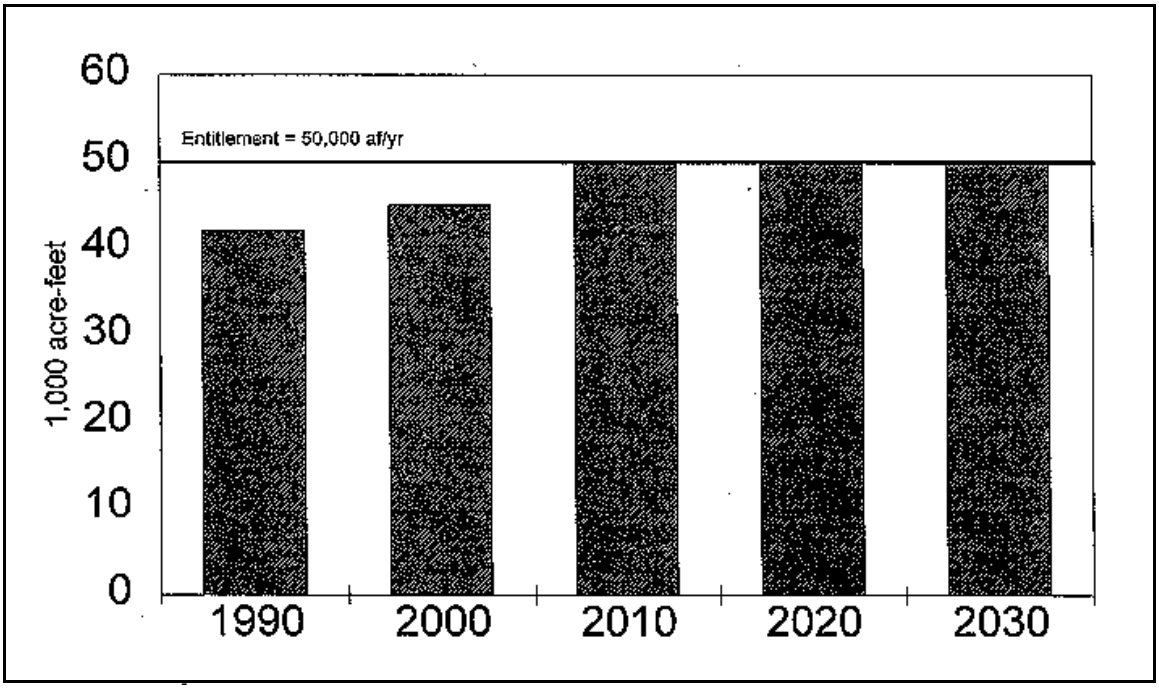


Figure 6.—Projected Colorado River water use in Arizona (Upper Basin).
Source: BOR, 1996.

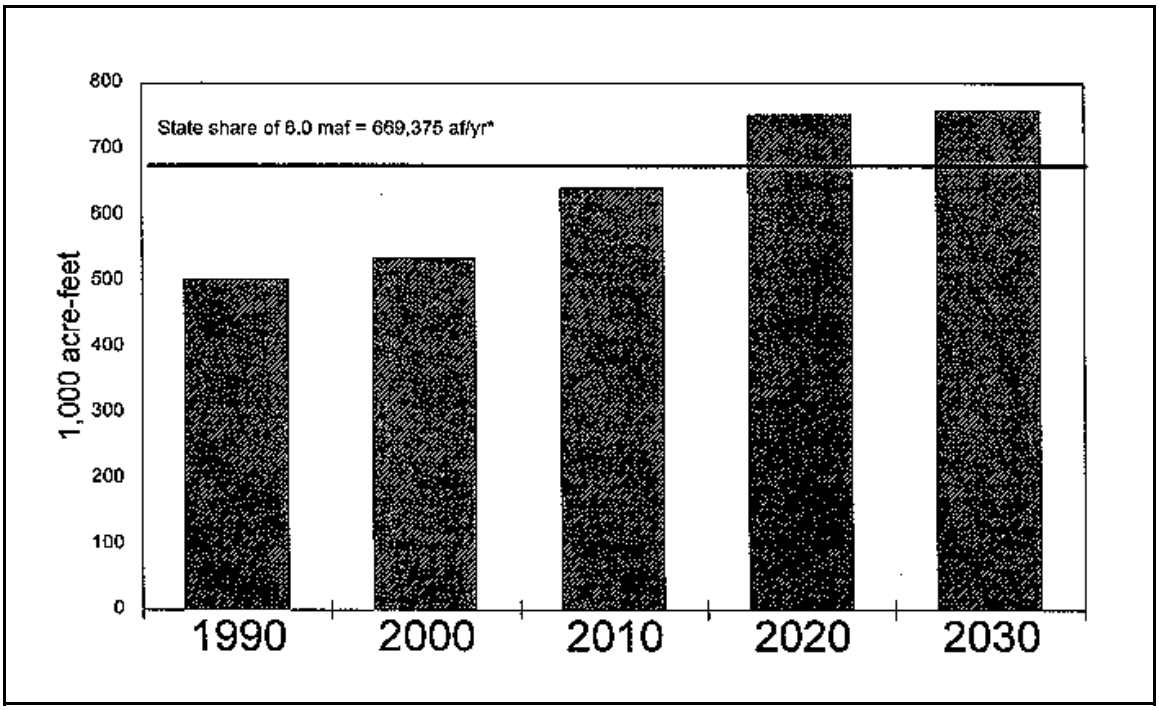


Figure 8.—Projected Colorado River water use in New Mexico.
Source: Cook, 1997.

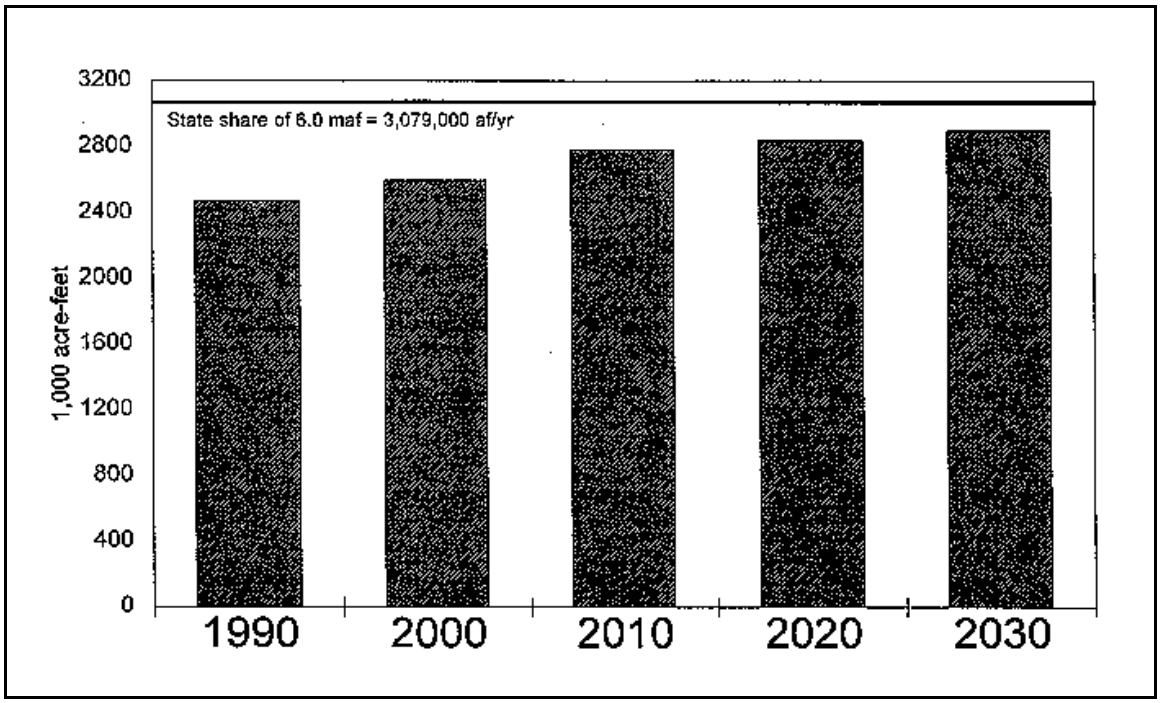


Figure 7.—Projected Colorado River water use in Colorado
Source: Cook, 1997.

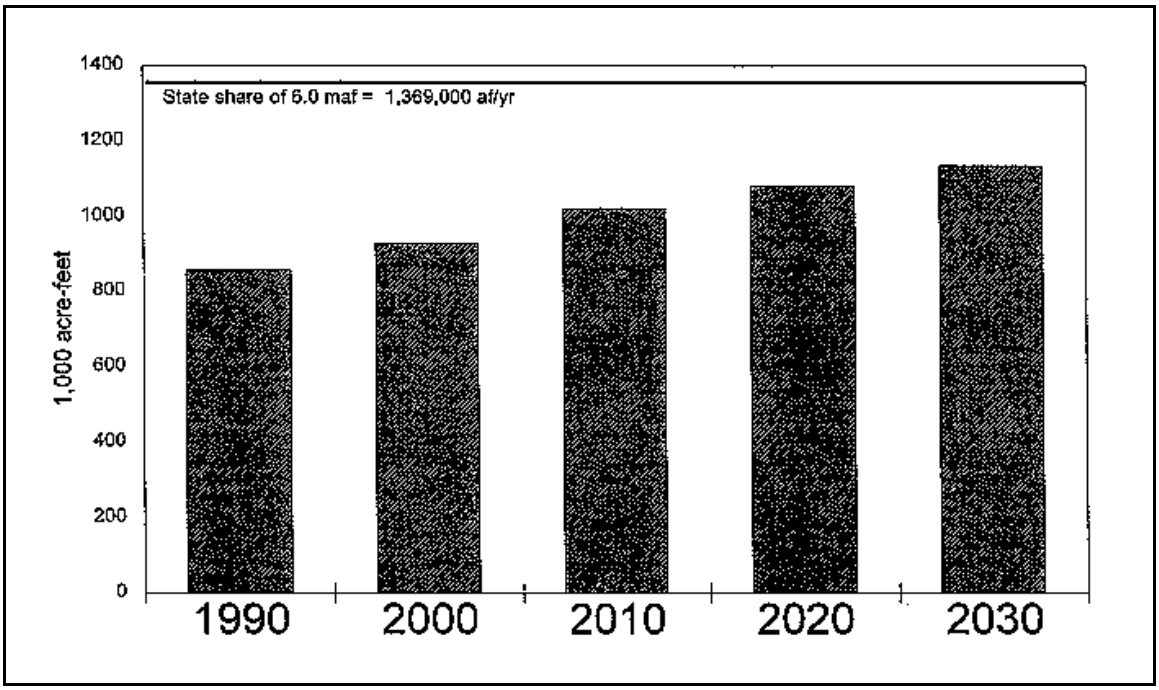


Figure 9.—Projected Colorado River water use in Utah
Source: Cook, 1997.

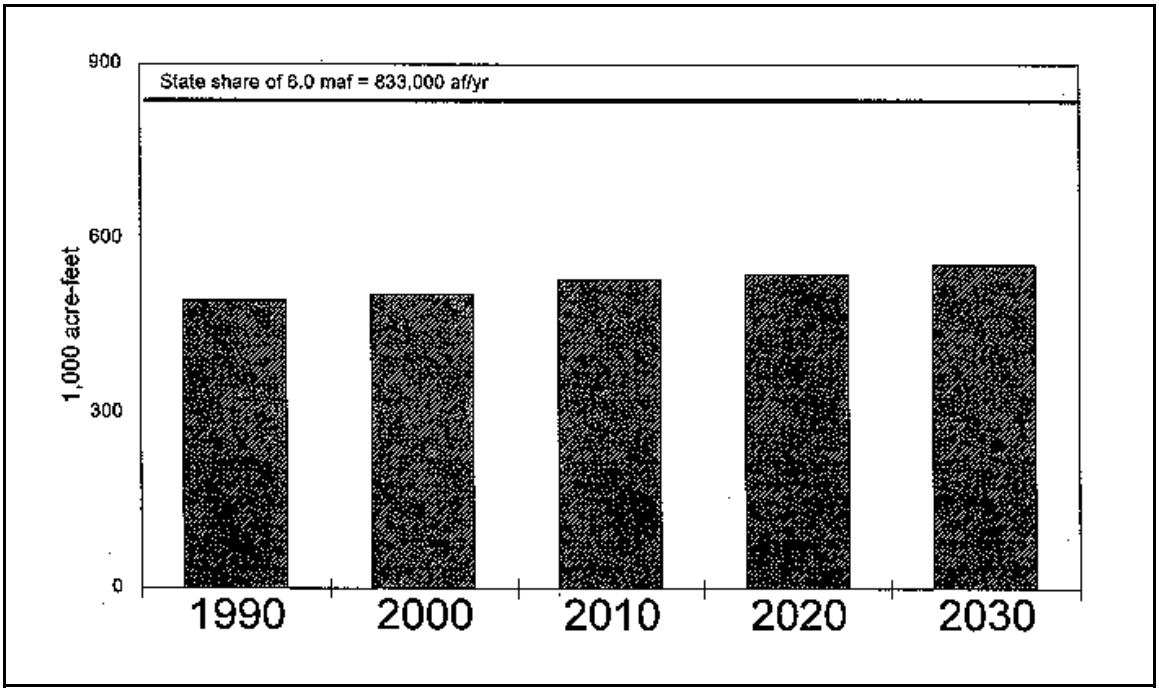


Figure 10.—Projected Colorado River water use in Wyoming.
Source: Cook, 1997.

There is increasing demand for non-consumptive, instream uses for fish, wildlife, habitat, and recreation. These uses, however, sometimes require changes in flow regimes which can impact power generation and diversions for other uses, which are generally senior in priority.

Operation of the River

Federal Involvement in the Colorado River Basin

Many if not most of the unresolved issues in the Colorado River basin discussed in this report require the active involvement, cooperation, and sometimes decisions by the Secretary of the Interior (Secretary) or other federal officials as well as significant federal appropriations. As will be discussed in more detail below, the allocation and use of water in the Colorado River basin is affected or influenced by at least ten federal agencies, including the Army Corps of Engineers (ACOE), Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), Bureau of Reclamation (BOR), Environmental Protection Agency (EPA), National Park Service (NPS), Natural Resource Conservation Service (NRCS), Fish and Wildlife Service (FWS), Forest Service (USFS), and the Western Area Power Administration (WAPA). The geographic jurisdiction of these agencies is depicted on the maps in Appendix A. While the western states control the

allocation and use of water within the states under state water law regimes-- and the federal government must acknowledge water rights established under state law -- a number of federal laws and court decisions (such as those establishing and interpreting reserved water rights on federal and Indian reservations) impact water allocation and use in the basin, whether directly or indirectly, including the Clean Water Act (CWA), the National Environmental Policy Act (NEPA), and the Endangered Species Act (ESA). Furthermore, the Secretary of the Interior has multiple sometimes conflicting responsibilities that impact water use in the basin such as his fiduciary responsibility to Indian tribes, to enforce the ESA, to manage federal lands and to administer reclamation law and the Law of the River.

Over the course of the last century, there has been massive federal investment in the basin to construct, operate, and maintain the dams, delivery systems and other infrastructure associated with federal projects. The federal government has an interest in protecting this investment, assuring repayment where applicable, and to operate these facilities consistent with federal law. In the Upper Basin, it is estimated that federal investment in water development totals around $3.6 billion (Calhoun, 1997). In the Lower Basin, this number is even greater. For example, the recently completed Central Arizona Project cost over $3.5 billion (of which some $1.8 to $2.2 million will be repaid over time). And although the BOR's new role in the West is primarily as a water management agency rather than as a project builder, its budget for this fiscal year for the Colorado River basin is approximately $285 million, which does not include hundreds of millions of dollars of revenues from power sales that are used to finance project OM&R and other costs.

In addition, the CWA has made the ACOE and EPA major players in important water policy arenas such as water quality issues involving municipal and industrial discharges, mine waste, and approving permits for new projects under Section 404 of the CWA. For example, the Two Forks Dam in Colorado was ultimately vetoed by the EPA Administrator pursuant to Section 404.

And, the ESA has generated a whole new level of federal-state-tribal tension in the basin because most water projects have a federal nexus and must undergo consultation with the FWS to determine if current or proposed water development will have an adverse effect on listed species. Federal, state, tribal and stakeholder efforts to develop, fund and implement plans for species protection and recovery within the framework of federal and state law and the ESA have been a major source of contention in recent years. Even if the ESA is amended to address the provisions in the law most objectionable to states, tribes, and water users, it seems clear that broad public support for preserving biodiversity and protecting ecosystems will require a continuing federal presence for the foreseeable future.

The Law of the River

The Law of the River (LOR) is the legal and institutional framework for managing the river and defining the states' and individual entitlement holders' rights and obligations.[6] Over the years, the LOR has evolved to some extent to accommodate changing policies and values about water management in the basin. The Grand Canyon Protection Act of 1992, for example, led to changes in the operating criteria for power production at Glen Canyon Dam to reflect concerns about downstream impacts on environmental and cultural resources and recreation. And, the enactment of the federal environmental statutes mentioned above add an overlay to many of the other components of the LOR which is still being sorted out.

While there is broad acceptance of the LOR within the basin's water interest community, some aspects of the LOR are still unsettled and may create management problems for the future as competition for Colorado River water increases. For example, nothing in the statutes or the *Arizona v. California* decree specifically authorizes interstate marketing of apportionments, and some provisions arguably prohibit it. When BOR tried to clarify the legal authority for interstate marketing in its rule-making process in 1994, a number of states and water users raised legal objections. As will be discussed in this report, water marketing, including off-reservation and interstate leasing of Indian water rights, and other issues remain unresolved under the LOR.

Furthermore, the *Arizona v. California* decree did not settle the extent of "*Winters* rights" for many of the Indian tribes in the Lower Basin. Paragraph VIII© of the decree states that the decree shall not affect the "rights or priorities, except as specific provision is made herein, of any Indian Reservation." The main stem rights of the Navajo Nation the Hualapai Tribe, and the Havasupai Indian Reservations, all located between Lee Ferry and Hoover Dam were not adjudicated in that case and remain as significant unresolved claims in the Lower Basin.

Other federal reserved rights for a number of national parks and monuments and other federal reservations have not been quantified. Grand Canyon National Park (GCNP) is a prime example. This is now a major problem for the GCNP, which is in need of additional water supplies to serve its growing number of visitors and for park facilities. On a more positive note, negotia-tions concluded recently between federal, local, and state officials in Utah that resulted in an agreement that will protect Zion National Park from

[6] The major components of the LOR are listed in Appendix B. This report will not attempt to summarize the various laws, contracts, opinions, compacts and treaties that make up the LOR.

upstream dam proposals, recognizing a federal reserved water right to the Virgin River, which flows through the park. There are a number of other outstanding federal claims in the basin which must be addressed and quantified through similar negotiations.

Arizona and Nevada, who claim the right to tributary water under the Compact, can divert water from the tributaries but cannot divert it once it has flowed into the Colorado River. Thus, Nevada would have to build a pipeline approximately 60 miles long at great expense to divert Virgin River water. Arizona would have to do something similar to make use of water from the Bill Williams River, even though it flows into Lake Havasu very near the CAP diversion point. The issue of rights to tributary water and a number of other issues remain unsettled despite the LOR.

The Secretary of the Interior: Water Master in the Lower Basin

While the states have authority over water management within their borders,[7] Congress delegated considerable authority to the Secretary of the Interior over the use and management of Colorado River water in the Lower Basin. The Boulder Canyon Project Act of 1928, as interpreted by the Supreme Court in *Arizona v. California*, vested extraordinary authority with the Secretary to serve as "water master" for the Lower Basin. Any user of main stem Colorado River water in the Lower Basin (with few exceptions for prior perfected rights) is required to have executed a contract with the Secretary to use Colorado River water. The Secretary has the authority to define what is "reasonable beneficial use," to contract for the disposition of hydropower, to develop an annual operating plan for the reservoirs, and to establish surplus and shortage criteria, among other things.

The Secretary is required, under Section 602(b) of the Colorado River Basin Project Act, to consult with the seven basin states regarding the annual operating plan and the BOR regularly consults with the states, tribes, and other interests on a range of management issues on an *ad hoc* basis. If consensus cannot be reached on an operational issue, such as reservoir operations, however, it is clear that the Secretary has the authority to act.

Although the Upper Basin states have a significant interest in the annual operating plan, reservoir operations, and other decisions regarding water use in the Lower Basin, they are not subject to the same level of "federalized" management. In 1948, the Upper Basin states approved the Upper Colorado

[7] States generally do not have authority over water management on Indian Reservations within their borders. State regulation of water use in Indian country may be barred if preempted by federal law or if it would infringe on tribal sovereignty.

River Basin Compact, subsequently approved by Congress, which established each state's apportionment and the Upper Colorado River Commission to address issues related to water development in the Upper Basin. While the Secretary has responsibilities to administer the various reclamation laws and statutes that authorized projects in the Upper Basin, he does not have the level of authority to regulate water use as was delegated to him by Congress in the Lower Basin. The Upper Basin states control the rights to use Compact water under state water law.

Proposed Regulations for the Lower Basin

In 1994, the BOR proposed regulations to address a number of issues in the Lower Basin. Initially, the purpose of these regulations was to deal with the increasing problem of illegal pumping of the river's "sub-flow" (groundwater hydrologically connected to the river). However, growing interest in water marketing and a number of other unresolved issues led the BOR to also draft regulations to deal with beneficial use, new conservation requirements, prohibited uses, establishing fees for services to water users, and to govern leasing, banking and exchanging water entitlements, including tribal water rights, on an intrastate and interstate basis.

Under the draft regulations, water conserved as a result of "extraordinary" conservation measures or land fallowing could be marketed. One of the more controversial provisions provided that conserved water would be considered a "beneficial consumptive use" within the state in which it occurred and, therefore, would no longer be considered "Colorado River water" which was subject to LOR restrictions. This water could therefore be conveyed for use in another Lower Basin state or banked as "top water" in Lake Mead (meaning it had the lowest priority of stored water and would be released first when flood control releases were necessary).

Another major point of controversy in the proposed regulations was the Department's position that tribal water rights could be leased off reservation under existing law. The BOR set forth an extensive legal analysis defending this proposal, relying on a number of statutes, Solicitor opinions, and court cases, including *Arizona v. California* (and the 1979 Supplemental Decree), and concluded:

> *In summary, it is the Department's preliminary conclusion that it is appropriate to include Indian reserved water rights in the direct leasing and banking-marketing provisions of the proposed regulations ... that most of the legal commentators who have considered the subject of Indian water marketing have agreed that Indian reserved rights are*

> *transferable property rights which have the potential to generate not only financial benefits, but also to create jobs, increase services, and stimulate reservation economic growth* (BOR, 1994).

The rules also proposed new requirements for conservation plans required for all contractors of Colorado River water, if economically feasible, and a time schedule for meeting these objectives. If the water user failed to implement a plan, the BOR could make a determination that the user was engaging in unreasonable beneficial use and presumably reduce the diversion right under the contract.

As the state with the largest unused apportionment in the Lower Basin, Arizona was concerned with a number of these marketing provisions, which were viewed as promoting interstate marketing of Arizona's water without adequate state involvement or control, and threatened to sue. A number of other states and interests expressed similar concerns about the draft regulations. As a result, the Secretary put the regulations on hold to allow the states time to seek a regional solution and reach consensus on water marketing in the Lower Basin.

In a speech to the Colorado River Water Users Association (CRWUA) in December of 1995, Secretary Babbitt acknowledged that the process had broken down, but reiterated his optimism that consensus could be reached on a number of water marketing and transfer issues and that "whenever possible, the administration of the river should be by consensus among the three affected states..." (Babbitt, 1995).

In December of 1996, the Secretary was back before the CRWUA in Las Vegas. There was still no consensus on marketing apportionments and California's failure to resolve internal disagreements between major water users had become a basin-wide issue. In the interim, Arizona had established its water bank, which could provide a solution for meeting future needs in Nevada and California, if necessary federal regulations could be put in place. Secretary Babbitt seemed less optimistic about consensus than the previous year, but vowed to continue facilitating that process.

The Secretary also took a less ambitious position on future regulations for the Lower Basin, citing the need for incremental progress on a number of issues, such as the water bank, finding a way to implement the San Luis Rey Indian settlement, and resolving the internal dispute in California. He deferred action, for example, on adoption of surplus criteria until California had developed a plan to reduce their use, over time, to their 4.4 maf/yr apportionment. In the final analysis, however, the Secretary does have the authority -- and hinted he may ultimately have to exercise it -- if agreement cannot be found on these management issues that is acceptable to the basin states and the federal government, given its statutory and trust responsibilities. Ultimately, the federal stick held by the Secretary may need to be invoked in the Lower Basin to resolve some of these issues.

The BOR is currently drafting new rules for the Lower Basin, which are expected to be less ambitious in scope given the controversy that accompanied the 1994 draft. It

is not anticipated that these regulations will allow for interstate marketing of tribal water rights except as it may occur through state authorized water banks.

The Mexican Treaty Obligation and Augmenting the Basin Supply

There is no consensus within the basin as to how to meet the requirements to deliver 1.5 maf/yr to Mexico as required by the 1944 treaty.[8] There is some ambiguity as to whether this is an obligation of the basin states, as contemplated by the 1922 Compact, or whether this is now a federal obligation.

In 1968, Congress enacted the Colorado River Basin Project Act (CRBPA), which authorized the Central Arizona Project and a number of water projects for the Upper Basin.[9] In section 202 of the CRBPA, Congress declared:

> *the satisfaction of the requirements of the Mexican Water Treaty from the Colorado River constitutes a national obligation which shall be the first obligation of any water augmentation project planned pursuant to section 1511 of this title and authorized by the Congress. Accordingly, the States of the Upper Division (Colorado, New Mexico, Utah, and Wyoming) and the States of the Lower Division (Arizona, California, and Nevada) shall be relieved from all obligations which may have been imposed upon them by article III© of the Colorado River Compact so long as the Secretary shall determine and proclaim that means are available and in operation which augment the water supply of the Colorado River system in such quantity as to satisfy the requirements of the Mexican Water Treaty together with any losses of water associated with the performance of that treaty:* Provided, *That the satisfaction of the requirements of the Mexican Water Treaty (Treaty Series 994, 59 Stat. 1219), shall be from the waters of the Colorado River pursuant to the treaties, laws, and compacts presently relating thereto, until such time as a feasibility plan showing the most economical means of augmenting the water supply available in the Colorado River below Lee Ferry by two and one-half million acre-feet shall be authorized by the Congress and is in operation as provided in this chapter.*

This provision seems to say that delivering to Mexico is now a national obligation, but it could be interpreted to mean that it only becomes a federal obligation when (and if) the basin's water supply is augmented by 2.5 maf as a result of programs funded by Congress.

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[8] Federal law directs the Secretary of the Interior to operate federal reservoirs so as to meet the Mexican obligation (43 USCA § 1512).

[9] Besides the Central Arizona Project, the CRBPA authorized Hooker Dam in the Gila Wilderness of New Mexico, the aqueduct from Lake Mead to Las Vegas, the Dixie Project in Utah, and the Utah Unit of the Central Utah Project. It also authorized the San Miguel, Dallas Creek, West Divide, Dolores, and Animas-La Plata projects in Colorado.

Assuming that it is now a federal obligation, as the states maintain, how is it to be met? California and other states have repeatedly pressed for augmentation studies, including cloud seeding in the Upper Basin, but very little federal money has been budgeted for such research and there are no realistic plans on the drawing board to augment the river's supply. While augmentation is not a dead issue, it does not seem to be a very feasible option in the foreseeable future. Congress has ruled out looking to the Columbia River basin for an inter-basin transfer, which was once considered. The Colorado River basin may well have to live within the natural supply.

Due to above-average flows in recent years, unused apportionments, and sufficient storage, enough water has been available to meet the 1.5 maf/yr obligation to Mexico. And it has not been necessary to operate the Yuma Desalting Plant (YDP), which would produce approximately 68,000 af of the Mexico allocation and lower salinity levels in the river by desalinating Wellton-Mohawk drainage water. This water is now bypassed through a BOR canal to the Cienega de Santa Clara in Mexico and is not counted toward the U.S. obligation because of its excessive salinity.[10]

This issue has been avoided for now, but will ultimately have to be confronted. Assuming this is a federal obligation, how is the water to be obtained in times of shortage other than from state apportionments? How will shortages be shared? Would the Upper Basin be required to deliver more than half of the Mexican obligation if the Upper Basin is not using its full entitlement, as is now the case? Although shortages are not forecast for the river for some time to come, shortages are inevitable and clarification needed as to how the Mexican obligation will be met during an extended drought.

[10] Under Section 102 of the Colorado River Basin Salinity Control Act, the U.S. obtained temporary right to approximately 130,000 af of water saved by lining the Coachella Canal. However, under the statute, this water is only available for treaty obligation purposes for an "interim period" which will expire when there is not enough water to meet California's needs, at which time the Secretary has to find a substitute supply.

Major Issues

Water Management

How the over-appropriated Colorado River will be managed in the 21st century to meet the ever-increasing demands for its water is one of the most critical issues in the West. The Colorado is relied upon by seven states and northern Mexico to supply water for food, cities, and recreation, and to sustain a vast ecosystem that stretches from the Rocky Mountains to the Gulf of California.

Water management issues in the 21st century will be more complex and even more closely tied to the resolution of the other critical issues discussed in this report: ecosystem protection, salinity control, and Indian water rights. Issues such as protecting habitat for endangered fishes and other species at risk, maintaining water quality standards, adequate flows for sport fisheries and rafting, as well as resolving Native American rights to Colorado River water and meeting our treaty obligations to Mexico must all be dealt with within the context of water management in the basin. Thus, while these issues will be discussed separately, it is important to keep in mind that they are integral components of successful water management within the basin in the future.

Water Management in the Lower Basin

Current Uses and Projected Demand .—Colorado River water currently serves over 20 million people in the Lower Basin. The majority of these people live outside the Colorado River basin, primarily in the southern California metropolitan areas. (Table 6 shows the major water users in the Lower Basin.) Lower Basin demand for water is projected to continue to increase substantially (Figures 11 to 13). By 2025, California may gain more than 16 million people and the areas of Arizona and Nevada using Colorado River water may double in the next 25 years (Pacific Institute, 1996). Arizona, which has historically relied heavily upon the use of groundwater, now has the capacity to transport 1.5 maf/yr of Colorado River water through the Central Arizona Project (CAP), which was completed in 1993, to central Arizona cities and farms. In addition, implementation of the Arizona Water Bank (discussed below) means that Arizona will divert its full apportionment as early as 1998. Nevada is projected to be using its full 300,000 af appor-tionment by 2010.

California's Water Issues .—California is the largest user of Colorado River water with a basic apportionment of 4.4 maf, but has consumptively used much more than that for many years. Between 1983 and 1996, California used from 4.2 to 5.2 maf/yr, taking advantage of unused apportionments.

Table 6.—Colorado River main stem water use in the Lower Basin, 1996

Entity	Water use[1] (1,000 af)
Nevada	**249**
Southern Nevada Water System	209
Others	40
California	**5,222**
Metropolitan Water District	1,227
Irrigation Districts	3,962
Others	33
Arizona	**2,532**
Central Arizona Project	1,196
Others	1,336
Total Lower Basin	**8,003**
Delivery to Mexico	**1,505**

[1] Preliminary estimates.
Source: Carson, 1997.

The 1931 Seven Party Agreement set priorities for apportionment and use of Colorado River water in California. Under the agreement, priorities for beneficial use of Colorado River water within California were established, as shown in Table 7.

The total water right for the first three priorities for agriculture is not to exceed 3.85 maf, but it is not quantified per entity. This has led the BOR to conclude that these apportionments were "at best difficult to administer and, at worst, impossible to administer" (Rieke, 1994). It is difficult to assign responsibility for over-use if the 3.85 maf is exceeded (as it has been) and there are disagreements among the agricultural entities over accounting and whether some irrigation uses are wasteful and exceed beneficial use standards. The Colorado River Board of California, which is an umbrella agency for the seven entities, has been unable to obtain an agreement among these entities to quantify their rights despite repeated efforts over the past few years.

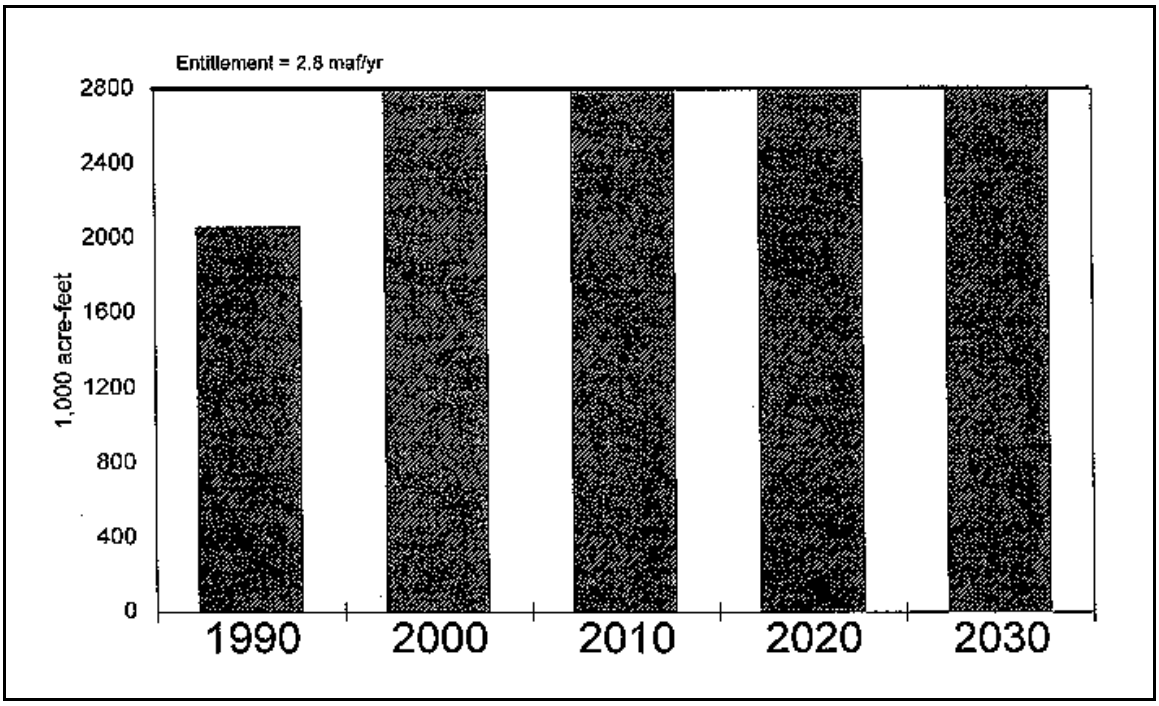

Figure 11.—Projected Colorado River water use in Arizona (Lower Basin).
Source: ADWR, 1997.

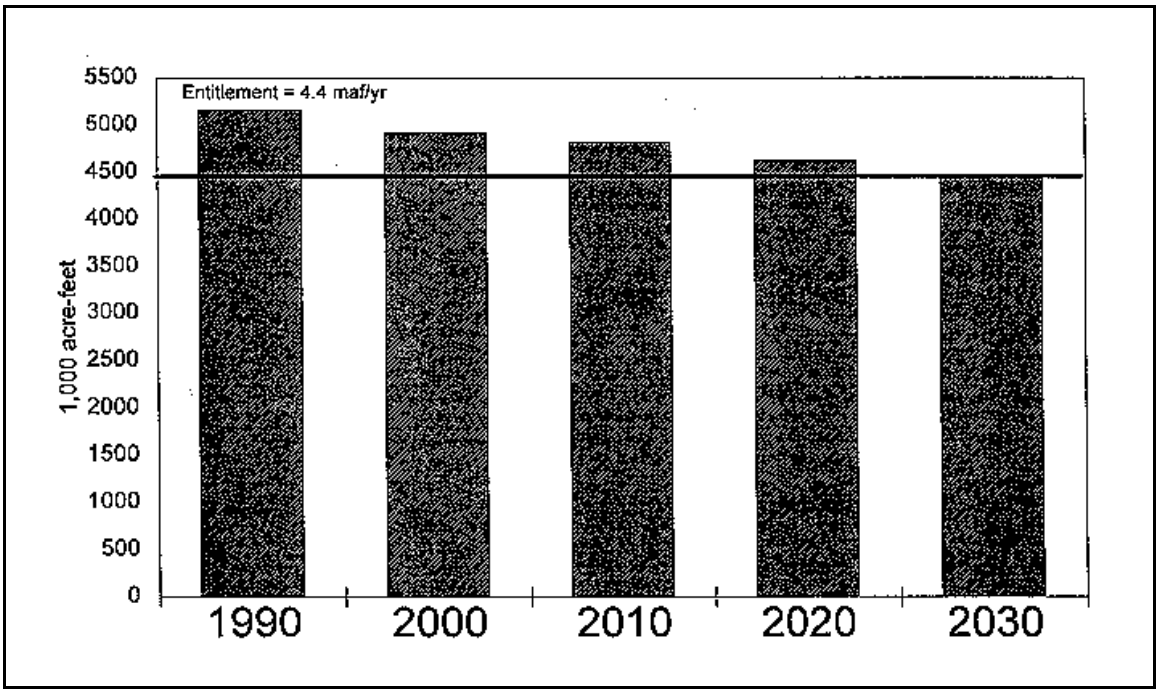

Figure 12.—Projected Colorado River water use in California.
Source: BOR, 1996.

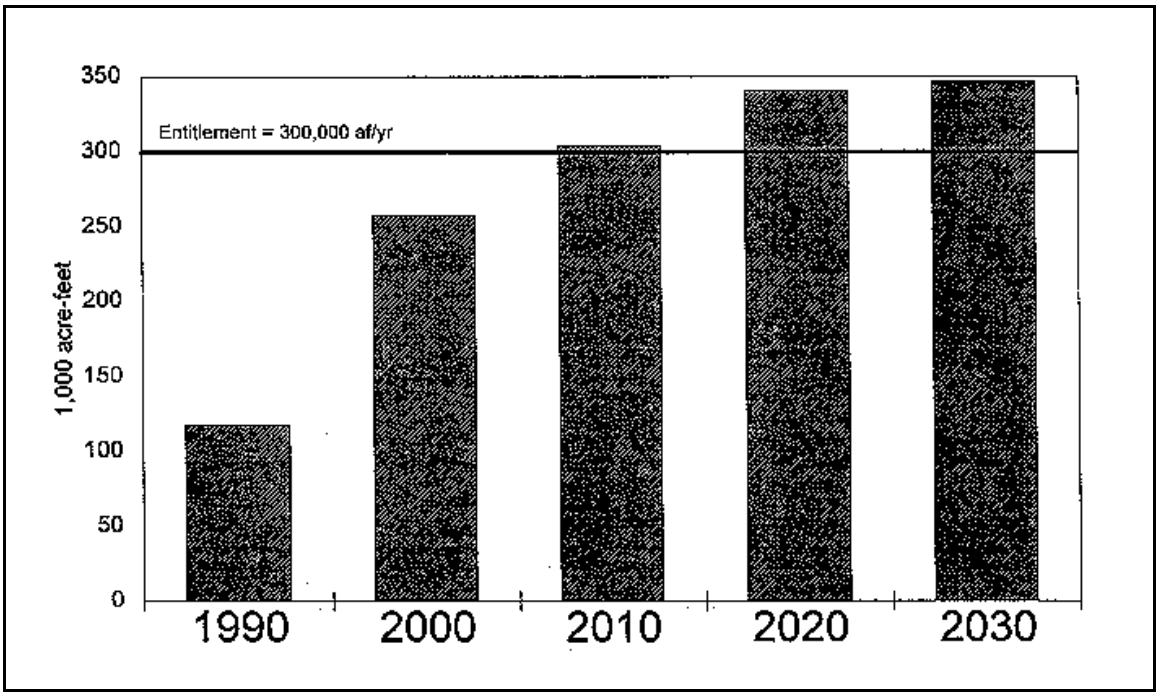

Figure 13.—Projected Colorado River water use in Nevada.
Source: BOR, 1996.

MWD, which is the wholesale provider for southern California municipal users, diverts about 1.2 maf/yr in its aqueduct.[11] MWD faces a shortfall in supply as they project the population of their service area to grow from the current 15.7 million to 19.5 million by 2010. Comparing the existing supplies to the projected hot/dry weather retail demands, MWD forecasts a water supply shortage of 1.1 maf in the year 2000 and 2.1 maf in the year 2020 (MWD, 1996).

Beneficial Use Issues.— IID's rights stem from a water service contract with the U.S. executed in 1932 for delivery of water stored behind Hoover Dam. This contract is for "permanent water service" and at no cost to the district, except for their repayment obligations, which have been met. IID submits that the Secretary must deliver water "as reasonably required for potable and irrigation purposes." This rather vague and unquantified right has led to attempts by the State of California Water Resources Control Board in 1984 and, more recently, the BOR to determine what is reasonable

[11] Under the Seven Party Agreement, San Diego has an equal fifth priority right to MWD for 112,000 af, although the San Diego apportionment was consolidated with the MWD apportionment in agreements made in 1946-1947, when San Diego became a member of MWD.

Table 7.—Priorities for Colorado River water in California

1.	Water to irrigate 104,500 acres in Palo Verde Irrigation District (PVID)	
2.	Water to irrigate 25,000 acres in Yuma Project (California Division)	
3.a.	Imperial Irrigation District and Coachella Valley Water District	
3.b.	Water to irrigate an additional 16,000 acres in PVID	
Subtotal		**3.85 million acre-feet**
4.	Metropolitan Water District of Southern California	550,000 acre-feet
5.	Metropolitan Water District of Southern California	662,000 acre-feet
6.a.	Imperial Irrigation District and Coachella Valley Water District AND	
6.b.	Water to irrigate an additional 16,000 acres in PVID	300,000 acre-feet
Total divisions within California		**5.362 million acre-feet**

beneficial use on the qualifying IID acreage. As cropping patterns have changed and double and tripping cropping of water intensive crops has been introduced, other users with junior priorities, such as the Coachella Valley Water District (CVWD), have objected.

The BOR refused to approve IID's water request this year for 3.1 million acre-feet and is now evaluating how beneficial use should be quantified within the district. IID contends that state law as to what constitutes "reasonable beneficial use" controls, not federal law, and that, under state law, extraordinary conservation (as proposed in the MWD and SDCWA agreements) is deemed to be a beneficial use which allows transfers of the conserved water. CVWD argues that federal law controls and that the Secretary has this regulatory authority under the Boulder Canyon Project Act, as established by the Supreme Court in *Arizona v. California*.

In fact, IID is now using as much or more water than it was before the investment of over $110 million in water conservation improvements financed by MWD under a 1989 agreement. Under this agreement, MWD has the right to use the 106,110 af/yr that is conserved by these on-farm improvements. A BOR consultant concluded that despite water conservation measures implemented by IID from 1990 to 1994, diversions of Colorado River water had remained at the same level (Jensen, 1995). The Jensen report found that runoff resulting from surface irrigation practices on fine-textured soils was the main cause of irrigation inefficiency in the IID and suggested pump-back systems be used to redistribute runoff and that irrigation should be scheduled based on precise estimates of evapo-transpiration (ET) and soil-water depletion. IID complained that it had
been bypassed in the review process and hired its own consultants to review the Jensen report. They concluded that the report contained many errors which skewed

the results. The BOR has agreed to work with IID to reconcile the different assessments of water use and this effort is continuing.

Other Conservation Agreements.— Last year, the SDCWA and IID reached tentative agreement on a conservation program under which SDCWA would receive approximately 200,000 af of water conserved as a result of SDCWA's investment in other on-farm conservation improvements in the district. SDCWA hopes to "ramp up" this process in the future to acquire as much as 500,000 af from IID from conservation. Following the severe California drought in the early 1990s, San Diego was determined to diversify its sources of supply and improve reliability and began negotiating directly with IID. MWD objected to this proposed agreement and initially refused to agree to allow its aqueduct to be used to transport this water to San Diego. However, MWD and SDCWA are currently negotiating an arrangement under which SDCWA would be able to transport conserved water from IID, although questions involving the costs for wheeling this water through the MWD aqueduct and other capital investment issues involving the MWD system have not been worked out.

CVWD objects to the SDCWA-IID agreement and plans to file a lawsuit if it is consummated. CVWD maintains that it has the next junior right to any unused or "conserved water" from IID under the Seven Party Agreement and the LOR. CVWD claims it needs this water to reduce a serious groundwater overdraft and that IID is wasting water and exceeding beneficial use requirements under federal and state law, citing the significant return flows discharged from the IID to the New River and the Salton Sea.

IID claims, however, that it is operating efficiently, but that the high salinity level of Colorado River water requires a significant amount of water for leaching, which they deem to be a beneficial use. IID recently offered to settle with CVWD by amending their 1934 water agreement to provide CVWD with an equal priority for 330,000 af, but CVWD has rejected this proposal as insufficient. This conflict has created a difficult problem for California. The Colorado River Board of California does not have the authority to force a "state" position on any water user and repeated attempts to facilitate settlement of this very public dispute have failed. It seems clear that a resolution of this dispute, either by legislation, agreement, or litigation, is critical if California is to present an acceptable plan for reducing its use to 4.4 maf/yr.

In addition to the conservation agreement with IID, MWD entered into a pilot fallowing agreement with the Palo Verde Irrigation District (PVID) in 1992 under which 20,000 acres of district irrigated lands was fallowed for two years at a cost to MWD of $26.7 million. MWD in turn banked 186,000 af in Lake Mead for use by the year 2000. Unfortunately, with heavy precipitation this past year, all of this water has been spilled, underlining the current difficulties with top-water reservoir storage.

MWD has also pursued a project, authorized by Congress, to build a concrete-lined canal parallel to the existing All-American Canal. Under a proposed agreement with IID in 1995, MWD would receive or bank over 67,000 af/yr for 55 years for its share of this investment; however, this proposal has lapsed and the project put on hold for now.[12]

Reservoir Operations and Surplus Criteria.— The vulnerability of top-water reservoir storage to flood control releases and California's concern about keeping its aqueducts full led the state to propose new reservoir operating criteria several years ago. California argued that its proposal to draw down Lake Mead would make more efficient use of the existing supply and reduce losses to flood control spills and evaporation, with minimum or no risk to other states or users. California pointed out that in the early 1980s, when extreme runoff could not be contained in the main stem reservoirs, over
50 maf flowed to Mexico and that some of this water spilled could have been conserved if the reservoirs were operated differently. However, other states and agricultural users with senior rights were concerned about just such risk, and there was concern in the Upper Basin about the impact of this proposal on their ability to meet compact obligations.

Until California settles its internal disputes and develops a plan to reduce its reliance on the Colorado River to its 4.4 maf basic annual apportionment, the other six basin states will not agree to support future declarations of surplus by the BOR in the annual operating plan (see letter of Dec. 9, 1996, from six states to California, Appendix C). The other basin states made it clear that they expect California to develop an enforceable plan by next year. Recently, California presented a "Draft" Conceptual Water Budget to reduce con-sumptive use by up to 900,000 af/yr to 4.4 maf/yr. The outline calls for up to 400,000 af/yr saved from IID conservation, up to 100,000 af/yr from fallowing agreements between MWD and PVID, 100,000 af/yr from seepage recovery from the All-American and Coachella Canals, up to 100,000 af/yr from a conjunctive use program by CVWD, 100,000 af/yr from "additional conservation" and 100,000 af/yr from a plan to desalinate agricultural drainage water (California Draft Plan, May 27, 1997). This draft is still a working concept and there are many, many questions to be answered before a plan can be agreed upon or put in place. If California's political leadership can resolve its internal disputes and agree on a plan soon, major Colorado River facilities and operating criteria issues affecting all the basin states conceivably could be resolved. If not, litigation and gridlock could continue for some time.

Arizona's Concerns.—

[12] Mexico opposes this project, as it now uses the seepage from the All-American Canal.

The Central Arizona Project.— The Central Arizona Project was authorized by the CRBPA of 1968 after years of conflict between California and Arizona over Arizona's share of the river and how it would be delivered. The main aqueduct system of the project was substantially completed in 1993 and the regulatory storage facilities were declared substantially completed in 1996. The CAP cost approximately $3.5 billion to complete and will deliver 1.5 maf/year of Arizona's apportionment of 2.8 maf from its diversion point in Lake Havasu to central Arizona through a 336-mile canal which terminates several miles south of Tucson. It is one of the most massive and expensive public works projects in U.S. history.

Arizona was forced to compromise, however, to gain California's support for the legislation and as a result the CAP supply is now junior in priority to California's and Nevada's apportionment. However politically necessary, this compromise has important future consequences for Arizona, as it means that in times of shortage, CAP users may have to cut back. Add the uncertainty about the extent and timing of Upper Basin development, how the Secretary will allocate inevitable shortages, and the need to satisfy Indian reserved rights, and it is easy to understand why the question of Arizona's junior CAP priority continues to haunt negotiations with California.

The CAP was originally conceived as primarily an agricultural water supply project, and was authorized with the understanding that it would be a substitute supply for non-renewable groundwater that was being rapidly depleted by Arizona irrigators and cities. It was assumed that as the state population grew, the CAP allocations would be converted to M&I uses. Initially, 309,810 af was allocated to Indian tribes, 640,000 af was allocated to M&I uses, and the rest was contracted to irrigation districts.

In 1980, Arizona enacted the Groundwater Management Act, which required that future development be tied to an "assured water supply," meaning for cities and developers, a CAP contract. Agricultural uses could continue (although only land with a recent history of irrigation could be irrigated), and conservation goals were established for all sectors. The Act required the three Active Management Areas (AMAs) created around Phoenix, Tucson, and Prescott to reach "safe yield," meaning ending the overdraft of ground-water, by 2025. The Pinal AMA, where most of the irrigation districts are located, was allowed to continue "planned depletion." Cities were assured they could continue to expand their service areas and thus their use, but would have to demonstrate an assured water supply for new development. The cities have contracted for as much M&I water as available and some, such as Scottsdale, that have limited other supplies, are competing to acquire the unallocated water or acquiring contracts from others who for one reason or another cannot use their allocation. A limited water market has developed for CAP water. Some tribal CAP allocations are also being leased to cities as part of negotiated Indian settlements.

Repayment Concerns.— Although there were warnings forecast by economists in the late 1960s that the CAP water would be too expensive for agriculture to use by the time the project was built, they were ignored at the time. A number of factors, including the price of CAP water and a drop in cotton prices, however, did lead to most of the major irrigation districts canceling their water orders. Districts found it cheaper to continue to pump groundwater, which they have a right to do under the "grand-fathered rights" obtained in the 1980 Act, rather than pay for CAP water. Many irrigation districts filed for bankruptcy protection, which upset repayment projections and touched off widespread speculation about the ability of CAWCD to meet its repayment obligation.

As of January 1994, the Central Arizona Water Conservation District (CAWCD), which was established under state law to operate the CAP, began repayment of the state's obligation, which is $1.8 to 2.3 billion, an amount now in litigation. The CAWCD determined that it could save $12 million a year in repayment costs if agriculture was using the water since agricultural costs are interest free under the master contract. Over a number of years, these savings are significant and as a result, the CAWCD adopted a subsidized pricing arrangement whereby irrigators could use the water under short-term contracts for about one third of the delivery cost; some water was priced at $17/af and some at $27/af, both of which were scheduled to increase by 1 af/yr for the next 10 years. CAP M&I rates are expected to be $140/af in ten years. This policy was adopted and implemented to keep agriculture using CAP water, to reducing repayment costs and to conserve groundwater, despite criticisms that this subsidy was not justified and financially questionable over time.

Critics pointed out that the CAWCD would quickly exhaust its reserve fund and not be able to meet its repayment obligations, citing the fact that the CAWCD would have to get legislative approval to raise the ad valorem tax on district property owners (Glennon, 1995). As of this year, agriculture was using nearly 600,000 af of CAP water under this arrangement. The then Chairman of the House Natural Resources, Committee, Congressman George Miller of California, asked for a GAO report on this and other CAP issues and held an oversight hearing in Phoenix in 1995 to explore CAP repayment and other related issues. The CAWCD assured the Congress and the public that it was fully prepared and able to meet its repayment obligation and pushed ahead with the new contracts.

The Governor's CAP Advisory Committee.— In late 1992, Governor Symington created a CAP Advisory Committee to address the repayment and underutilization issues and to explore an Arizona solution for the CAP to avoid any possible federal action to restructure the CAP. Chaired by Mark DeMichele, CEO of Arizona Public Service, the committee included representatives of all interest groups. In 1993, the Committee issued its report which endorsed steps to maximize use of CAP water by subsidizing costs for both M&I and agricultural customers in the short term. Agri-cultural prices were to be set at or below groundwater pumping costs and an additional 4 cent ad valorem tax and some energy sales to increase revenues was recommended. The Committee also

recommended against the sale or lease of any of Arizona's water to Nevada or California. Following up on these recommendations, the Legislature moved up the date that munici-palities must demonstrate an assured water supply to 1997 to encourage earlier CAP use.

The CAP Committee also looked to the federal government for additional financial help by shifting more of the fixed OM&R costs to the federal government for federal purposes, such as flood control, fish and wildlife and Indian water settlements. For example, if unallocated CAP water was reserved by the Secretary for other "federal purposes" such as Indian settle-ments or for environmental uses, such as on wildlife refuges, this would transfer the burden of repayment and OM&R costs from the state to the federal government for this water. The Committee also endorsed a proposal by environmental members to reserve up to 150,000 af for environmental enhancement purposes.[13]

The interim contracts for agricultural water will have to give way at some point to a pricing mechanism that more realistically values CAP water or substantial revenue will have to be raised from other sources, such as taxes, for the CAWCD to meet its repayment obligation. It is quite possible that the CAP's main customer will ultimately be the federal government as it is a primary source of water for the major unresolved Indian settlements in the state and other federal purposes.

Indian Water Settlements and the CAP.— A major unresolved issue between the CAWCD and the Secretary is the extent of the CAP supply that ultimately will be reserved for federal purposes and how project costs attributed to that water will be paid. The tribes have been very concerned that Indian water will cost much more than non-Indian water and that even if the federal government picked up the bill, it would devalue the total settlement since there is a limit to federal money for any one settlement so other financial aspects of settlements would be affected. The tribes suggested this was an equal protection violation and opposed the proposed settlement of the lawsuit between the CAWCD and the Department of the Interior (DOI) over the amount of the repayment obligation, which is one of the main reasons it was not approved. One solution explored in the settlement negotiations was to use a cash payment from the CAWCD to "buy down" the cost of Indian water, but this was only a short-term solution and the cost of the CAP water for tribes would still be higher than non-Indian agricultural water.

[13] In addition, the Committee recommended establishing an environmental trust fund at the state level which would be funded from revenues obtained from surcharges on under-ground storage projects in Arizona financed by California and Nevada, but not from CAWCD revenues. However, in 1994, the legislature established and funded the "Arizona Water Protection Fund" (AWPF), creating a commission to oversee the expenditure of a $5 million appropriation for "enhancing and restoring the state's rivers, streams and riparian habitat." Since then, with additional appropriations, $12.3 million has been committed to environ-mental enhancement projects through the AWPF.

As it stood when negotiations ceased, under the proposed settlement the Secretary would have retained 612,000 af, or roughly 43 percent of the total CAP supply to be used for federal purposes within the state. Most if not all of this water was earmarked for Indian settlements, which presumably could be leased to cities and other users by the tribes since much of this water could not be put to beneficial use by the tribes for some time.

CAP Environmental Issues.— Environmental groups also requested that the Secretary reserve some of the CAP federal purpose water for environ-mental enhancement purposes, a position supported by the Governor's Advisory Committee. Documentation provided the committee by the FWS stated that the three wildlife refuges along the lower main stem needed an additional 78,000 af for habitat purposes.[14] The environmental interests pointed out that while fish and wildlife conservation was an authorized project purpose under the Act, no money had ever been specifically appropri-ated for that purpose (although there was mitigation funding to offset environmental losses from construction). Congress had recently restructured the Central Valley Project (CVP) and the Central Utah Project (CUP) to include environmental water allocations and funding and a "greening" of the CAP also seemed logical. The groups petitioned Secretary Babbitt to provide funding for an environmental trust fund from some of the proceeds of the proposed settlement with the CAWCD and to reallocate some CAP water for environmental enhancement purposes. Secretary Babbitt had not responded to these requests when the settlement collapsed.

In an unrelated event, a jeopardy opinion was issued by the FWS in 1994 concluding that the delivery system of the CAP is likely to jeopardize endangered fish survival throughout the CAP service area by the inadvertent importation of exotic species that could escape into the Gila River basin threatening endangered native fish. The reasonable and prudent alternative (RPA) adopted by the BOR and FWS, without input from the CAWCD, who will ultimately be responsible for the costs, includes constructing fish barriers at an estimated cost of $6 million and 25 years of studies at a total cost of $12.5 million ($500,000 a year). The CAWCD strongly criticized the opinion and RPA, believing the money will be wasted, and threatened to sue. State water interests have been successful in blocking appropriations to fund the mitigation measures set forth in the RPA and the issue remains unresolved. The CAWCD is clearly unhappy about inheriting this obligation without being involved in the Section 7 consultation process.

The Arizona Water Bank.— As water use in the Lower Basin approached the 7.5 maf a year level, water marketing and water banking proposals were widely

[14] The three refuges had their water rights adjudicated in *Arizona v. California*, but these needs are in addition to the federal reserved rights established in the decree. One problem with the decree rights is that the FWS has not been able to transfer the water rights from one refuge to another, which they would like to be able to do.

explored and discussed in the Lower Basin. In 1991, California proposed a seven-state forum to develop an interstate water bank and develop a plan for dealing with all states' needs during critical periods (State of California, 1991). This concept paper also laid out California's proposal for reservoir operations and surplus use. In 1994, Nevada proposed a regional solution as well (discussed below) which included a Lower Basin water bank to deal with these concerns. Both the California and Nevada proposals, however, had a number of problems from other states' perspectives and were not pursued.

California has been diverting Arizona's unused entitlement for a number of years and expected to be able to continue to do so until the year 2020. The idea that California's continued use and its formidable political power might ultimately result in a claim to that water, or that federal regulations might be adopted that opened up interstate marketing that the state could not control, did not sit well with Arizona and the state responded aggressively. First, they threatened legal action to challenge the regulations proposed by the BOR in 1994 to facilitate leasing of apportionments. Then, in 1996, Arizona enacted legislation to establish and fund the Arizona Water Bank, with the goal of diverting its entire apportionments as soon as feasible, recharging some of the water in central Arizona aquifers and exchanging the rest for future groundwater recovery rights in an "in-lieu recharge" plan.

Funding for the program is expected to grow from $10 million in 1997 to $13 million in a few years, and Arizona expects to be diverting its entire allocation as soon as next year. In the near term, it is anticipated most of the water will be banked through in-lieu recharge, with farmers using the CAP water directly and banking the groundwater they would otherwise pump, which can be withdrawn by the bank in years it is needed. The initial rate to be charged an in-lieu user is $21 per acre foot, with the Arizona Water Banking Authority (AWBA) making up the difference in delivery costs. The AWBA also hopes to involve the Arizona Indian tribes, which could facilitate marketing of tribal water and to provide a pool of water for Indian settlements.

The Arizona law also allows up to 100,000 af/yr to be banked by California and Nevada once federal regulations governing these interstate purposes are promulgated by the Secretary. Nevada has responded positively to Arizona's water banking program and seems intent on participating. As proposed, if California and Nevada chose to participate they would pay the costs of transporting unused apportionment to be recharged or used "in-lieu" in Arizona and acquire the right to divert that amount of water from the river as needed. Patricia Mulroy, General Manager of the SNWA, estimates that the cost of banking the full 100,000 af/yr for ten years would be $100 million, which translates to $100/af (Greene, 1996). Arizona has moved quickly to sign up agricultural users for this water since rates are more favorable than pumping costs; the operation and maintenance and delivery costs will be paid from state appropriations and a tax that was authorized in the Groundwater Management Act.

It seems clear that Arizona acted when it did to put an end to any specula-tion as to what might happen to its unused apportionment vis-à-vis California and Nevada's unmet needs. Its decision to divert its entire apportionment as soon as possible and to commit state funds to do it was viewed by many in the state as a political coup. The water bank is widely supported in Arizona as a creative step to provide for the state's future water needs. It remains to be seen, however, whether this program will be more efficient and successful as a recharge program or as political leverage with California on other issues -- and whether the expense is justified by the Governor's publicly-expressed fears that Arizona has to "use it or lose it."

Many questions remain, especially since a plan has not been developed yet that spells out how this water will be recovered when needed, and whether the water will be recharged in ways that are consistent with existing Arizona groundwater management plans and objectives (i.e., in areas of significant overdraft), and how long the legislature will be willing to subsidize these water rates with appropriations. In addition, there are concerns that if most of this banking is done through in-lieu agreements, farmers will enjoy a whole new subsidy of cheap surface water, only delaying the time when groundwater again will be pumped. Indeed, not only did all the irrigation districts sign up for the program, but some retired land is being put back into production in southern Arizona to take advantage of this cheap water.

Notwithstanding these concerns, the interstate aspects of the Arizona law provide a new marketing mechanism in the Lower Basin that allows for interstate banking and storage by all three states as well as Indian tribes. Moreover, Arizona's move to divert its entire remaining apportionment sooner rather than later has forced the issue of how and when California will reduce its Colorado River use to 4.4 maf/yr. The Arizona Water Bank is potentially a new institution to facilitate interstate water marketing in the Lower Basin while possibly helping to reduce Arizona's groundwater overdraft.

Nevada's Concerns.— When the Boulder Canyon Project Act (BCPA) was enacted in 1928, an apportionment of 300,000 af/yr for Nevada seemed adequate. No one anticipated the phenomenal growth that would occur in the state once Las Vegas was established. Southern Nevada is now one of the fastest growing urban areas in the country and Nevada is expected to fully utilize its basic apportionment by 2010.

In 1994, Nevada proposed a tri-state Lower Basin water bank to be administered by a three state Commission. The Lower Basin bank would collect and allocate unused Colorado River water and other voluntarily contributed water, assure MWD a full aqueduct to fulfill municipal needs in Southern California, allow Las Vegas to divert Virgin River water from Lake Mead, and put an end to Arizona's junior subordination of its CAP portion of its entitlement to California. This ambitious plan had perhaps too many changes in the LOR requiring too many sign-offs, (and a troublesome provision providing for equal voting power for each state) and seems to have given way to the more narrowly focused Arizona Water Bank plan.

In addition to its Lower Basin proposal, Nevada has pursued a number of proposals to augment its limited Colorado River apportionment in recent years, including holding a "Nevada Water Summit" in 1993 where the state discussed some 30 proposals solicited for that purpose. In addition, Nevada officials have been in discussions with the State of Utah regarding an agreement to lease a portion of Utah's unused apportionment. The other Upper Basin states, however, vehemently oppose any transfers of Upper Basin apportionments to the Lower Basin and if this proposal is consummated, it is sure to end up in court.[15] Nevada has aggressively pursued all possible sources to augment its supply and has been frustrated the most by the gridlock in the Lower Basin. Nevada had hoped that the 7/10 process (meetings that included the seven basin states and ten Colorado River Indian tribes) would lead to consensus and a regional solution that would satisfy the needs of all the Lower Basin states, and "insure a level of interstate cooperation among sovereigns not before contemplated" (Rogers, 1994).

In similar testimony before the U.S. Senate, Patricia Mulroy, General Manager of the SNWA, spoke in terms of a "water crisis" in southern Nevada, due to a 32 percent population growth from 1989 to 1993 in Clark County, which is projected to reach 1.3 million by the year 2000 (Mulroy, 1994). In 1991, the Las Vegas Valley Water District, the largest water provider in the Las Vegas Valley and a member of the SNWA once it was created, suspended commitments for water delivery to new projects for a year, to determine exactly how much water it had committed for future years. In 1995, during the SNWA's resource planning process, SNWA's citizen advisory committee recommended that the SNWA utilize all available supplies to meet water demands, including temporary supplies, while working to acquire more permanent ones. Before that time, the SNWA had considered only long-term water to meet demands. Now, Nevada is looking to unused apportionments, surplus, and participation in the Arizona Water Bank for interim supplies and to the federal government to expand its permanent supply.

Water Management in the Upper Basin

The Upper Colorado River Basin Compact.— In 1948, the Upper Colorado River Basin Compact was signed which apportioned to the Upper Basin states their respective rights to use Colorado River water. The states' apportionments under the Compact are based on a percentage of the total 7.5 maf/yr apportionment for the Upper Basin, or the supply available
if there are shortages, with the exception of Arizona which received
50,000 af/yr of Upper Basin water in addition to its Lower Basin apportionment. These percentages and current and projected uses are depicted in Figures 6 to 10.

[15] Utah seems to be the only Upper Basin state that is currently entertaining the idea of an inter-basin transfer, although in the 1980s a proposal by private entities, who had acquired substantial water rights in Colorado in anticipation of oil shale development, attempted to market this water in the Lower Basin. The "Galloway proposal" received considerable attention but was unsuccessful.

The Compact established a Commission consisting of appointees by the governors of the four Upper Division states (Arizona is excluded) and a Commissioner appointed by the President to represent the United States. The expenses of the Commission are borne by the states in proportion to their apportioned percentages. The Commission's powers and duties primarily consist of data collection, forecasting and measuring the water supply, assuring deliveries to the Lower Basin, commissioning studies and preparing annual reports. It is also a forum for discussing issues of interest to the states in the Upper Basin and promoting those interests in Washington.

The Colorado River Storage Project Act.— In the early 1950s, Upper Basin project reports were completed and in 1956 Congress passed the Colorado River Storage Project Act (CRSPA), which was essentially a basin development plan, authorizing Glen Canyon Dam, Flaming Gorge Dam on the Green River, Navajo Dam on the San Juan, the Curecanti Unit on the Gunnison, which included three dams and powerplants (Blue Mesa, Marrow Point and Crystal), and a number of smaller projects, as well as initiating planning on a number of others. It also established a separate CRSPA fund in the Treasury Department to allow for revenues produced from the power generated by these hydropower dams to repay project costs and to fund O&M costs with any excess revenues apportioned among the states.

A number of additional projects in the Upper Basin were authorized in the CRBPA of 1968, which authorized the CAP. They were the Animas-La Plata, San Miguel, Dallas Creek and West Divide projects in Colorado, and the Uintah unit of the CUP along with the reauthorization of the Dixie Project in Utah. Of these, some units of the CUP, the Dallas Creek Project and the Dolores Project have been built.

Upper Basin Concerns.— The major concern of the Upper Basin states is whether they will be able to fully develop their Compact apportionments. Although a number of water development projects have been authorized, many have not proved economically feasible and authorization and federal funding for these projects or new projects is even more difficult to obtain in today's fiscal climate. Water development took place sooner in the Lower Basin, much of it before the enactment of major environmental laws such as the CWA, NEPA, and ESA and before projects received the budgetary scrutiny they receive today. In that sense, the Upper Basin is being penalized for its timing.

The federal mandates under the ESA and other laws are seen today as major obstacles to any significant new water development in the Upper Basin. Federal regulatory permitting under Section 404 of the CWA and ESA Section 7 consultations have been a major concern for some water development projects. The Animas-La Plata Project (ALP) has been stalled in large part due to legal challenges under NEPA and ESA and, as mentioned, the Two Forks Dam in Colorado was vetoed by the EPA. The Navajo Indian Irrigation Project (NIIP) in the San Juan River basin has run into similar endangered species roadblocks which may limit full

development of that project. The fact that there are still viable populations of endangered fish in the Upper Basin and more natural riparian and aquatic habitat left than in the Lower Basin may mean that more fish recovery efforts will take place in the Upper Basin, which raises questions of equity and how responsibility for these recovery programs is ultimately shared.

There is concern also that the rapid growth in the Lower Basin will lead to even more dependence by the Lower Basin states on unused Upper Basin apportionments, particularly since the Lower Basin states are now consuming more than 7.5 maf/yr. The Upper Basin states have expressed concerns for years about California's use in excess of its basic apportionment and its proposals to bank unused water in the reservoirs and to draw down Lake Mead. Under the "equalization criteria" included in the CRBPA of 1968, Lake Powell is maintained at about an equal level with Lake Mead and Glen Canyon Dam was built in part to store sufficient water to meet the Upper Basin's Compact obligations. The Upper Basin does not want to see Lake Powell drawn down significantly to meet the Lower Basin's extra needs if it could result in losing power generation capability or leaving an inadequate supply to fulfill Upper Basin needs and Compact requirements.

Another issue of concern is the controversy over bypass flows in national forests. The clash of state-sanctioned water rights and the USFS assertion of instream flow needs through national forests has led to the establishment of a task force to review the issues and make recommendations, which are expected soon. Environmentalists are also concerned that state instream flow programs in Colorado and elsewhere have not received priority or funding needed to make a difference. In Colorado, instream flow rights have been established on over 7,000 miles of streams and are held by the Colorado Water Conservation Board (CWCB) on behalf of the people of the state. A change of the law in 1987 clarified that only the CWCB can hold instream flow rights in the state. According to one environmental group, there has never been a "call" issued to protect one of these rights from other depletions (Glazer, 1997). The CWCB has been successful in intervening in some proceedings to protect instream flow rights and in some cases applicants received less water (MacDonnell *et al*., 1989). A senior conditional water right on the Gunnison River was donated to The Nature Conservancy (TNC) several years ago; TNC effectuated a transfer of that conditional water right to an absolute instream flow right and entered into an agreement with the state to protect that right.

There are also continuing controversies in Colorado over the transfer of western slope water to the front range, where the pace of urban growth continues to frustrate water planners. There are substantial water rights on the western slope that have been acquired by urban water providers and diversion capacity exists to transport this water to the front range. Over half a million acre-feet is now transferred in Colorado from the Colorado River Basin to the Platte, Arkansas, and Rio Grande basins. However, rural counties could halt some of the more recent diversion plans based on a state law that provides counties with a right to regulate projects of a statewide interest that occurs within their jurisdiction, such as power lines, airports, or major water projects (House Bill 1041, C.R.S. 24-65.1-101). These issues involve protection of local communities, their economies and lifestyles, and

the growing awareness that the future value of this water for local communities is for recreation, meaning leaving much of it in the streams. A 1995 report by Resources for the Future entitled Economic Value of Freshwater in the United States, (Frederick *et al*., 1995), as cited by MacDonnell and Driver, concluded that in the upper Colorado region the value of water for recreation, fish and wildlife was $51 an acre-foot as compared to $21 for hydropower and $5 for irrigation. However valid these numbers, they reflect the changing values of water rights in the new west based on tourism and recreational economies.

Current Uses and Projected Demand in the Upper Basin.— As shown in Table 4, the Upper Basin currently uses more than half of its basic apportionment. And, as discussed, more recent studies have shown the actual flows of the Colorado River to be considerably less than was thought when the Compact was signed in 1922. As a result, for planning purposes, the Upper Colorado River Commission uses 6.0 maf/yr as full development. Based on this number, current depletions in the Upper Basin (including 520,000 af/yr of reservoir evaporation) are already over 75 percent of the available amount and projections show that the Upper Basin states will be using 90 percent of 6.0 maf/yr by the year 2030 (see Figures 6 to 10).

Central Utah Project Status.— The CUP is the largest of the "participating projects" authorized by the CRSPA. The CUP was designed to capture snow-melt from the south side of the Uinta Mountains and divert it out of the Colorado River Basin to farms in the Sevier River basin and urban areas along the Wasatch Front. A complex network of reservoirs, tunnels, canals, and power plants was designed to deliver some 136,000 af/yr of irrigation and M&I water.

Three major changes have since taken place: 1) the state's CUWCD took over construction of the CUP in 1992; 2) projected water users in the Sevier River basin withdrew from the CUP; and 3) an environmental component was added to the CUP when it was reauthorized in 1992.

Financial problems for the CUP emerged in 1985. The project was burdened with a supplemental repayment plan that mandated recovery of all costs before the CUP would receive any further funding and the project exceeded its authorized ceiling. In 1992, the CUP Completion Act (CUPCA) turned over control of construction to the CUWCD and authorized $922 million to complete the project.

In 1993, water users in the Sevier River basin, including Millard and Sevier Counties, decided to withdraw from the CUP. County officials determined that it was no longer cost-effective to participate in the project, indicating that they could fund their own water conservancy districts for approximately 50 percent of what they paid for CUP water. In addition, county officials feared that diversions into the Sevier River basin would bring unwanted federal regulations and complicate an already delicate balance of water rights along the river.

When the CUPCA passed in 1992, Congress also balanced a "mitigation debt" which had accrued over a number of years due to inadequate mitigation efforts associated with federal water projects in Utah. CUPCA authorized $15 million for the Utah Reclamation Mitigation Conservation Commission (URMCC), to design and implement a comprehensive program to restore, protect, and conserve fish, wildlife, and recreation resources impacted by BOR projects in Utah. A coalition of eight conservation organizations, the Utah Outdoor Interest Coordinating Council, works closely with the CUWCD on these fish, wildlife, and recreation issues and the CUWCD has funded a position to facilitate this communication. The URMCC was authorized to spend approximately $141 million on mitigation efforts in its five-year program. The Congress also earmarked up to $50 million over several years to fund water conservation projects. Conservation efforts were expected to both increase supplies for irrigation (delaying the need for large projects with significant impacts) and restore some natural flows.

Under an agreement between BOR, the State of Utah, and the CUWCD, fishery flows have been allocated 44,000 af of CUP water, or 17 percent of the total allocations of the project. These flows, when added to 10,500 af from annual spills or intentional bypasses to meet other uses, are expected to maintain 50 percent of the historic adult trout habitat on the Strawberry River, Currant Creek, Rock Creek, and West Fork Duchesne River. Any or all of the 10,500 af may be released at the discretion of the FWS and Utah Division of Wildlife Resources, in consultation with the USFS and Utah Division of Water Resources.

Animas-La Plata Project Status.— As authorized in 1968, the ALP would divert flows from the Animas River near Durango, Colorado to produce some 191,230 af/yr, including 111,130 af/yr of irrigation water and 80,100 af/yr of M&I water. The project has been embroiled in controversy; pitting farmers, ranchers, municipalities, developers, and the Ute Mountain Ute and Southern Ute Indian tribes against conservation interests, taxpayer groups, and a small but vocal group known as the Southern Ute Grassroots Organization[16]. Project opponents have indicated that the diversion would jeopardize endangered fish species, cause water quality problems, destroy riparian ecosystems and habitat, and impact recreational uses. Proponents argue that the project is needed to provide water for the settlement of Indian water rights, as well as for growing populations in Colorado and New Mexico.

Resolution of the issues surrounding the ALP has proceeded at what some have called a "glacial" pace. Since authorized by Congress, the ALP has undergone several modifications in response to fiscal and environmental concerns and to date a total of only $60.5 million has been appropriated. A key element of the ALP is the 1988 Ute Indian Water Rights settlement, under which ALP water is dedicated to satisfy reserved water rights claims of the Southern Mountain Ute and Ute

[16] The Navajo Nation has never endorsed ALP, but is on record as supporting the implementation of the Ute Settlement Act and the delivery of the water to the Colorado Ute Tribes (Letter from Stanley Pollack, Supra).

Mountain Ute Indian Tribes. The tribes have claims to approximately one third of the project water. Most tribal council members favor the project due to its major role in fulfilling the water rights claims of the 1988 settlement. Opposition to the project in the Indian community comes from the Southern Ute Grassroots Organization, which is concerned about environmental damages and the financial obligations the project would impose on the tribes. In addition, the Navajo Nation has recently raised issues regarding a conflict with their *Winters* rights claims, which date from 1868 and have never been adjudicated, and which could be impacted by the project. The last Congress debated cutting funding for the project, but $10.86 million in funding was restored for
FY 1997 (Bingham, 1997).

In an attempt to resolve the continuing disputes about the project, Governor Roy Romer and Lt. Governor Gail Schoettler convened a state-wide negotiating process. Among the stakeholders involved in this process are the Utes, Navajos, Animas-La Plata Water Conservancy District, San Juan Water Commission, conservationists, Southern Ute Grassroots Organization, and interests from New Mexico, Colorado, EPA, and DOI. Secretary Babbitt indicated that he believes the process "may provide a helpful model for negotiated settlement of knotty problems within the Colorado River Basin."

Most agree that the Romer/Schoettler process is innovative. *High Country News* called the negotiations "revolutionary in their recognition of the newest arrivals' right to be at the table" *(*Marston, 1996*)*. Financial support for this process is being offered by an array of agencies, including DOI, EPA, and the State of Colorado (through cost-sharing and in-kind contributions).

The Romer/Schoettler process is an alternative to the on-going litigation. Project proponents and opponents have entered into a "stand still" agreement, which places pending lawsuits on hold and allows stakeholders to focus their resources on resolving differences within the negotiating process. To enhance the potential for resolution, Governor Romer and Lt. Governor Schoettler have established a set of ground rules for the stakeholders. The rules require stakeholders to refrain from publicly voicing or publishing personal attacks on the character or motives of other parties and to recognize that each party deserves to be treated with dignity and respect despite differing points of view.

Jim Lochhead, Executive Director of the Colorado Department of Natural Resources (CDNR), stated that the 1986 settlement agreement "required vision, extraordinary leadership, respect for the needs of all sides, a willingness to listen to and explore new solutions, and a commitment to stay at the table until a solution is reached. If these same qualities are applied in [the Romer/Schoettler] process, we can reach a positive and lasting result" (CDNR, 1996).

The process builds upon a trend in water resource management to identify and solicit participation from all stakeholders. This strategy was critical to the resolution of controversies surrounding the Central Arizona Project and California's 30-year water war in the Bay-Delta Accords. Agreements on these projects were not

reached easily, and consensus on the ALP will require new partnerships to form among diverse and differing interests.[17]

State Conservation Programs: Some Examples

There is great potential in the Lower Basin for conservation and reuse of water supplies. Estimates vary, but there is widespread agreement that the greatest potential is in the agricultural sector where there has been little incentive to conserve because cheap water is plentiful. One report suggests that 1.2 maf in savings could be achieved in this sector, which uses two thirds of the water, by investments in irrigation efficiency and retiring marginal lands (Pacific Institute, 1996). Another study suggested that a ten percent rise in prices could reduce water use on some California farm crops by as much as 20 percent (Gardner, 1983). In 1984, the California Water Resources Control Board found that with irrigation efficiency improvements, the IID could save up to 400,000 af/yr.

Conservation programs do not generally receive a high priority in terms of budgetary resources. In California, the state Department of Water Resources was allocated $2.3 million in water conservation staff support and $17 million in loan funds to local agencies in its 1996-1997 budget (which are expected to increase $39 million in fiscal year 1997-1998) out of an overall Department budget of $415 million (Letter from California Department of Water Resources, April 1, 1997). California's municipal water conservation strategy is highly dependent upon programs requiring significant invest-ments by water providers. In 1991, M&I water providers signed a *Memorandum of Understanding (MOU) Regarding Urban Water Conservation Best Management Practices (BMPs).* Implementation of the BMPs is projected to result in 882,000 af in savings by the year 2020, approximately 50 percent of which would be derived from relatively costly programs such as fixture retrofit programs and distribution system leak repairs (MWD, 1996). More than one million ultra-low flush toilets have been installed under MWD's conservation program, which are expected to save 40,000 af/yr for 20 years. By 1995, MWD and its member agencies had invested over $8.5 million in toilet retrofits.

There is a similar MOU being developed for agricultural users, as authorized by the California legislature in 1990. Water savings in agriculture are dependent on financial investment in canal lining, installation of control structures and irrigation systems to improve water deliveries, crop switching, and other structural and non-structural measures.

Arizona's Groundwater Management Code was widely praised when it was enacted 17 years ago, but it is debatable whether its conservation requirements have had much effect in reducing water use in any sector. Agricultural use was grandfathered

[17] Due to the dynamic nature of the ALP discussions, it is likely that developments have occurred since this writing. The Governor's office maintains a World Wide Web site with the current status and updates on the process. The address for this site is http://www.state.co.us/gov_dir/govnr_dir/a_lp/index.html.

and a liberal allowance provided for the right to irrigate all acres ever in production during the five-year qualifying period, with water duties that allow high water use crops. Moreover, flexibility accounts were established for years in which the maximum allowable was not used. Due primarily to economic factors, considerable land was fallowed during the 1980s. These flexibility accounts now total millions of acre-feet and these credits can be exchanged or transferred. Perhaps the most progress has occurred by providing on-farm services to farmers where savings can be demonstrated by changes in water application at no cost to the farmer.

Municipal conservation efforts under the Arizona Groundwater Code have been inconsistent; the gallons per capita per day (GPCD) measuring standard is arbitrary and difficult to evaluate because large users and the number of users on a system can skew the results. Modest savings are expected from municipal conservation and education programs, with GPCD rates decreasing slightly.
The SNWA has a minimum conservation goal of 10 to 15 percent by the year 2000. By the end of 1996, the SNWA claimed it had already achieved an estimated 11 percent cumulative savings from conservation programs and water rate increases since 1991, when conservation programs began in the Las Vegas Valley. All water customers are metered and water rates are designed to encourage conservation (increasing block rates whereby large users pay higher rates). The SNWA has a current conservation program budget of $3 million. Programs include indoor plumbing retrofit programs, daytime outdoor watering restrictions during the summer, extensive conservation education, a “Cash for Grass” turf replacement incentive program, and water audit programs for outdoor irrigation systems.

Denver Water has developed a Conservation Master Plan, which is a voluntary program to provide guidance and suggestions to its customers to help reach water conservation goals, including leak detection, metering, low use fixtures, and education. Denver Water expects to save 37,000 af through these efforts by 2035. San Diego's conservation program includes financial incentives for low water use fixtures, funding for programs on irrigation efficiency and low water use landscaping, and elementary school education. SDCWA estimates that county-wide water use has dropped by 15 percent since 1990 and that new conservation programs will save an additional eight percent by 2010.

The City of Steamboat Springs, Colorado has implemented a water efficiency program that is expected to save 30 million gallons a year and over $230,000 for its customers in that small city. New Mexico has begun to develop a state program in which conservation measures will be implemented at a state, regional, and local level. The state envisions its role as one of coordination, information, and assistance. The New Mexico state engineer requires that all water right applications include a water conservation plan.

Reuse Programs.— Reuse of treated wastewater is an important component of water conservation. For every acre-foot of reclaimed water used for an existing non-potable need, an acre-foot of drinking water is saved. For purposes of augmenting water supplies, reuse is particularly advantageous for coastal cities; it can provide

new supplies in areas where wastewater is currently being discharged to the ocean. Water reuse is slower to develop in the Upper Basin, but one reason is because there is considerable reliance by downstream users on return flows. The law in Colorado and many other appropriation states requires that return flows, whether effluent or irrigation water, be returned to the stream and available to the next senior water right. More progress may be possible in municipal reuse programs. The City of Rock Springs, Wyoming reduced annual its expenses for ceme-tery irrigation from $65,000 to $4,529 by converting to effluent, saving 33,000 gallons a day of fresh water. The City of Tucson, Arizona has had an extensive effluent reuse program for years, building major distribution systems so that effluent could be conveyed to golf courses and parks for irrigation. In Utah, the City of Tooele will be the first to use effluent on a golf course.

California has the most potential for expanding reuse. California currently has an active reuse program, with some 80 projects producing over 150,000 af/yr in southern California alone. These projects are used for a variety of purposes, including groundwater recharge, hydraulic barriers to salt water intrusion, landscape and agricultural irrigation, and direct industrial use. Approximately 80 more reuse projects have been proposed in California, and reuse within the state is projected to provide about 1 maf/yr of water supply by the year 2020.

There may be no better example of where reuse was not seriously considered in water resource planning than the new South Bay Ocean Outfall in southern California. When completed, up to 195,000 af/yr of treated effluent from the new International Boundary Water Commission (IBWC) International Wastewater Treatment Plant and the City of San Diego's South Bay Water Reclamation Plant will be discharged into the Pacific Ocean via the outfall. The outfall will have an average daily flow capacity of 174 mgd and a peak flow capacity of 333 mgd.

In Arizona, over 140,000 af/yr of effluent is being used statewide, including about 60,000 af/yr for the Palo Verde Nuclear Power Plant west of Phoenix and 30,000 af/yr by the Buckeye Irrigation Company and 30,000 af/yr exchanged with the Roosevelt Irrigation District for potable water. In southeast Arizona, a plan to recharge the San Pedro River with effluent from the City of Sierra Vista is being developed.

Southern Nevada has a unique program in that it uses its wastewater to generate "return flow credits." This means that, for every acre-foot of treated Colorado River wastewater that Southern Nevada returns to the river, it can divert that much more Colorado River water, as long as its consumptive use (defined in the LOR as "diversions less return flows") is no more than 300,000 af/yr. Southern Nevada's existing diversion contract quantities are already based on the assumption that most of the treated wastewater is returned for credit. Because of this, more reuse of the wastewater for outdoor irrigation and power plants, for example, rather than returning it to the river for credit, would not increase the region's supply. Instead, decisions to reuse are usually based on facility capacities and costs. As a result, effluent reuse has been increasing in Southern Nevada and is expected to continue.

Some water features on the famous Las Vegas Strip treat and use gray water and nuisance shallow groundwater.

Ecosystem Sustainability

A century of development in the Colorado River basin has dramatically altered the natural hydrograph and functions of the river system; a series of large dams and reservoirs capable of storing four years' average flow moderate or prevent most floods, change the timing and reduce peak flows, lowering the water temperature, fragmenting habitat, trapping sediment and altering instream and streamside habitats. In the Lower Basin, from Lake Mead to the border, the river can be characterized as a plumbing system of dams, reservoirs, huge diversion works, canals, and flood control levees; only a small percentage of natural habitat remains along the lower river.

The economic wealth in the American Southwest and southern Rockies is largely the result of the power, water, and flood control benefits that resulted from the substantial investment in the Colorado River basin. And the great reservoirs have become recreation meccas for millions of people who visit each year, providing substantial economic benefits to the area as well.

This development, however, has not been without a price. The diversion of millions of acre feet of water, changes in water quality and temperature and the alteration of the natural habitat, coupled with the intentional and unintentional introduction of exotic species throughout the basin has impacted fish, birds and other aquatic dependent species. As stated by
W.L. Minckley, "The fish fauna collapsed from downstream to upstream, in the same sequence as the river was regulated" (Minckley, 1991). The introduction of exotic, non-native fish throughout the basin is now considered to be one of the major reasons that native fish populations have crashed over the past 50 years and perhaps is the most important reason, according to Dr. Minckley. "Native fishes of the American West will not remain on earth without active management, and I argue forcefully that control of non-native, warm-water species is the single most important requirement for achieving that goal" (Minckley, 1991).

The four "big river fishes" -- the Colorado squawfish (once called the "salmon of the Colorado"), the razorback sucker, the bonytail, and the humpback
chub -- are all listed as endangered. The squawfish has been extirpated in the Lower Basin, but small populations still exist in the Upper Basin, primarily in the Green and Yampa rivers. The bonytail is the rarest, and viewed by some experts as on the verge of extinction. The razorback sucker population, once widely distributed, now consists of primarily old fish living in Lower Basin reservoirs and in the Yampa and Green rivers in the Upper Basin. There has been an extensive razorback augmentation program in the Lower Basin since the 1970s, where razorback fry are reared in hatcheries and backwater areas of Lake Mohave and Lake Havasu until they are large enough to escape predation. The humpback chub has a healthy population in the Little Colorado confluence in the Grand Canyon, and persists in various areas of the Upper Basin.

Recovery plans have been adopted for the squawfish, the bonytail and the humpback chub, and the FWS is now developing a recovery plan for the razorback sucker that is intended to integrate all four fish in a single multi-species plan. A draft of this plan has not yet been released for comment.

The Upper Basin Recovery Implementation Program

The Upper Basin Recovery Implementation Program (RIP) has been underway since 1988 when a coordinating committee was formed, consisting of the BOR and FWS, the states of Colorado, Utah, and Wyoming, and environmental and water user representatives. The San Juan sub-basin was excluded from this program as it involved a different set of issues, including the controversial ALP and several Indian tribes (see discussion below). Major elements of the program include identifying and protecting instream flows for fish, restoring, and protecting floodplain and backwater habitats, installing fish passage facilities, controlling non-natives, restocking natives and genetic conservation. Some of the program's accomplishments to date include:

- BOR officials helped improve endangered fish habitat by altering the timing of releases from Flaming Gorge and Blue Mesa reservoirs. These releases, which total 2.5 maf/year, improve endangered fish habitat by providing higher spring flows and more stable flows the rest of the year.

- The Utah State Engineer set a water rights policy to benefit endangered fish by protecting Green River flows between Flaming Gorge Dam and in the Duchesne River.

- A 350-foot fish ladder has been built at the Redlands Diversion Dam in Southwest Colorado, opening up 50 miles of historical habitat to endangered fish. The ladder is on the Gunnison River two miles upstream of the Colorado River confluence.

- An agreement is in place between Colorado State Parks, the Colorado Water Conservation Board, and the FWS to release 3,300 af annually from Steamboat Lake into the Yampa River to offset periods of low flows.

Restoration of floodplain bottom lands is considered an important element of the program, as these wetlands serve as important nurseries and food sources for young fish and because a large percentage of wetlands have been lost since the region was settled.[18] A major unresolved issue is how to control and reduce the predation threat that introduced and stocked non-native fish present for successful native recruitment.

[18] Source: "Wetlands losses in the United States, 1780s to 1980s," U.S. Department of the Interior, U.S. Fish & Wildlife Service, as cited in Recovery Program for the Endangered Fishes of the Colorado newsletter, Winter 1995.

There have been serious disagreements in Colorado over the level and variability of instream flows needed for the fish, to what extent existing and planned water uses would be protected from jeopardy opinions and where new water development can occur. There is also concern that establishing instream flows for fish by filing for state appropriations could deprive Colorado of part of its compact entitlement. The Colorado Water Conservation Board has filed, on behalf of the state, for instream flow water rights in several important river reaches. These rights, if adjudicated by the state's water court, will be junior to existing decreed rights, but will include a base flow right during low flow conditions and a "recovery flow right" to create more natural flow conditions at certain times of the year.

The major issue is whether water users will be able to obtain an acceptable level of regulatory certainty from the FWS; whether the RIP agreed to and funded as the "reasonable and prudent alternative" to jeopardy will be sufficient or whether it will be reopened at the discretion of the FWS down the road. Water users believe they are entitled to "a deal is a deal" treatment and the same "no surprises" policy promised private landowners under Section 10 habitat conservation plans for endangered species on private lands. Currently, proposals are being explored by the parties that would protect a certain block of already developed water plus a future block of water for projects already built, conditioned on sufficient progress taking place toward recovery by the year 2000. This issue, however, is still in a state of flux.

Indeed, knowing how to deal with the cumulative impacts of water development, what actually works, and what happens if it doesn't are questions that have perplexed participants from early on in the program. It is difficult to evaluate how effective the program has been to date, but it has allowed water development to continue under state law within the framework of the ESA and has created a cooperative process for resolving conflicts generated by the ESA.

The Upper Basin RIP is at a critical crossroads. There is still strong opposition from many water users in Colorado to setting aside flows for fish. Some filed objections to the instream flow water rights filings, which angered environmentalists who feel the water users are trying to have it both ways -- meaning they are benefitting from the current non-jeopardy status by continuing to divert water while opposing the long-term requirements for recovery of the species.

A total of approximately $64.7 million has been spent on the RIP program since its inception. There is an annual operating budget of $2.5 million, but long-term funding estimates are that $70 to $100 million is needed for the significant capital costs of acquiring habitat and water rights, fish ladders, hatcheries and research. These funds presumably will come from Congressional appropriations, funds contributed from the three states and from small, one-time water development "depletion fees." A more stable source of funding is being sought by redirecting Upper Basin CRSPA power revenues, which will require federal legislation, and an increase in state cost sharing for construction activities.

The San Juan River Recovery Implementation Program (SJRRIP)

The San Juan River Basin makes up about one-fourth of the Upper Basin and drains 25,000 square miles of the four corner states. The San Juan River is the second largest tributary of the Colorado. It includes four Indian reservations, which make up about 60 percent of the land in the basin. Private land makes up about 13 percent of the basin and government land the rest. At its confluence at Lake Powell, the San Juan River produces an average annual flow of 2 maf; about half of which is controlled upstream by Navajo Dam, which was authorized in 1956 by the Colorado River Storage Project Act.

Navajo Dam and Reservoir (which stores 1.7 maf) have been described as "truly the quintessential cornerstone of the future potential management options in the San Juan River Basin" (Gold and Jensen, 1996). Water users in the basin, including the NIIP, depend on this reservoir. New Mexico derives most of its Upper Basin Compact water from this project and the San Juan-Chama Project.

The endangered fish program for the San Juan River Basin was developed as the RPA to a jeopardy opinion on the Animas-La Plata Project, which as designed would deplete 154,800 af from the Animas and La Plata rivers in Colorado and New Mexico. A MOU was signed by New Mexico, Colorado, and the Southern Ute Indian, Ute Mountain Ute and Jicarilla Tribes and DOI to develop a recovery implementation program to address the needs of two listed fish (squawfish and razorback) and other native fishes. The program was initiated in 1992 and is to run for 15 years.

A second MOU was signed to deal with the NIIP and Navajo Reservoir releases. The Navajo Nation initially refused to participate because the RPA required protection of flows from Navajo Reservoir for the life of the ALP, as opposed to the duration of the SJRRIP. This was later modified and the Navajo Nation is now a full participant. Sufficient progress toward recovery of the two listed fish is required by the RPA in order for there to be additional depletions above recognized levels. A seven-year research period was initiated to determine what flows are needed for fish recovery, meaning that what constitutes "sufficient progress" is still to be determined.

The main controversy is over the need for water releases in the spring for endangered fish downstream of Navajo Dam, which impacts water available in storage for Project users and other projects depending on the SJRRIP as the RPA. The conflict in the San Juan River Basin between endangered species and Native American rights is profound. The Navajo Nation opposes releases from the dam for fish because they claim the stored water is reserved for full development of the NIIP and the ultimate satisfaction of their reserved water rights. The two Ute Tribes claim the right to fully develop their reserved rights which were to be satisfied with water developed by the ALP.

The SJRRIP is similar to the Upper Basin program; the major differences are that it includes more emphasis on water quality and involves a number of other native

species to avoid listings in the future. The SJRRIP is currently funded at a level of $800,000 a year from BOR and FWS appropriations, but after the research period has ended, it is anticipated that up to $15 million will be needed for capital projects to recover the fish, with an annual operating cost of at least $600,000.

The Lower Basin Approach: The Multi-Species Conservation Program

Background.— Extensive fish management and recovery efforts have been carried out for years in the Lower Basin by cooperative efforts between BOR, Region 2 of FWS, the states, and Arizona State University. In 1995, a Lower Basin "management prospectus" was drafted by FWS biologists to focus research and management efforts on the stabilization and enhancement of populations of razorbacks and bonytails in Lake Mohave and Lake Havasu by restocking both fish and continuing the program of using grow-out ponds in backwater areas of the lakes to rear these fish to sizes that could escape predation and to ensure the survival of the gene pool while long term solutions could be developed and implemented. The prospectus has been replaced by a Lower Basin Management Plan developed by the FWS.

In August of 1996, the BOR completed a Biological Assessment (BA) of the impacts of BOR operations in the lower main stem from Hoover Dam to the Mexican border on endangered species. As a result, Section 7 consultations were initiated with the FWS and in April of 1997 a Biological Opinion was released which concluded that the proposed action (including existing operations and maintenance) is likely to jeopardize the continued existence of the bonytail chub, razorback sucker, and southwestern willow flycatcher. Two other species, the endangered Yuma clapper rail and the proposed threatened flat-tailed horned lizard received a non-jeopardy finding. A RPA with 14 terms and conditions to reduce take of the three species was approved by the FWS and submitted for public comment. The Biological Opinion addresses BOR's discretionary program for continuing operations in the 100-year floodplain from the upper end of Lake Mead to the Southerly International Boundary (SIB) over the next five years, which is also the projected period for the development of a long-term "multi-species conservation program." In short, the RPA is designed to provide interim measures to assure sufficient progress toward protection and recovery of these species while a long-term program is developed by the Lower Basin states, federal agencies and other involved interests.

The Lower Colorado River Multi-Species Conservation Program.— In 1993, the Lower Basin states and water users created a Steering Committee to explore options for addressing endangered species concerns along the Lower Colorado River. The goal of this effort was to develop a proactive approach that would provide ESA compliance and avoid new listings, if possible, while continuing existing water and power uses on the river. A feasibility study was commissioned to explore alternatives and a hybrid approach was selected which included a Habitat Conservation Plan (HCP) and incidental take permit under Section 10 of the ESA merged with the expected Section 7 consultation process. The states and water

users believed that this approach would assure more state and stakeholder involvement and control over the process and product, protect more species, control costs, and help assure that water and power operations could continue.

A Memorandum of Agreement (MOA) was signed by the DOI and the water resources and fish and wildlife agencies of the three Lower Basin states in 1995 to develop and implement what is now called the Lower Colorado River Multi-Species Conservation Program (LCR MSCP). A cost-sharing agree-ment between the states and DOI was executed which established a 50-50 funding formula. Several environmental groups objected to the wording of the MOA, arguing that it placed water and power operations at a higher priority than species recovery and would compromise Section 7 requirements. A Memorandum of Clarification was negotiated and signed in 1996 which provided assurances that the MOA was not intended to avoid compliance with Section 7 of the ESA or somehow delegate this authority to the Steering Committee. The Steering Committee was also expanded to include representatives of Indian tribes and environmental groups.

The Steering Committee now has been redesignated as an "Ecosystem Conservation and Recovery Implementation Team" (ECRIT) by the FWS. The ESA authorizes the Secretary to appoint "appropriate public and private agencies and institutions, and other qualified persons"[19] to help implement recovery actions and exempts this committee from Federal Advisory Committee Act requirements. The ECRIT membership is being expanded to include public members representing various interests like sport fishing and recreation, and additional tribes and environmental groups.

The Steering Committee had agreed on and funded a series of interim conservation measures to assure ESA compliance until a long-term conservation program could be developed and implemented. These will be reviewed annually by FWS and the ECRIT to measure "sufficient progress." Consultants have been selected to work with the ECRIT over the next 3 to
4 years to prepare what is expected to be a 50-year plan. Approximately
102 species that are either listed or considered at risk have been identified as occurring in or along the Lower Colorado River. This list will be narrowed and prioritized during the planning process.

This is a unique approach to endangered species planning as it places major responsibility in a committee of state and federal agencies, Indian tribes, water users and interest groups. The FWS, however, has a statutory obligation to assure that there is sufficient progress toward species recovery and has stated that if the ECRIT is not meeting its objectives, FWS reserves the right to withdraw this designation and proceed accordingly. While this collaborative process seems to be on track, there is still some concern by environmental groups that the RPA is sufficient to meet ESA compliance. Concerns have been raised also about the need to expand the conservation program to include the Colorado River delta in Mexico.

[19] Section 4(f)(2) of ESA.

The Southwest Center for Biological Diversity (SCBD), which recently become a member of the ECRIT, has filed a number of lawsuits over what it sees as the failure of the FWS to designate and protect critical habitat for the southwestern willow flycatcher, particularly in the upper Lake Mead delta. At least 14 pairs of flycatchers are known to be nesting in the delta habitat. The SCBD contends that higher lake levels in Lake Mead threaten to inundate and destroy prime nesting sites for the flycatcher and are seeking a court order to require the lake to be lowered, which would require releasing 3-4 maf of water from the reservoir. BOR believes it has no discretion to make such a release under the law and water users and states are strongly opposed. The issue of whether the ESA can be invoked to radically change water and power operations on the Lower Colorado is a critical one; whether any compromise solution can be found in the ECRIT process is yet unclear, and studies, data collection, and discussions are proceeding.

The LCR MSCP can be contrasted with the Upper Basin RIP in a number of ways. First, establishing instream flows is not as major a concern for the Lower Colorado main stem. Since at least 1.5 maf must be delivered to the Mexican border each year, there is adequate water in the river for the fish (although the timing of releases and reservoir levels are issues). Second, some biologists believe the razorback sucker and bonytail have adapted to the reservoir habitat and that the primary problem for the fish in the lower river is predation and competition for food with the many non-native fish that occupy the same habitat. And, by concentrating on all species at risk (and not just fish), the Committee believes this will be a cost-effective program, saving both more species and money over the long run. In addition, the LCR MSCP is focused solely on the main stem of the river and its 100-year floodplain. Some conservation groups have questioned whether the program should be that limited given that the Lower Colorado main stem has been so developed, and ask whether recovery and mitigation efforts should also include some of the tributaries, such as the upper Gila river system.

A budget of $4.5 million has been established to develop the 50-year conservation plan and fund interim conservation measures. The plan will be developed, with the assistance of a consulting team, over the next 3 to 5 years. The ultimate cost of implementing this program or how it will be funded is unknown at this time.

Summary.— There are a number of questions about the three recovery implementation programs in the basin and especially how “recovery” will be measured. One problem is that there is not agreement as to how recovery is defined; does it mean the endangered fish species must be “self sustaining” as the Upper Basin RIP seems to indicate, or may recovery necessarily require hands-on management in some areas for the foreseeable future? And, the existing recovery plans for big river fish do not specifically or adequately deal with many issues, including how to control exotic species, which may be the most difficult challenge and the key to successful recovery. Finally, both federal and non-federal agencies pursue stocking and management programs for sport fish to enhance recreation in the basin. These programs are often in conflict with and in competition for funds

and support for native fish which could be very detrimental if cooperation cannot be achieved between sport fishing advocates and native fish advocates.

The Colorado River Delta and Upper Gulf Ecosystem

While the LCR MSCP stops at the Mexican border, there has been considerable attention paid by scientists and environmental groups in recent years to the rest of the ecosystem in Mexico. The Colorado River delta was once one of the most biologically significant wetlands in North America, home to a multitude of species of plants, birds, waterfowl, and animals. Once the main stem dams were built, however, the delta lost its primary source of water, nutrients and silt the river once generously provided with its spring flows, and has steadily deteriorated ever since.

Historically, the upper gulf tidal area, with its mix of freshwater and salt water, provided important spawning and nursery habitat for shrimp, fish and other species in the upper gulf food chain. The vast salt marsh wetlands and cottonwood-willow bosques observed by Aldo Leopold in the 1920s are mostly gone, with only remnants remaining, supplied by agricultural run off and a few freshwater springs. In the upper gulf, the once prolific totoaba, a highly prized commercial and sport fish, is nearly extinct, as is the vaquita, the world's smallest porpoise and most rare mammal. Once thriving shrimp, commercial, and sport fisheries have steadily declined, but noticeably improved when flood waters reached the gulf, such as in 1983-88, when millions of acre-feet of water was spilled from upstream reservoirs and revitalized wetlands such as the Laguna Salada. The Gila River floods in 1993 produced similar results.

In 1993, Mexico designated the delta and upper gulf as a Biosphere Reserve and has now implemented a management plan to protect and restore its marine and other resources and the local economies dependent on these resources. Many conservation organizations, scientists, government officials, and citizens groups in Baja and Sonora have become actively involved in discussions about the restoration potential of the ecosystem. Some 250,000 hectares of the delta is still undeveloped and parts could be restored if water is available. In addition, NAFTA has raised the promise of environmental action on this part of the border. The delta is also part of the important Pacific Flyway for migratory waterfowl. Large numbers of these and other migrating birds depend on the remaining wetlands, raising the potential of significant recreational, economic, and environmental benefits for the area if restoration of other wetlands, such as the Laguna Salada, can occur.

The revival of the Cienega de Santa Clara has demonstrated that these wetlands can be restored if water is made available. The Cienega is now prime habitat for a number of species, including a significant percentage of the endangered Yuma Clapper Rail population. This wetland now measures some 6,000 acres (2,428 hectares) as a result of receiving approximately 130,000 af/ yr of drainage water from the Wellton-Mohawk Irrigation Project that is bypassed to the delta through the Main Outlet Drain Extension (MODE), constructed by the BOR as part of the

1974 Colorado River Basin Salinity Control Act (CRBSCA). The Wellton-Mohawk water is too saline to meet treaty standards and is not, therefore, counted toward Mexico's entitlement. Under the CRBSCA, the Wellton-Mohawk water would be desalinated and 68,000 af delivered to the Northerly International Boundary (NIB) of Mexico in the river. Since the YDP has not operated since operationally tested when completed, all the Wellton-Mohawk water has been diverted to the Cienega. If, however, the YDP is operated at full capacity, a substantial portion of the water supply to the Cienega will be cut off unless replaced by other sources. The impact of the various operational scenarios for the YDP on the wetlands have not been established.

Scientists and environmental groups on both sides of the border are concerned about preserving this valuable wetland and considering what other restoration is possible in the delta area. Recent reports (Pacific Institute, 1996; Glenn *et al.*, 1996) have focused on the importance of these wetlands and the connection between the health of the delta-upper gulf ecosystem and the river. While it is unrealistic to restore this ecosystem to its pre-dam status, the potential for some restoration and for protecting what is left are evolving environmental issues in both countries. Conservation groups such as Environmental Defense Fund, Conservation International, Pronatura, and the Southwest Center for Biodiversity have been developing information and exploring alternatives informally with scientists and other experts. The questions to be answered are: what is possible, with what water, from what source, and at what cost? Is there water within the system that could be made available for these purposes, including municipal wastewater, agricultural return flows, flood flows, or other sources? The answers aren't so obvious. It is an extremely complicated issue, with an international treaty involved and Lower Basin and Mexican water users intent on using every acre-foot of Colorado River water available. Yet it is an issue that cannot be ignored and will require discussion and action on a binational level.

Glen Canyon Dam

On October 9, 1996, Secretary Babbitt signed the Record of Decision (ROD) for the operation of Glen Canyon Dam, a significant milestone in a long process that began in 1989 with the decision by Secretary Lujan to establish an interim flow regime and prepare an Environmental Impact Statement (EIS) to re-evaluate dam operations. In 1992, the Grand Canyon Protection Act became law, which mandated the EIS and operation of the dam to protect these downstream resource and cultural values. An extensive public process followed and over 30,000 comments were received on the Draft EIS. The purpose of the EIS was to evaluate options to minimize adverse impacts on the downstream environment and cultural interests in Glen and Grand Canyons. At stake were competing interests for recreation, Native American cultural interests, hydropower, sport fishing and protecting the natural resources of the Grand Canyon.

The Final EIS, as approved by the Secretary, implements the "modified low fluctuating flow alternative," which also incorporates periodic beach-habitat

building flows (high releases for short duration) to rebuild sandbars, deposit nutrients and restore backwater channels. The Final EIS took over five years and nearly $60 million, paid by power users, to complete. It has changed the way a major federal dam in the West will be operated to alleviate some of the negative impacts downstream. As a result, about one third of the peaking capacity of the power plant has been idled, which reduces the revenue producing capacity of this facility significantly.

During the EIS process, the FWS issued a draft Biological Opinion stating that the preferred alternative was unacceptable and would jeopardize the razorback sucker and humpback chub. The FWS preferred a "seasonally adjusted flow" for these fish. These flows will be studied as a part of the adaptive management process to determine what will best protect the fish. Other issues that remain are temperature control modifications (should the water be warmed up to help native fish) and sediment transport (should expensive modifications be made to transport sediment downstream).

In March of 1996, a simulated flood release, or "spike flow" as it is commonly called, of 45,000 cfs (about 50 percent of a normal flood) was agreed to by the states and the Secretary in the 1996 Annual Operating Plan. The purpose of the spike flow was to move sediment within the system to rebuild beaches and sand bars and remove exotic vegetation. Since construction of Glen Canyon Dam, much of the historic sediment supply has been trapped, although the Paria, the Little Colorado, and other tributaries still contribute some. It was estimated that the spike flow would double the sand transport capability of the river. The experiment was pronounced a success, although monitoring over time will produce a more scientific analysis.[20] It is anticipated that additional periodic flushing flows will be recommended in the future, particularly when the reservoirs are full, but this remains a controversial issue as power users do not want to see a precedent established whereby water is bypassed around the power plant and could challenge its legality.

In perspective, the Glen Canyon EIS and environmental studies process should be analyzed for what can be done and what should not be done in terms of "lessons learned" (Gold and Jensen, 1996). Environmentalists are pleased; this is indeed a major precedent as to what might be done to re-operate a major federal reclamation

[20] According to the *New York Times*, "The scientific papers now emerging show that the flood heightened and slightly widened existing sandbars, built scores of new camping beaches, liberated large quantities of nutrients and created 20 percent more backwater area for spawning fish. No endangered species were significantly harmed, it was found. Nor was the trout fishery, although some experts are unsure what would happen to it if floods became routine. No archeological sites were damaged; indeed, some were actually protected from erosion damage by a new blanket of sediment. But the sandbars and beaches were found to be eroding not long after the flood, and higher everyday water releases made necessary by the heavy runoff of melting snow rendered the backwaters unusable for spawning. Non-native fish species and large, invading shoreline plants were scarcely affected" (Stevens, 1997).

dam. However, the fact that it involved the Grand Canyon National Park, enjoyed bipartisan support, and Congress passed a law to deal with the issue were significant factors. Second, it is a classic example of how science can be brought to bear on a natural resource management issue. While the scientific studies were extremely costly, as critics are quick to point out, scientists need to stay involved over the long term as part of the adaptive management process. The results could have significant influence on future federal policy for dam operations in the West. Finally, the process was long, tedious, and contentious at times, as a result of involving all interest groups with many conflicting agendas. Such broad-based, inclusive decision making processes are cumbersome and take time, but also may be the only way to get it done.

A 26-member Adaptive Management Work Group has been appointed by the Secretary as an advisory committee to facilitate the adaptive management process and oversee the long range monitoring and research that will continue. The Secretary's designee will chair the Adaptive Management Work Group, which includes conservation groups, recreational interests, power purchasers, the seven basin states, and the 12 cooperating federal and state agencies and tribes.

Salinity Control

Introduction

The salinity of the Colorado River, and to a lesser extent salt loading, has fluctuated significantly over the period of record (1941-1995). Salinity concentration is generally inversely proportional to flow rate, in that it decreases in periods of high flows and increases during periods of low flow, as illustrated in Figure 14. While high runoff and flood control releases have helped keep the river within standards within recent years and Congress has taken a series of actions to control salinity, salinity levels have had significant domestic and international impacts in the Colorado River basin.

Human development shares the responsibility about equally with nature for the levels of salinity that occur in the Colorado River. As seen in the percentages below, nearly half the salt is from natural sources:[21]

- Natural (saline springs, erosion of saline geologic formations, and runoff): 47%
- Irrigation Return Flow: 37%
- Reservoir evaporation and phreatophyte use: 12%
- Municipal and Industrial: 1%

[21] 1996 Triennial Review Report, Colorado River Basin Salinity Control Forum.

- Out-of-Basin Exports: 3%

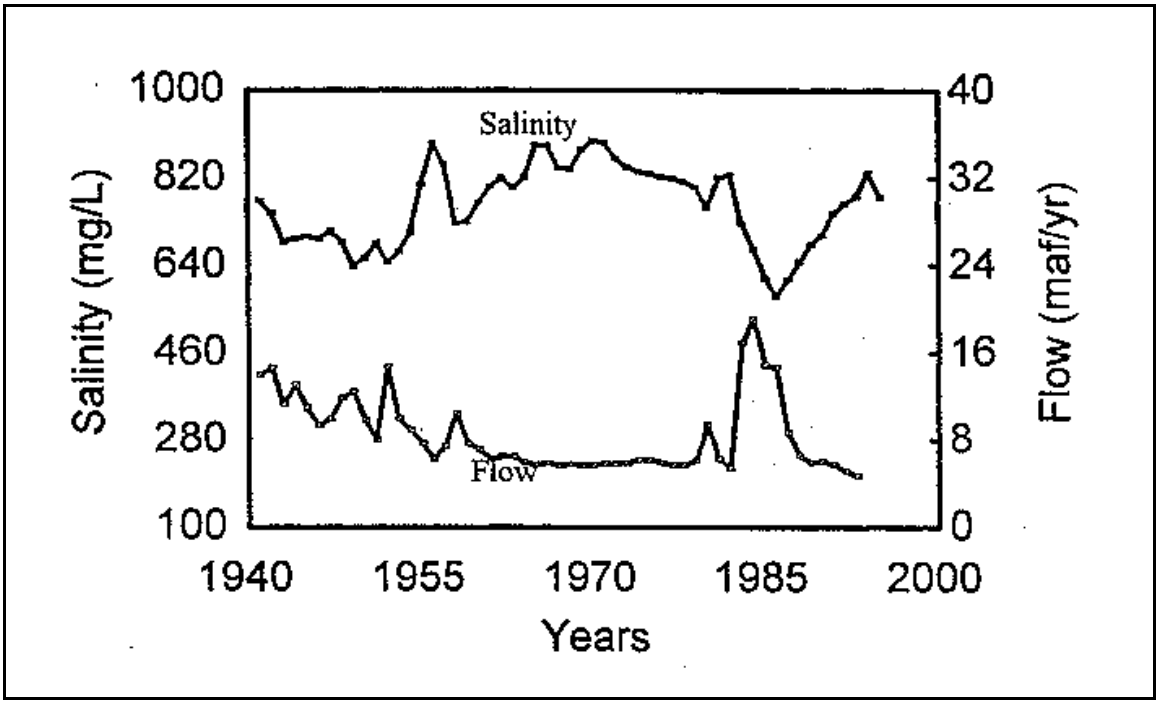

Figure 14.—Salinity vs. flow at Imperial Dam. (Source: CRBSCF, 1996).

Minute No. 242

In 1964, salinity became an international issue when the Mexican government complained that deliveries of Colorado River water with salt concentrations of 2,000 ppm were affecting their ability to grow crops and asserted that this was in violation of the 1944 Mexican Water Treaty. Salinity became a major problem for Mexican agriculture in the Mexicali Valley after the 75,000-acre Wellton-Mohawk Irrigation District was developed in southern Arizona and the filling of Lake Powell reduced flows in the river. After ten years of negotiations, Mexico and the United States signed Minute No. 242 to the Treaty in 1974 which established salinity standards for water delivered upstream of Morelos Dam at no more than 115 ppm plus or minus 30 ppm over the annual average salinity of water arriving at Imperial Dam. Approximately 140,000 af of water could continue to be delivered to the SIB at substantially the same historic salinity level.

The Salinity Control Forum

In 1972, Congress enacted amendments to the Clean Water Act in P.L. 92-500 which required the states to adopt, with EPA approval, basin-wide salinity standards

based on numeric criteria. The Act also required a triennial review to assess whether the standards were being met. The standards adopted and approved by EPA and which are in effect today are:

- Hoover Dam: 723 mg/l[22]
- Parker Dam: 747 mg/l
- Imperial Dam: 879 mg/l

The Colorado River Basin Salinity Control Forum (CRBSCF) was established by the basin states in 1974 to develop a basin-wide salinity control imple-mentation plan. The goal of the implementation plan is to maintain the salinity levels at or below these 1972 levels and to offset the effects of water development on salinity. The most recent Triennial Review Report (CRBSCF, 1996) estimates the amount of salts that would need to be removed by 2015, as well as with full development of compact apportion-ments, to comply with the standards. It is estimated that 1.48 million tons of salt will need to be removed annually to meet the standards in 2015 and 1.8 million tons of salt a year will have to be removed at full development. The implementation plan is predicated on an average annual water supply to the basin of 15 maf. The standards can be exceeded on a temporary basis and are flow-weighted average levels for the calendar year; the amount of water in the system and runoff variations have a significant impact on salinity levels and can cause salinity at Imperial Dam to fluctuate by as much as 450 mg/l.

Salinity Control Programs

In 1974, Congress enacted the CRBSCA in response to Mexico's concerns and to implement Minute No. 242 of the Mexican Water Treaty. Title II of the CRBSCA authorized four salinity control units in the Upper Basin and studies of a number of others to improve irrigation efficiency, to reduce leaching of salts and dispose of natural salt sources through evaporation and other processes.

A variety of salinity control programs have been implemented in the Colorado River basin. Current and potential projects and their associated removal rates are identified in Table 8. The contribution column is the tons per year of salt that is being added to the Colorado River as a result of the

[22] 1 mg/l is equivalent to 1 ppm.

Table 8.—Salinity control projects in the Colorado River Basin

Source	Contribution (tons/yr)	Current removal (tons/yr)	Potential additional removal (tons/yr)
Grand Valley	580,000	198,000	92,600
Uinta Basin	450,000	83,600	48,700
Lower Gunnison	360,000	68,000	203,400
Dolores/McElmo Creek	119,000	34,000	35,000
Paradox Valley	205,000	128,000	52,000
Meeker Dome		48,000	
Las Vegas Wash		3,800	
Big Sandy River	164,000	24,600	28,300
Non-Point Sources (BLM)		25,000	49,600
Well Plugging (BLM)		8,400	5,620
San Juan/Hammond	1,000,000		27,700
Price/San Rafael	430,000		161,000
Unidentified BOR			178,600
Total		621,400	882,520

Source: CRBSCF, 1996. Specific information on various projects is provided in the 1996 Triennial Review Report.

project or geology in the vicinity of the project. The total identified contribution that full implementation of the salinity control projects could have on reducing the salt load is about 1.5 million tons per year, or an average of 67 mg/l more (measured below Hoover Dam) than the concentration would be with only the current salinity control measures in place in the year 2015. The Colorado River carries an average salt load of
9 million tons per year past Hoover Dam.

After the base flow concentration of salt reaches 500 mg/l, each additional ton of salt costs users an estimated $340. Based on this estimate, all of the treatment solutions implemented in salinity control projects are considered economically feasible. The Upper Basin salinity control projects have cost between $25 and $138 per ton of salt removed. Reducing salinity in the

agricultural sector has also resulted in lower water use, as the participating farmers have higher irrigation efficiencies. A secondary benefit of increased irrigation efficiency is lower fertilizer use.

Salinity control has also been implemented through the National Pollutant Discharge Elimination System (NPDES) permit program under the Clean Water Act. The implementation plan consists of placing effluent limitations on industrial and municipal discharges. The plan impacts direct or indirect discharges into the Lower Basin. The goal is to require industries applying for NPDES permits to have a "no-salt" return policy, except when it is deemed not to be practicable. Municipalities are allowed a net increase of 400 mg/l in salinity.

Salinity Control Funding

In 1995, Congress increased the appropriations authorization ceiling for the program by $75 million and authorized the Secretary of the Interior to implement a basin-wide program and initiate additional cost effective programs without specific Congressional approval.[23] The 1996 Farm Bill[24] consolidated the U.S. Department of Agriculture (USDA) Colorado River basin salinity program with several other programs intended to assist farmers with conservation improvements and authorized $200 million a year for the years of 1997-2002 for these programs. The USDA has not yet allocated this money among the various programs.

DOI program costs are now 70 percent federal and non-reimbursable and 30 percent reimbursable. However, none of the BLM's cost are reim-bursable. The Upper Basin may repay its share over a 50-year period with interest but the Lower Basin must pay its share in the year the cost was incurred. The USDA program requires at least a 25 percent non-federal cost share. The Lower Basin funds for salinity control are derived from a 2.5-mill levy on hydroelectric energy generation from the Hoover power plant.

Federal funding for salinity control projects has been decreasing in recent years. In the past three years, Congress has appropriated $77 million, of which the BOR received 70 percent, USDA 27 percent, and BLM 3 percent, although the CRBSCF had recommended a funding level of $138 million. Table 9 shows the drop in appropriations over the last decade. USDA funding has declined significantly in recent years, from $13.7 million in 1994 to $9.2 million in 1996. These sharp cuts in USDA funding, according to the 1996 Triennial Review Report, jeopardize "the ability of the Plan of

[23] P.L. 104-20.

[24] Federal Agricultural Improvement and Reform Act, P.L. 104-127.

Table 9.—Summary of Colorado River Basin Salinity Control Program funding for BOR, USDA, and BLM by Federal fiscal year since 1988

Federal fiscal year	BOR ($)	USDA ($)	BLM ($)
1988	20,783,000	3,804,000	500,000
1989	16,798,000	5,452,000	500,000
1990	14,185,000	10,341,000	700,000
1991	24,984,000	14,783,000	873,000
1992	34,566,000	14,783,000	873,000
1993	33,817,000	13,783,000	866,000
1994	32,962,000	13,783,000	800,000
1995	12,540,000	4,500,000	800,000
1996	8,205,000	9,161,000	800,000

Source: CRBSCF, 1996.

Implementation to be implemented in a manner that assures compliance with the numeric criteria" (CRBSCF, 1996). Some basin water interests are worried about the long-term success of the program to meet these water quality standards unless new funding sources are found to allow on-going and identified projects to be completed. As budgets for discretionary spending shrink even further in the next few years, the ability to meet the numeric standards in the future is in question.

In a Supplemental Report to the 1996 Triennial Review Report, the CRBSCF acknowledged that "for the first time... with the long term mean water supply in the system... flow-adjusted salinity concentrations in the river system presently exceed the numeric criteria" (CRBSCF, Supplemental Report, 1996).[25]

Economic Impacts

Increased salinity has major economic impacts throughout the Colorado River basin; total estimated costs to the economy are now approaching

[25] This information was provided to the author by the IID, which added in its comment letter that they do not believe that the goal of reducing salt loading by 1.48 million tons/yr is achievable due to the shortfall of funding and backlog of projects, and that as of 1995, the program had a shortfall of 418,000 tons in salt/yr reduction (IID, 1997).

$1 billion annually.[26] The agricultural sector is negatively impacted on both sides of the ledger. Salt buildup in the soil results in lower crop yields, which affects the income side of the ledger, and requires higher water use to leach the salts, which results in higher water and fertilizer costs. High levels of salinity also add costs to M&I users, from construction and operation costs of treatment facilities to corrosion damage and more frequent replacement of plumbing and water use appliances. Bottled water, which is more expensive than tap water, has experienced a marked increase in sales in parts of the Colorado River basin due to the high total dissolved solids (TDS) in Colorado River water.[27]

The salinity of the source water is also affecting the amount of reclaimed water for use in the Lower Basin states. Potable use and resultant wastewater treatment concentrates the salts. Regulatory agencies have placed restrictions on reuse or recharge of waters that exceed specified salinity levels. These levels will soon be reached in parts of California, and future use of effluent will require additional treatment to reduce the salinity of the effluent prior to reuse. The residents of Tucson, Arizona passed an initiative that rejected the use of CAP water as a potable water supply, unless it meets or exceeds the water quality of local groundwater, because of the damage it caused to water heaters and residential plumbing when CAP use was initiated by the city.

The San Diego area provides a good example of the economic impacts of high salinity levels. According to the SDCWA, wastewater salinity in the San Diego region has increased over the past decade due to increased total salinity present in imported Colorado River water to the return of historic TDS levels in the Colorado River and MWD practices relating to blending Colorado River water with less-saline state water project supplies. Salinity levels on the river reached historic low levels after the 1988 flood flows, and rose toward historic average levels in the decade since. During this time, MWD changed its blending practice to supply San Diego with a supply that was high in Colorado River water, and thus higher in TDS. During the summer of 1995, the average wastewater salinity concentration was 1,260 ppm, a 20 percent increase over 1986. Sustained salinity concentra-tions above 1,000 ppm are expected to curtail the reclaimed water market demand in the San Diego area due to potential long-term effects on plant growth and soil characteristics. Reclaimed water will have salinity levels greater than 1,000 ppm if the salinity of the potable water supply increases above 700 ppm. The salinity of Colorado River water has increased from a dry season average of 485 ppm in 1986 to over 700 ppm in 1994. One of
San Diego's solutions is to demineralize reclaimed water. A new 1-mgd facility will deliver 1,200 af/yr (to produce 4,000 af/yr of blended supply) at
a capital cost of approximately $3.5 million and annual operating costs of $0.3 million.

[26] Telephone conference with Jack Barnett, Executive Director, CRBSCF.

[27] In assessing water quality, TDS is a surrogate standard for salinity.

The Yuma Desalting Plant

Title I of the CRBSCA authorized construction of the YDP, the MODE canal to bypass Wellton-Mohawk water if the YDP was not operating, the construction of a wellfield near the border to supplement the flows to the river, a limitation of pumping within five miles of the border, the retirement of 10,000 acres of Wellton-Mohawk lands, and the lining of 49 miles of the Coachella Canal, which would reduce seepage by some 130,000 af and could be used to meet salinity control objectives for an interim period, until such time as BOR cannot meet California's water orders.

Completed in 1992, at a cost of $258 million, the YDP now sits idle, costing approximately $6.8 million per year to maintain in "ready-reserve" status. At full capacity, it is designed to produce 68,000 af of water per year with a TDS of 300 ppm at an annual O&M cost of approximately $25 million. This comes to approximately $370 per af for the water, which does not include capital costs. The Wellton-Mohawk water must first be pre-treated before desalinated, which adds to the cost. A periodic expense associated with YDP is the need to replace the reverse osmosis desalting membranes, which cost $18 million and take time to manufacture. The BOR has not included funds in its budget for this purpose and the longer the YDP sits idle, the more obsolescent the technology and the more expensive it becomes to bring it on line.[28]

The Yuma Area Office (YAO) of the BOR is currently analyzing options for the YDP, including possible markets for the water if the plant is operated at one-third capacity. At one-third capacity, the YAO estimates the price will be $515 per acre foot at the property line (a buyer must have a legal entitlement to use it and transport it to the place of use.) The city of Yuma has a right of first refusal on the water produced and is said to be looking for an industry to locate there that could use this water supply. Other ideas have ranged from piping the water to California to sending it to the Middle East by supertanker.

Current Mexican Concerns

As noted, about 140,000 af is currently delivered to the SIB as return flows from the Yuma Valley. The average annual salinity of this water since 1974 has been 1,500 ppm, which the U.S. views as acceptable under Minute
No. 242. The average annual salinity of the water delivered at the NIB has not exceeded 1,000 ppm since 1974 and the differential between the salinity of these waters and those arriving at Imperial Dam has been within the terms of Minute No. 242 (Ybarra, 1996). Mexico recently objected to the delivery of the SIB water, stating that the water quality causes reduced yields on 93,860 acres where it is used, causes soil deterioration and higher groundwater salinity, and is possibly

[28] If the YDP were required to operate in 1999, the YAO anticipates having only enough viable membranes to operate one-half of the YDP. However, these membranes may be able to be restored and reused, rather than replaced as previously thought.

contaminated with pesticides. Mexico maintains that the quality of this water has deteriorated over time and cannot be diluted enough to make it usable. Mexico has requested that the entire 1.5 maf be delivered at the NIB at Morelos Dam, which would require finding another 140,000 af from the river. At present, discussions are taking place to resolve this issue and the BOR is looking at scenarios to produce water in the 1,000 to 1,200 ppm range from other sources, including the Yuma-Mesa wellfield, operating the YDP, or a combination of the two.

Indian Water Rights

Introduction

Issues surrounding water allocation and management are of central importance to Indian tribes in the Colorado River basin. The major issues include: the trust responsibility of the federal government to protect Indian natural resources; the effects of decisions of a myriad of federal agencies on Indian land, such as endangered species regulation; quantifying remaining Indian water rights claims, including adjudications in state courts and negotiated settlements; distribution of hydropower revenues; whether reserved rights apply to groundwater as well as surface water; marketing of Indian water off-reservation; the creation of a tribal water bank and economic development bank; conflicts between states and Indian tribes over the management of water; increased Indian participation in decisions concerning water use and management; funding for infrastructure; a greater institutional presence for Indian tribes in the basin; and recognition of tribal sovereignty.

In the coming century, one of the most critical issues to be addressed will be how to integrate Indian water rights into the existing water management framework in the basin. While progress has been made in settling the claims of a number of Indian tribes, some tribes with major claims have not yet had their rights determined. And even those that have settled reserved rights claims have not been able, in most cases, to develop the water or achieve the full economic value of this resource through on reservation use or by off reservation leasing. How tribal water rights are quantified and utilized will have an enormous impact on future water management in the Colorado River basin.

Winters Rights

The cornerstone of Indian reserved rights is the *Winters* doctrine. This doctrine was first established in 1908 in *Winters v. United States* and later expanded in a series of cases. In the *Winters* case, the Supreme Court held that when land was withdrawn and reserved from the public domain for an Indian reservation, enough water to fulfill the purposes of the reservation was implicitly reserved. The water right is given a priority date from the time the reservation was established and, unlike state water rights, the right cannot be lost through non-use.

While Indian reserved rights were first recognized by the Supreme Court in the *Winters* case, they remained essentially unquantified in the Colorado River basin until 1963 when the Supreme Court decided *Arizona v. California*. In this landmark case, five Indian tribes along the main stem of the Colorado River were granted use of 905,496 acre-feet of annual water diversions from the Colorado River or the quantity of water necessary to supply the use required for the irrigation of 136,636, whichever is less. The standard for quantification used by the court to determine these rights was the Practicably Irrigable Acreage (PIA) standard. Under the PIA standard, Indian tribes are awarded enough water to irrigate all the practicably irrigable acreage on the reservation.

Indian Water Rights in the Colorado River Basin

Arizona v. California had significant long-term implications for water management in the Colorado River basin. First, this case put parameters on the *Winters* doctrine, parameters which could result in relatively large amounts of water for most Indian tribes. Second, this case placed Indian water rights squarely within the framework of western water law, not only by quantifying the rights, but also by holding that the Colorado River Indian Tribes were included in Arizona's apportionment. Finally, this landmark decision means that Indian water rights could no longer be ignored when making decisions about water allocation in Colorado River basin.

The inescapable fact is that Indian water rights have been largely ignored when decisions were made concerning water allocation and management. The Colorado River Compact, for example, divided the use of Colorado River water among the seven states in the Colorado River basin but virtually ignored the issue of Indian water rights claims to Colorado River water, with the exception of Article VII of the Compact, which states that nothing in the Compact shall be construed as affecting the obligation of the United States to Indian Tribes.

However, the decision in *Arizona v. California*, coupled with increased tribal activism beginning in the 1960s and 1970s, caused a number of Indian tribes to actively seek to quantify their water rights. In some cases, lawsuits were filed seeking to bar non-Indian water uses. Because most Indian water rights are senior, dating from the establishment of the reservation, non-Indian users who had appropriated water under state law became increasingly concerned about the possible displacement of their own water rights. Indian water rights were commonly characterized as the "sword of Damocles" hanging over the basin because of the uncertainty caused by such large claims to water, which, once quantified, could limit non-Indian uses of water. In fully-appropriated basins, for example, Indian claims could mean that non-Indian water users with junior rights would have to forgo water uses.

The most common method for determining the scope and priority of Indian water rights has been general stream adjudications in state court in which all the water rights to a river system, both Indian and non-Indian, are determined and assigned a priority date. The McCarran Amendment waives the United States' sovereign

immunity from suit in state court for purposes of its assertion of water rights both on its own behalf and on the behalf of Indian tribes. In some cases, such as the massive Gila River Adjudication and the Little Colorado River Adjudication in Arizona, both of which involve the water rights of a dozen Indian tribes, non-Indian water users initiated general adjudications in order to have Indian water rights quantified in state rather than federal courts, which they viewed as friendlier forums. In Arizona, this prompted a decade long legal battle over whether the adjudication was a fair and comprehensive process for determining tribal rights under the McCarran Amendment. The U.S. Supreme Court ruled that the Arizona state court general stream adjudication process was fair and comprehensive, and so long as the process remained fair and comprehensive, the Arizona courts could adjudicate the United States' and Tribes' water rights claims in the state. The United States and Tribes have again challenged the fairness of the adjudications based on amendments to the state adjudication law in 1994 which the United States and Tribes view as discriminatory. In addition to the sheer size of the general stream adjudications, these lawsuits have been part of the reason the Arizona adjudications have progressed so slowly.

Because of the length, expense and complexity of general stream adjudications, many parties began to question the efficiency, equity, and practicality of resolving these often complex disputes through protracted litigation in general stream adjudications. Attention in the Colorado River basin turned to negotiating settlements between the Indians and non Indian water users. These settlements usually require the approval of Congress, generally involve the states, DOI, the tribe and water users who seek to lessen the impact of the settlement of Indian claims on non-Indian water use. Negotiated settlements have provided alternative sources of water to settle the Indian claims, funding to develop water distribution systems, and some allow intrastate off-reservation leasing to lessen the impact of Indian uses of water on surrounding non-Indian water users.

Indian Settlements Within the Basin: Some Case Studies

In the past 19 years, there have been a number of settlements of Indian water rights in the basin that have been approved by Congress. Thirty-four Indian reservations are located within the Colorado River basin, with the status of their water claims ranging from quantified in court, quantified through negotiated settlements, or still unquantified. A number of tribes located outside of the boundaries of the basin, such as the Mescalero Indian Reservation in New Mexico, have traditional or aboriginal interests in the basin as well. Each of these 57 reservations have very different interests, needs, and desires concerning the management of the Colorado River.
Table 10 lists the settlements that have occurred in the basin and Table 11 lists the major remaining outstanding Indian water rights claims in the basin.

Ak-Chin Settlement.— The first negotiated settlement in the Colorado River Basin was approved by Congress in 1978 (and amended in 1984 and 1992) and

involved the water rights claims of the Ak-Chin Indian Community in Arizona. It was one of the few Indian settlements that was entirely federal funded. The settlement included an interim ground water supply from a new well field and a permanent supply of 85,000 af to be developed within 25 years. It was amended in 1982 to reduce the amount of the permanent supply, which would be available by 1988, and required the government to pay damages for failure to meet timely delivery. The Ak-Chin will receive 50,000 af of Colorado River water with a 1928 priority from an unused entitlement of the Gila Irrigation Project, at a cost to the federal government of about $27 million. The remainder of the settlement water will come from a 58,300 af CAP allocation, although if unused, some of this allocation will be available for other settlements or CAP use. In 1992, the Act was amended again to authorize some off reservation leasing of water in parts of central Arizona.

Tohono O'odham Settlement.— In 1982, Congress passed the Southern Arizona Water Rights Settlement Act (SAWRSA) to settle the water claims of the San Xavier District and part of the Schuk Toak District of the Tohono O'odham Nation. The Act provided for 76,000 af of settlement water, 37,000 of which would be supplied by the CAP, an additional 28,200 af of effluent from the City of Tucson effluent and another 10,000 af of ground-water pumped from the reservation. The federal government would fund the infrastructure to convey the water to the reservation and a $15 million trust fund was established to pay for on-reservation distribution systems. President Reagan vetoed the original bill because of the federal expense -- over $100 million -- but a revised bill was signed which included some local cost-sharing. The federal government was required to pay damages if water was not delivered to the tribe in ten years, which was later modified by an amendment which further delayed any damage payments. The implementation of the settlement is complicated by allottees who have refused to dismiss their claims.

Table 10.—Settlements of tribal water rights in the Colorado River Basin

Settlement	Indian tribe(s)	State	Quantity of entitlement (af/yr)	Date of settlement	References
Ak-Chin Water Rights Settlement	Ak-Chin Indian Community	AZ	85,000	1978 1984 1992	PL 95-328 PL 95-530 PL 102-497
Southern Arizona Water Rights Settlement	San Xavier & Schuk Toak Districts, Tohono O'odham Nation	AZ	66,000	1982 1992	PL 97-293 PL 102-497
Salt River Pima-Maricopa Indian Community Water Rights Settlement	Salt River Pima-Maricopa Indian Community	AZ	122,400	1988	PL 100-512
Colorado Ute Indian Water Rights Settlement	Southern Ute & Ute Mountain Ute Tribes	CO	70,000	1988	PL 100-585
Fort McDowell Indian Community Water Rights Settlement	Fort McDowell Indian Community	AZ	36,350	1990	PL 101-628
San Carlos Apache Tribe Water Rights Settlement	San Carlos Apache Tribe	AZ	77,435	1992	PL 102-575
Utah Ute Indian Water Rights Settlement	Northern Ute Tribe	UT	481,000	1992	PL 102-575
Jicarilla Apache Tribe Water Settlement[1]	Jicarilla Apache Tribe	NM	40,000	1992	PL 102-441

[1] This water is to be diverted from the San Juan system, including 6,500 af from the San Juan-Chama Project (letter from Jessica Aberly, Attorney for Jicarilla Tribe, April 17, 1997).
Source: Checchio and Colby (1993).

Table 11.— Outstanding Indian water rights claims in the Colorado River Basin

Reservation	State	Amount (acre-feet)[1]
Camp Verde	Arizona	6,599
Gila River	Arizona	1,599,252
Hopi	Arizona	140,406
Hualapai	Arizona	14,495
Navajo	Arizona	513,042 [2]
Pascua Yaqui	Arizona	3,520
Tohono O'odham	Arizona	650,000
Tonto Apache	Arizona	191
White Mt. Apache	Arizona	179,847
San Carlos	Arizona	Unknown[3]
Ute Mountain Ute/ Southern Ute	Colorado	80,000 [4]
Cocopah	Arizona	16,008 [5]
Quechan	California	57,330 [5]
Colorado River Indian Tribes	Arizona	21,000 + [5, 6]
Fort Mojave	California	12,087 [5, 7]

Sources: Whiteing, 1997; Hansen, 1997; Eden and Wallace, 1992; Checchio and Colby, 1993.

[1] Claim estimates are for annual demand and do not include fill or storage requirements. Also, in some cases, the claim may be the estimate of the federal government on behalf of a reservation.

[2] This number reflects claims only to the Little Colorado River in Arizona and does not include claims to the main stem Colorado in Arizona, or for the Little Colorado River in New Mexico or the San Juan Basin. The total claims could range from 2 million to 5 million af (Letter from Stanley Pollack, Navajo Nation, supra).

[3] The water rights claims of this tribe were partially settled through a negotiated settlement under which the Tribe received 77,435 acre-feet of water. Outstanding claims remain on the Gila and San Pedro rivers.

[4] The water rights claims of these two tribes were quantified in a negotiated settlement. However, currently, the only water supply is the Dolores Project in Colorado, which supplies about 25,000 acre-feet to the Ute Mountain Utes. The remainder of the claim for this tribe and the entire claim for the S. Mountain Utes is to be supplied from the proposed Animas-La Plata Project.

[5] MWD (1997) indicated that water rights claims related to the Colorado River, Fort Mojave, and Fort Yuma [now Cocopah and Quechan] Indian Reservations are outstanding in the respective amounts of 22,811; 12,003; and 67,097 acre-feet of diversions or the quantity necessary to irrigate 3,420; 1,858; and 10,181 acres, whichever is less.

[6] This amount is not yet settled and will depend on amount of acres,

[7] In addition, Fort Mojave has 129,767 acre-feet of water under existing *Arizona vs. California* decrees.

The Salt River Pima-Maricopa Indian Community Water Rights Settlement Act of 1988.— This very complex settlement involved seven municipalities, the Salt River Project (SRP), irrigation districts, the State of Arizona and the Indian Community. When Roosevelt Dam was built on the Salt River in 1911, as one of the nation's first reclamation projects, it essentially shut off the flow of the Salt River through the reservation. Since the Community was not included in the reclamation project's water allocations and was only able to irrigate about one third of its lands with groundwater and some surface water it received from SRP, litigation was filed in the 1970s. When the Gila Adjudication was filed, the U.S. claimed 190,000 af on behalf of the Community.

The eventual settlement provided the Community with 122,400 af of water from a number of different sources, involving a number of complicated exchanges in which the cities ended up with Colorado River water and the Community with SRP water, some CAP water, and developed groundwater. In the final package, the federal contribution was about $60 million, or about 58 percent according to one analysis (Starler and Maxey, 1989), although various valuations have been attributed to the federal and local shares. The settlement also included a trust fund for the needed infrastructure and rehabilitation of the existing system. One of the key issues was how to determine the value of the water contributed by the local entities to the

settlement; the cities set a value of $3,000 per af, but this was later adjusted to around $1,800 per af. Except for some limited leasing of 13,300 af of water to the 7 cities of Maricopa County for 99 years, the Act restricts off reservation uses.

The final settlement reflects a realistic understanding of the current need for substantial local contributions in Indian water settlements. It also reflects an understanding that litigation and the judiciary are not equipped to deal with the necessary complexities of reaching a solution that will work for all the interests at stake and that litigation risks must be factored into the equation in negotiated settlements.

The Colorado Ute Water Settlement Act of 1988.— The Ute Mountain Ute and Southern Ute Indian Reservations were set aside for the benefit of the Tribes in 1868. The two reservations together encompass 900,000 acres in the San Juan basin. After years of litigation initially in federal court and later in state court, in 1985 the Tribes entered into settlement negotiations with the United States, the States of Colorado, and New Mexico, and other non-Indian parties. The parties reached an agreement two years later in 1986. The 1986 settlement agreement is multifaceted, seeking to resolve all anticipated issues between the parties. The settlement of the Ute Tribes' claims has essentially four parts: (1) providing developed water supplies to the Ute Tribes though the Dolores Project and the ALP, an approximate combined total of 88,000 af; (2) recognition of the Tribes' legal entitlement to defined water rights in other streams; (3) state and federal endowment of a tribal development fund of $60.5 million, $20 million for the Southern Ute Indian Tribe, and $40.5 million for the Ute Mountain Ute Indian Tribe; and (4) detailed provisions for the administration of the tribal rights.

In 1988, Congress enacted legislation implementing the 1986 settlement agreement (P.L. 100-585). The ALP is the physical and political catalyst for the settlement. Under the terms of the settlement, the ALP is intended to provide the Ute Tribes with combined totals of 32,500 af/yr of M&I water and 29,700 af/yr of agricultural water. The 1988 settlement legislation provides an additional benefit in that the Ute Tribes are expressly exempted from paying any costs associated with the tribal water until that water is actually used.

Although the settlement became "final" in 1991 upon the entry of consent decrees in Colorado state court, which, among other things, required congressional appropriation of the full development funds, the Ute Tribes may revive their claims on the Animas and La Plata Rivers in the event that the facilities required to deliver water in accordance with the terms of the Agreement are not completed by the year 2000. Under the Agreement, the Ute Tribes are compelled the choose between litigating and water provided under the ALP by the year 2005.

Construction on the ALP has been held up by lawsuits and a jeopardy opinion issued by the FWS. Eventually, FWS cleared part of the project and seven years of research will help determine the future of the rest. The ALP is presently undergoing environmental compliance. The BOR completed the Supplemental EIS

in April 1996 pursuant to NEPA. In addition, Governor Romer of Colorado has convened meetings among the Ute Tribes, the other parties to the 1986 Settlement Agreement and the 1988 Settlement Act, and the ALP opponents to attempt resolution of the issues.

The State of Colorado would not agree to language in the 1988 Act implementing the 1986 settlement agreement authorizing out of state leasing of the Ute Tribe's Water rights on the basis that this is contrary to the LOR provisions that control use of state apportionments. A provision was included in the 1988 Act, however, which provides that any water marketed off reservation will be treated as a Colorado "state water right" for purposes of the LOR. Many of the basin have adamantly opposed interstate marketing of any Upper Basin apportionments and many other interests and states have been opposed to interstate marketing of Indian water rights. However, as discussed below, various Indian tribes, including the Ute Tribes, favor interstate marketing of water and have formally embraced this policy stance, as part of the Ten Tribes Coalition.

Implementing Indian Settlements

Some tribes that have received settlements have been unable to develop their water rights either from lack of funding or because of political problems or regulatory restraints such as the ESA. It is becoming increasingly difficult to turn paper water rights into wet water. The Utes, for example, are concerned that the fight over the ALP will jeopardize their settlement agreement, since the water to implement it would be delivered through that project. The Jicarilla Apaches have 40,000 af of water from the San Juan that faces environmental hurdles before it can be developed. As discussed, the Tohono O'odham Nation in southern Arizona is yet to realize any water from their 1982 settlement passed by Congress. The Utah Ute Indian Water Rights settlement is subject to a compact being worked out with the State of Utah. The proposed revision to the compact allocates 480,000 af to the Ute Indian Tribe for diversion and approximately 250,000 af for depletion. However, the original Ute Indian Compact of 1980 did not expressly provide for off-reservation use of water and in exchange for the state's consent to off-reservation use of water, and the receipt by the Tribe of federal monies, Utah is seeking a reduction in the allocation of water. Discussions are ongoing between the Tribe and the state concerning this issue.

The San Luis Rey Indian Water Settlement Act, which was approved by Congress in 1988, is stalled. The Settlement was to provide 16,000 af of water, conserved as the result of lining the All-American Canal, to the San Luis Rey Water Authority (SLRWA) at a discounted rate. This would in turn allow the five Indian bands of the SLRWA to release their claims against water users in San Diego County. The All-American Canal project, which is key to producing water to implement this settlement, is on hold and this project seems tied to resolution of other internal disagreements between California water users. During his speech to the CRWUA last December, Secretary Babbitt stated that "securing such a settlement is in my view key to advancing Colorado River issues of interest to the State of California."

Major Outstanding Claims

The Gila River Indian Community.— The Gila River Indian Community (GRIC) has one of the largest unresolved reserved water rights claims in the basin. The GRIC has a long history of agricultural use in the Gila and Salt River valleys in central Arizona. As the state was settled, however, upstream agricultural development intercepted much of their surface water supply and ground water supplies have been impacted by extensive pumping on adjacent irrigation districts.

The GRIC claims rights to approximately 1.5 maf and has been involved in negotiations for several years to settle these claims. A federal negotiating team recommended a settlement number of 650,000 af, of which 300,000 would come from the CAP. For CAP water to be acceptable, however, it must be affordable and funds must be available for distribution systems. The GRIC also wants controls placed on off-reservation pumping to protect their ground water supply. The Arizona Groundwater Act did not place pumping limits on agriculture in the Pinal County AMA adjacent to the reservation.

Part of the GRIC's claims involve the San Pedro River, a tributary to the Gila River that flows north from Mexico, which has been impacted by groundwater pumping around Sierra Vista and Fort Huachuca in southern Arizona. Tribal and other hydrologists believe that groundwater pumping there is capturing the river's subflow and has reduced historic flows to the reservation. This issue ended up in the Arizona Supreme Court, which upheld Arizona's bifurcated legal system for regulating groundwater and surface water, although after rehearing, an expanded test for determining subflow is now back before the Supreme Court. The DOI has been attempting to facilitate a settlement in the upper San Pedro sub-basin, which also involves protecting federal reserved instream flow rights to the BLM's San Pedro Riparian Conservation Area.

Navajo, Hopi, Zuni, and San Juan Southern Paiute Claims to the Little Colorado River.— The Navajo Nation and the Hopi Tribe have filed substantial claims in the Little Colorado River adjudication. In addition the Zuni Pueblo and San Juan Southern Paiute Tribe also have claims in this watershed. The tribes have been negotiating for several years with SRP, Arizona, DOI, and other interests, including Peabody Coal. A potential settlement has focused on building a pipeline from Lake Powell to bring water to the Navajo and Hopi reservations and to replace groundwater currently pumped from the Black Mesa by Peabody Coal for their coal slurry operation, which the Hopis believe is drying up their springs. The settlement water from Lake Powell could come out of Arizona's CAP allocation, although it would be diverted in the Upper Basin, which is an interesting twist. Major obstacles to the settlement include: how this expensive pipeline will be cost shared; problems related to the Hopi-Navajo land dispute; rights of way, and other issues. In addition, the Navajos have discussed the potential of off-reservation leasing , which may not be acceptable to the state and SRP. An Arizona judge is now attempting to facilitate a settlement (Arizona General Stream Adjudication, Office of the Special Master, 1997).

Navajo Claims to the San Juan River.— The Navajo Nation also asserts a claim to the San Juan River which is in excess of the entire New Mexico Compact allocation, based on its extensive "practicable irrigable acreage" in the basin and with a priority date of 1868.

When the NIIP was authorized, the Navajos agreed to share shortages in the San Juan River of NIIP water during droughts. New Mexico diverts an average of 110,000 af/yr of its Colorado River apportionment out of the San Juan Basin to the Rio Grande Basin through the San Juan-Chama Project. New Mexico supported the NIIP, which was designed to irrigate 110,630 acres with 508,000 af of San Juan water, in exchange for Navajo support for the San Juan Chama diversion project. As of 1993, only about 60,000 acres of the NIIP had been developed (Checchio and Colby, 1993) and cost concerns could result in its completion being delayed even longer or being downsized. The legislation does not treat this project as a settlement of any part of the Navajo reserved right claim. However, the shortage sharing provision in the law serves a similar purpose. In the event of a shortage, NIIP, the San Juan-Chama Project, and other contractors for the Navajo Reservoir supply will share the available supply. The Navajos and the State of New Mexico recently initiated discussions on the Navajo San Juan claims.

Other Recent Developments

In 1992, the Colorado River Basin Tribes Partnership (Ten Tribes) was created by ten of the Indian tribes located in the Colorado River basin. (The Ten Tribes Position Paper is included in Appendix D.) The purpose of this partnership is to protect and develop tribal water resources, in recognition of their common interests in the basin's water issues. While the Ten Tribes' priority is to obtain water rights for use on the reservations, many tribes also advocate off reservation marketing of water rights. They maintain that there should be no restrictions on marketing of Indian water rights off reservation or interstate, whether used or unused, if the tribes are to realize the full economic value of these resources. The Ten Tribes believe that marketing this water could help solve reallocation problems in the Lower Basin while preserving existing wildlife habitat on undeveloped lands and leaving some water in the river for endangered species.

One of the Ten Tribes' major concerns is the administration of the ESA and its impact on tribal interests. For example, the Navajo Nation strongly objected to the FWS Biological Opinion for Glen Canyon Dam because they did not believe the RPA does more to protect the humpback chub than the preferred alternative and it will increase costs to Navajo power customers. The tribes object to the lack of consultation by the FWS on endangered species actions, such as designation of critical habitat, and take the position that Section 7 of the ESA is in direct conflict with the Secretary's trust responsibilities to protect their water rights and that the burden to protect endangered fish falls more heavily on the tribes than on private interests or the states. They see the ESA as a new obstacle to obtaining full realization and development of tribal water resources. The Ten Tribes have

recommended that all Indian water rights be considered as part of the "environmental baseline" in biological opinions issued by the FWS.

Problems With Indian Settlements

In today's climate of fiscal restraint, it is no longer possible to obtain the same high priority or level of federal funding from the administration and Congress for Indian water rights settlements as was possible in the 1980s. DOI has developed new criteria for Indian settlements which substantially reduce the federal cost share. The bottom line is that the federal check book is no longer quite so available to pay a large part of the bill; states and non-Indian water users will have to contribute more if settlements are to completed.

The appropriate balance of state-water user/federal contributions is one of the most difficult issues facing negotiators and legislators in the Colorado River basin, as the Little Colorado negotiation is demonstrating. The Secretary has a fiduciary responsibility to pursue resolution of these claims and to redress the failure of the federal government to protect Indian water rights since the *Winters* decision. Yet there is considerable dissatisfaction with the level of priority given Indian settlement funding by the Clinton Administration. What priority and support Congress and the Administration give to Indian water settlements in the next few years will be critically important in determining if these claims can be settled out of court.

Marketing

With the end of the era of big federal water projects, many tribes in the Colorado River basin may have lost the opportunity to acquire substantial federal funds to build projects to develop their water rights. The question now is whether these tribes will be able to realize the full value of their water resources, as they do for oil and gas, by leasing these rights for use off reservation, either intrastate or interstate.

There are substantial legal and political issues involved in off-reservation leasing of tribal apportionments, and to date legislation implementing settlement agreements has addressed this issue on a case by case basis. No interstate leasing of Indian water rights in the basin has been approved and there is strong political opposition to it for the simple reason that non-Indian interests can now use this water without paying for it.

The BOR draft regulations for the Lower Basin made a strong case for the legality of tribal leasing of water off-reservation. However, states and water users disagree with this position and argue that tribal water rights that are leased for out of state use deprive the state of its full apportionment under the Compact and are prohibited under the LOR. States want absolute control over their apportionments and this includes Indian water. State sovereignty is on a collision course with tribal

sovereignty and possibly the Commerce Clause of the Constitution, as articulated by the Supreme Court in the *Sporhase v. Nebraska* case.[29] The LOR has been read both ways. And the Secretary is in the middle, as fiduciary to the tribes.

Some experts have advocated that legislation is the preferable alternative, urging enactment of specific legislation to authorize leasing of Indian water rights (Getches, 1993). It also appears that the Secretary may be taking a more "go slow" approach as the next draft of regulations for the Lower Basin is expected to limit Indian water marketing to water with a history of beneficial use, and possibly only that which can be approved in the context of the Arizona Water Bank, which substantially narrows the opportunities. However, to require a tribe to develop expensive and possibly unwarranted agriculture on the reservation in order to lease the beneficial use value is a terribly inefficient use of resources.

The Ten Tribes plan takes a conciliatory approach; they proposed to work with the states to achieve consensus and not undermine state apportion-ments. Under their proposal, any lease would be subject to a marketing
plan developed by consensus with the seven basin states, the Ten Tribes Partnership, and the Secretary. If the tribes are willing to submit to some kind of joint authority over water leasing with the states and Secretary, as the Ten Tribes proposal seems to indicate, this would provide the states with a say in how Indian apportionments are used. Fair procedures need to be worked out in any new rules which will allow for Indian marketing on a par with non- Indian marketing. Some equitable resolution of this issue is needed to avoid more conflict in the future and to allow Indian communities to share in the economic value of Colorado River basin water. As stated by David Getches: "Denying tribes the right to negotiate arrangements for off reservation water uses robs them of much of the value of their water and effectively limits the quantities of water to which they have rights" (Getches, 1993).

Dolores River Watershed

The Dolores River watershed, in southwestern Colorado, provides a case study as to how consensus can be reached when conflict is high over a water resource issue;[30] how the federal government, local water users, states, and Indian tribes can work together to solve a water resource problem; how to manage a resource involving

[29] Many states and water attorneys believe that approval by Congress of the Colorado River Compact immunizes state compact rights from potential Commerce Clause arguments. See, *Intake Water Co. v. Yellowstone River Compact Commission* [769 F. 2d 568, review denied 476 U.S. 1163 (1986)]

[30] In BLM Colorado's view: "It is mistaken to characterize the negotiations on the Dolores River as a 'consensus' process that has 'solved' a water resource problem. Rather, it should be labeled as a productive 'negotiation' process that has 'partially addressed' a major resource problem, with the prospect of even greater results" (BLM, 1997).

multiple jurisdictions; and what changes occur as traditional water users are faced with accommodating other uses such as recreation and protection of fish habitat.

Background Information

From its headwaters in the San Juan Mountains to its intersection with the Colorado River near Cisco, Utah, the Dolores River flows some 200 miles. The river courses across a range of biotic communities, from alpine grasslands to montane forest areas to Sonoran desert lands. Along the way, the River provides water for municipal, industrial and agricultural uses of both Indian and non-Indian for a trout fishery. The Dolores River below McPhee Dam in southwestern Colorado, is a popular fishing spot, drawing several thousands of anglers each year from Colorado and from other Western states. A 12-mile stretch from McPhee Dam down to the Bradfield Bridge was recently named one of the 50 best trout streams in America by *Trout Magazine*. White water boating is also very popular on the Dolores River downstream from McPhee Dam and relies entirely on releases from McPhee Reservoir managed to avoid spills.

The Dolores River watershed encompasses approximately 4,620 square miles in southwestern Colorado and southeastern Utah (Figure 15). Most of the lands within the watershed are owned by the BLM or USFS.[31] The Dolores River, including the San Miguel and its tributaries, discharged approxi-mately 544,000 af/yr to the Colorado River. Beginning in the late nineteenth century, out-of-basin diversions by the Montezuma Valley Irrigation Company (MVIC) reduced the flow of the Dolores River to near zero during the irrigation season, July through October. With the 1987 completion of McPhee Reservoir, the primary storage facility for the BOR's Dolores Project, 69 percent of the historic flow of the Dolores River is depleted annually (BLM, 1990), as opposed to 39 percent before Project construction.

[31] Relatively rapid population growth is taking place near larger towns such as Telluride, which has nearly doubled in size. Population in the municipal areas served by the Dolores Project is increasing, but not at the rate of Telluride.

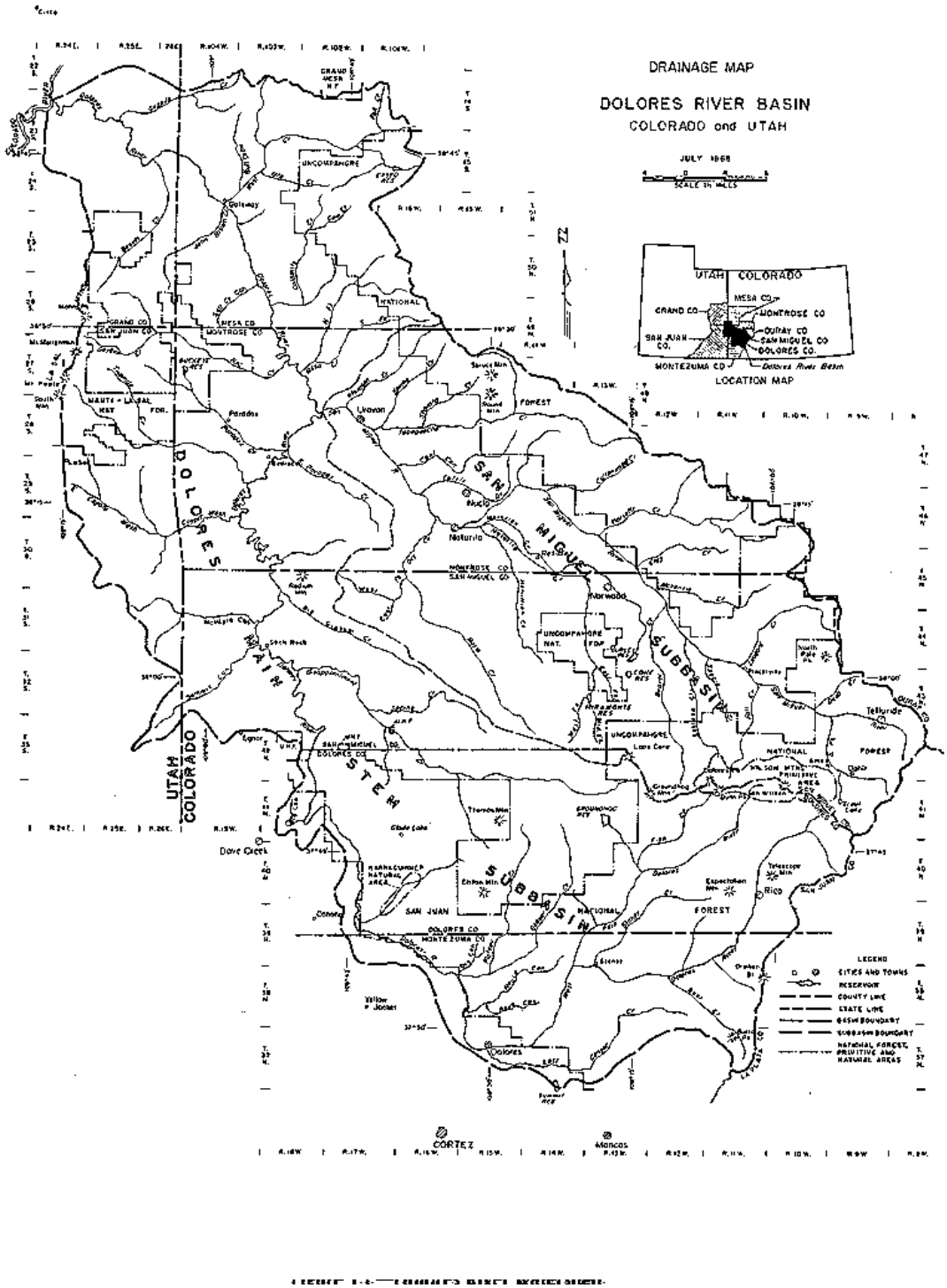

Figure 15.—Dolores River watershed.

The Dolores Project

The major purpose of the Dolores Project is to store and regulate flows of the Dolores River for irrigation, down stream fish and wildlife enhancement and M&I purposes. Other purposes of the Project are to provide flatwater recreational facilities in McPhee Reservoir, hydroelectric power generation, salinity control, fish and wildlife enhancement and mitigation measures, area economic development, and cultural resources and other mitigation. To achieve the purposes of the Project required a multi-agency effort. The BOR purchased 10,000 acres of land adjacent to and downstream of McPhee Reservoir and the associated water rights to protect the area around McPhee Reservoir from development with the senior downstream water rights deeded to the Colorado Division of Wildlife (CDOW). Lands to the east of the reservoir were turned over to the USFS to manage. Lands to the west of the reservoir and 300 acres below Bradfield Bridge were turned over to the BLM to manage. The BLM has historically managed most of the section of the River below Bradfield Bridge. Lands turned over to CDOW, BLM, and USFS are to be managed for recreation and Dolores Project wildlife mitigation efforts, including a sport fishery and river access. BOR built and the BLM operates a cultural center concerning the extensive Anasazi Indians ruins and archeological sites found in the area, some of which were partially inundated by the reservoir or disturbed by construction of Project delivery systems and roads.

Water rights for the Project are in the name of the Dolores Water Conservancy District (DWCD), the repayment entity established under Colorado law for the Dolores Project. The MVIC holds senior rights for non-project water for irrigation use in the Montezuma Valley (outside the Dolores River Watershed). Average annual diversions from the Dolores River pursuant to MVIC's rights, together with supplemental deliveries of Project water, were projected in the Definite Plan Report (DPR) to be these approximately 143,000 af (Sheftel, 1997).

The average annual flow into McPhee Reservoir is 352,900 af (BLM, 1990). The reservoir has an active capacity of 229,000 af and a total capacity of 381,000 af. The average annual amount stored in the reservoir is 126,000 af; approximately 70,000 af of the average annual flow spills though managed releases to avoid a spill and continues downstream.

The Dolores Project designed to supply an average annual of 90,900 af for irrigation, 8,700 af for M&I use, and 25,400 af for downstream fish and wildlife purposes. The Project will provide irrigation water for 61,600 acres of land, including full-service irrigation water for 27,920 acres in the Dove Creek area and 7,500 acres on the Ute Mountain Ute Indian Reservation, and supplemental irrigation water for 26,300 acres served by the MVIC. Total demand for project irrigation water ranges from 78,500 af during wet years (when the MVIC lands have a full supply of non-Project water) to 139,000 af during dry years (when MVIC non-project water is in short

supply). M&I uses are not yet fully developed,[32] but the supply is expected to be sufficient to meet future needs.

The Dolores Project now provides a dependable supply of water and therefore has stabilized the economies of Montezuma and Dolores Counties, including the Ute Mountain Ute Tribe. There are many benefits , some measurable and some not. Sales of agricultural products directly attributable to the Dolores Project totaled $11.7 million in 1996. Remarkable increases in land and water values are also measurable. Not easily measurable are the benefits from archaeological mitigation (Anasazi Heritage Center) and a dependable source of water for municipal and recreational uses.

Water Shortages and Protection of the Trout Fishery

The original operating criteria for McPhee Reservoir were specified in the Final Environmental Statement (FES) and DPR, published in 1977. Based upon records from 1928 to 1974, the FES/DPR indicated that and average 25,400 af/yr of storage was sufficient to supply flows to support the trout fishery downstream of McPhee Dam, designed to become a major sport fishery based on stocking and/or limitations on fishery methods and catch and release requirements. Releases from McPhee Dam were determined each year based upon how much water was in storage in McPhee Reservoir and how much snowpack was available in the watershed. Based upon these two totals, the year was declared dry, normal, or wet on March 1 of each year. If the river were declared dry, for the next 365 days, 20 cfs would be released to support the downstream fishery. In a normal year, 50 cfs would be released and in wet years, 78 cfs.

The operating regime for McPhee Reservoir came under fire when the first dry year was declared (1990) and the flow rate was changed from 78 cfs to 20 cfs on March 1. Biologists soon realized that the releases were not sufficient to sustain the downstream trout fishery and Trout Unlimited (TU), with support from CDOW, appealed to the BOR for increased flows. When the BOR ordered additional releases for the fishery, the DWCD challenged the BOR on the grounds that the BOR lacked the authority to order the additional releases because they were not specified DPR or FES and Project water was already otherwise allocated. In June, in a short-term DWCD agreement with BOR, flows were increased through the summer.

Despite this agreement, the low flows during 1990 caused significant losses to the trout fishery. To avoid a repeat of such losses, extensive negotiations began between BOR and the DWCD, with the input from TU, other management agencies and water users. In October 1990, the group established a three year interim operating agreement (IOA) in which the 20/50/78 cfs schedule was discarded in favor of the release of an average annual pool of water ("pool" management) of 25,400 af,

[32] Of the 8,700 af allocated for M&I purposes, approximately 80 percent is currently unused.

together with up to 3,900 af of downstream water rights senior to the Project, and an additional 3,900 af supplied during IOA period by the District.

TU and CDOW argued that the fishery pool should be increased to 36,500 af and challenged the original FES/DPR criteria. In response, during the IOA period, the BOR revised its assumption in its hydrological study and determined that the original average annual reservation of water for the fishery in the FES /DPR was short by 3,900 acre-feet. Negotiations began again between the BOR and the DWCD to permanently increase the pool of water to 29,300 af.

To increase the pool, the BOR requested a supply of 3,900 af from local entities. The MVIC suggested that it had an excess of 3,900 af water to sell to the BOR for $6 million. However, stockholders of the MVIC opposed the sale of the water, arguing it would cause a shortage for the company. Meanwhile, the City of Cortez offered to supply approximately, 3,900 af from its Dolores Project allocation for which Cortez, in turn, would be forgiven part of its repayment debt to the District, an estimated $500,000 annually. While the MVIC Board of Directors tried in earnest to convince its stockholders of the benefits of the sale, the new Clinton administration rescinded all offers.

In February 1994, the BOR proposed that the DWCD release additional flows to support the fishery, but would not waive what was ultimately the DWCD's repayment obligation to BOR for this additional water. This decision met with vocal opposition from local interests. The general sentiment was that the BOR was not taking responsibility for seeking to reallocate Project water to make up for its mistakenly low calculation of average annual fishery reservation in the FES/DPR when this water was already allocated others. Further, the regional office of the BOR requested $42 million to solve any remaining issues related to the Dolores Project, but only $21 million was authorized. Although local interests generally felt betrayed by the BOR Washington, DC office, they found common ground among themselves and a local coalition was established.

In 1996, an environmental assessment (EA) was completed which evaluated a permanent operating regime for fish flows. The operating criteria were modified to release a managed pool of up to an average 29,300 af to provide seasonally fluctuating downstream flows (comprised of a pool of the 25,400 af reserved in the FES/DPR and up to 3,900 af of senior downstream water rights). In addition, the EA proposed that additional flows of 7,200 af/yr
be acquired for fish and wildlife purposes, bringing the total releases to 36,500 af/yr.

To permanently increase the pool to up to 33,200 af/yr, the BOR purchased 3,900 af/yr from the DWCD. In addition, BOR leased 3,300 af/yr from the Ute Mountain Ute Tribe to reach a total average annual release of up to 36,500 af. The Ute Mountain Ute lease is for up to five years (until water year 2000) or until tribal lands are developed for irrigation. While the current arrangement provides an adequate supply for fish in the near term, CDOW biologists believe a permanent water source needs to be identified and acquired. When the lease ends, the

cooperation interested parties will need to acquire, lease, or otherwise obtain the 3,300 af increment.

Diverse interests have joined together to solve this problem, including the BOR, the DWCD, BLM, CDOW, FWS, USFS, irrigators and other water users, and TU. While the BOR has offered $371,000 as its cost share,[33] the cost to acquire a permanent water source has been estimated by others to cost from $2 million to $10 million. Stakeholders are considering different strategies to secure the necessary funding, including setting up an escrow account with a non-profit organization. By channeling funds to this account, agencies may have more flexibility in cost sharing efforts and applying for grants. For example, by demonstrating potential sellers and the availability of collaborative funding, agencies may have more success securing funds from programs such as the Land and Water Conservation Fund. As monies accumulate in the account, the stakeholders will seek to obtain water as opportunities arise.

Lessons Learned

Consensus has been reached on a number of issues in the Dolores River Watershed and a working coalition of stakeholders has formed. Several lessons may be derived from the process:

- **Involve all affected interests early in the conflict.**

An extended public participation process must be established as early as possible in conflicts over water. All interests must be involved at the earliest stages of problem identification, data gathering, and data analysis. If the initial alternatives (for reservoir management in this case) are determined only by agency officials and traditional water users, conflicts can develop. In the case of the Dolores, fishery and recreational interests did not initially feel that they were fully included in the process. It took several years to establish a common ground between these interests. It is only in recent years that these interests have developed a good working relationship. The inclusion of all interests at the earliest stages of a conflict can eliminate distrust among parties and decrease the time needed to resolve a conflict. Further, involving a broad spectrum of local residents and resource users increases the likelihood the decision will be accepted and maintained over the long term.

[33] MVIC stock, which is priced at $900 per share, entities the shareholder to 4 af/yr of water from the Dolores River. BOR assumed that 825 shares of this stock could be purchased to meet the 3,300 af increment at a total price of $742,500. Based on a 50% cost share, BOR offered half of $742,500, or $371,000. In practice, however, local irrigators rarely trade shares of the stock and when they do, market forces can drive the price up to $1,500 to$2000 per share (Sheftel, 1997). Local water users do not believe that as many as 825 shares of the stock will be traded in the foreseeable future.

- **Allow a long time period, especially when conflicts are entrenched.**

When competing water uses are involved, particularly between newer uses of water such as recreation and traditional uses such as agriculture, it can take a great deal of time for the parties to reach common ground. While in the Dolores River watershed there was a common understanding of the issues, it took seven years for the divers stakeholders to formulate solutions. Example: The stakeholders recognized from the beginning that the repayment contract between the DWCD and the BOR was the governing factor. It was recognized that since all of the agricultural and municipal uses of the reservoir are trans-basin diversions, without return flows from the Dolores River, any additional water for fish and wildlife habitat below McPhee Reservoir would come from another user's allocation. Therefore, irrigators had to be convinced the short-term damage (the burden of greater shortage during drought periods) was outweighed by the long-term benefit of a cooperative environmental/recreational community. Once this understanding was reached, a new operating regime for the dam was negotiated. But until all parties developed some measure of trust in each other, no solutions could be reached.

- **Let solutions generate from the local interests.**

The traditional public participation model in water resource management generally allows local residents to choose from alternatives developed by agency officials. Further, many decisions tend to be made at the national level of an agency, such as the BOR. In the Dolores River watershed, conflict over water management issues rose when the national office of BOR made decisions about the basin without input from basin residents. Solutions to problems should not be unilaterally formulated and imposed by agency officials. They must be crafted with the participation of local residents if consensus is to be achieved.

- **Local leadership is essential.**

In many high profile conflicts over water, personnel at the national level get involved, whether it is a federal agency or an environmental group. However, the events in the Dolores River watershed suggest the need for leadership to develop at the local level. Local leadership is more acceptable, often ensures local economic issues are not ignored, and engenders more trust in the community. In the Dolores River watershed, the conflict escalated with the entry of a national environmental group. National environmental groups, however, may be more effective by participating through their state and local chapters. National environmental groups have historically been an important component in decisions about natural resources, representing an important public interest that widens the debate on water resource issues. However, they may be much more effective if they utilize their expertise gained at the grassroots level.

- **Maintain an open, not formal, public participation process.**

Frequently, to settle conflicts over water management requires people who have never worked together before to formulate a solution agreeable to all. A prerequisite to developing a solution is the establishment of a open, informal, process of public participation. Maintaining an open process with no hidden agendas is important to overcoming distrust. The best approach will be one that is consensus-based and works to ensure that everyone's concerns have been addressed. After a common understanding of the problem has been reached, it may be more successful to establish informal working groups, rather than follow a more traditional formal public participation procedure. In the Dolores, much of the discussion over water management issues is currently being conducted by a small, informal, working group that is representative of all interests. This group, which emerged after many years of conflict and negotiation, meets regularly to discuss dam operation and any other water management issues, such as salinity control.

- **Federal agencies must provide resources.**

Federal agencies have an essential role to fill in settling conflicts by providing the necessary resources, including personnel, technical advice, financial incentives, and the establishment of research and monitoring programs. Accurate scientific information is needed to support the resolution of a conflict. For example, in the Dolores, the BOR mistake concerning the average annual amount of water to be reserved for the downstream fishery. This mistake had to be addressed before a new operating plan could be established. Once an accurate assessment of the water reserved for the fish was established, negotiations could proceed. Further, an important service provided by the BOR and DWCD in the Dolores was the establishment of a hotline for rafters to provide information on river flows during the rafting season. Under no obligation to establish such a service, the BOR and the DWCD improved working relations with this group.

Future Concerns

Collaboration between the diverse group of stakeholders on Dolores River did not come easily. The conflict can best be characterized as traditional water users pitted against "newer" demands on the river such as fishermen and rafters. A number of compromises were made during extensive formal and informal negotiations between the major parties, yet many residents in the watershed still oppose any additional allocation of water for fish. A recent survey of DWCD constituents revealed a sentiment that their interests had not been protected by DWCD's agreeing to provide more water for fish downstream; any additional water allocated to fish flows is viewed by many local residents as a "California water grab." Residents argue that the water cannot be put to a beneficial use in the watershed if it is allocated for fish flows because the water goes straight to the Colorado River (which to residents of

the watershed, means California). As one resident noted of the recent survey, "The local community spoke loud and clear -- no more water for fish."

Another outstanding issue in the watershed stems from the ALP. While the watershed currently has unused M&I water, the BOR recently withheld approval for DWCD to lease it to agricultural users pending resolution of issues related to the ALP. In the current negotiations concerning ALP, alternatives are being explored to full construction of the ALP. If a modified ALP was agreed to by the parties involved in these negotiations, the BOR has stated that excess water from existing BOR projects in the Four Corners region (including the Dolores Project) may be required to fulfill Indian settlement obligations.[34]

Recommendations

A Vision of the Colorado River Basin in 2025

In developing this report, we have attempted to step into the future and conceptualize a vision for the basin for the year 2025. The basic premise of this vision is that we should be working toward three general goals in developing water policy for the basin in the next century: they are equity, efficiency, and sustainability in water use and management.

- **Equity** in terms of fairness to entitlement holders who have acquired rights to water within the existing system, in regulation of water use when regulation is called for, and in dealing with the rights of Indian communities to realize the full value of their water resources.

- **Efficiency** in the use of a limited and valuable resource that will become even more in demand and more valuable in the future. Efficiency argues for flexibility in water management and the LOR, to allow water to move to its highest and best use, to more carefully analyze what constitutes reasonable beneficial use, and to instill a conservation ethic in the basin.

- **Sustainability** speaks to the "ability to meet the needs of the present generation without compromising the ability of future generations to meet their needs,"[35] recognizing the limitations of our natural resources and maintaining the integrity of natural ecological systems for future generations. Maintaining healthy aquatic systems and, whenever possible, restoring what has been lost should be a goal for the basin.

[34] The DWCD disagrees with the BOR position. In exchange for 23,200 af of the Dolores Project water, the Ute Mountain Ute Tribe agreed to settle its claims in the Mancos and Dolores Rivers. This resolution of the Ute Mountain Ute Tribe's reserved water rights cost the potential for Dolores Project irrigation of 10,000 acres of land, which, in the view of the DWCD, was a monumental sacrifice.

[35] World Commission on Environment and Development, 1987.

These suggested goals are admittedly general and idealistic, but it is really up to the leaders and citizens of the basin to set goals for water policy and management for the future. Such a vision necessarily requires a critical look at present practices in water management in the basin; what is working and what could be improved? What institutional changes might facilitate moving in this direction? What are the unresolved and difficult issues ahead? How can we integrate different values in decision making?

An obvious problem with this approach is that those currently in charge of water management in the basin, while generally acknowledging the problems that exist in moving toward equitable, efficient, and sustainable water management, do not see a need for changing much in a system they believe has served them well. Thus, for example, few water users or state water officials (with the possible exception of Nevada) want to see a basin-wide commission, forum, or council created, as has been suggested by a number of students of the Colorado River (Getches, 1997; Weatherford, 1994; Kenney, 1995; MacDonnell and Driver, 1996), that would include a broader public process and more diverse interests in formulating policy than has traditionally been the case. Although change is occurring, many of the major water policy decisions that affect millions of people are still made by a relatively small group of water managers and stakeholders with little real opportunity for meaningful public input. And, more often than not, these decisions are challenged by some aggrieved interest, invoking the LOR or regulatory statutes such as the ESA.

In recent years, there has been an increasing level of gridlock in water management within the basin and, except for a few examples, (such as in the Glen Canyon EIS and adaptive management process), the broad spectrum of public and private interests, including, commercial, academic, conservation, recreation, citizen groups, Indian communities, and others have not been involved at the front end in water policy decisions and often get involved only after decisions have been made through litigation or political action. (The decision by the voters in Tucson to block the use of CAP water is a case in point.) While litigation does play a role by forcing a conflict to a decision, it is increasingly more complex, more expensive and less desirable as a means of issue resolution. Conflicts over water in the next century must invoke alternative ways for dispute resolution and more consensus driven processes. Important issues are being avoided and left for the future because of a lack of consensus or an unwillingness to provide the leadership and funding to resolve them. And some issues are linked to other issues by interest groups to maximize leverage, which usually results in no action on either issue.

Few have advocated any major changes in the LOR, at least partly out of fear of opening Pandora's box and partly out of a sense that it is flexible enough to accommodate evolving changes in values over time. Major planning, management, and funding decisions have been deferred because there has been enough water to meet all consumptive needs and the reservoirs are expected to stay full for some years. With growing demand for water in the basin and the inevitable drought cycles, however, there is a need to examine how the basin will meet these challenges

in the next century without some institutional changes. Moreover, scientists have argued for some time that the natural river system has been shorted its entitlement, that it is extremely important to protect what is left and restore what is possible of the natural functions of rivers in the basin before even more aquatic systems collapse and more species and natural communities disappear forever.

A Vision of Basin Management

Simply stated, this proposed water management vision for the 21st century is to see the Colorado River basin states, Indian tribes and the federal government agree on the terms of shared responsibility for water management and evolve toward a system that allows for increased state responsibility and that considers all interests and values. Such a process should include a council or forum that meets regularly and involves the basin states, Indian communities, the federal government, and other interests. This forum would serve as a means of facilitating regular discussion and developing consensus on such unresolved issues as:

- How to resolve Indian water rights claims and integrate tribal water management within basin management;
- What changes in federal law are needed to provide states and local water providers with maximum responsibility and operational flexibility -- and less federal involvement -- for water management within the framework of federal laws and policies that reflect overriding national interests;
- How ecosystem needs can be agreed on and met, providing adequate resources to protect valuable natural systems; and
- How to allocate the basin's water supply to meet changing demands within the framework of existing water rights and the LOR.

Ideally, such a process would identify common goals and find common ground for achieving them throughout the basin, help develop the political support for the important decisions to come, and assure that state and tribal apportionments are equitably and efficiently utilized to meet the future agricultural, municipal, ecological, and recreational demands for water within the basin.

Water Management

Recommendation: The basin states and Secretary of the Interior should agree on and formalize a cooperative management structure for the basin to address and resolve major water management issues affecting the public interest and which defers to state implementation and management wherever possible.

As we move into the 21st century, we should move toward improving the governance process for addressing water management problems and develop a more inclusive, cooperative, and less parochial approach.

The Secretary of the Interior has considerable authority in the Lower Basin to administer water delivery contracts and over reservoir and facilities operations that affect both sub-basins. The Secretary, through the BOR, works in a cooperative manner with the basin states, Indian tribes and other interests to reach consensus if possible on major management issues in the basin. However, this is an *ad hoc* system and the emphasis and priority for resolving Colorado River issues is subject to change, particularly as top DOI personnel and the Department's priorities change. The Seven States and Ten Tribes (7/10) process and the Lower Basin Technical Committee (LBTC) made attempts over the past several years to develop consensus on key management issues, but these efforts fell short and did not always include other interest groups. The LBTC did develop a concept paper on a "Lower Basin Forum" which would include three representatives from each of the Lower Basin states, a tribal representative, and the BOR, but it dissolved after concluding it had gone as far as it could in discussing alternatives for a regional solution in the Lower Basin. The seven basin states and some tribes continue to meet on an occasional basis, but there is neither an institutional process nor a basin-wide forum where the agenda of pressing issues can be discussed and all interests heard from.

Existing Cooperative Efforts

There are forums and mechanisms in the basin for addressing particular issues (see Figure 16). The Colorado River Basin Salinity Control Forum serves this purpose, but for a single issue; the Upper Basin Recovery Implementation Program and San Juan River Recovery Implementation Program are forums for resolving endangered fish issues in the Upper Basin; the Upper Colorado River Basin Commission brings the Upper Basin states together to address technical and substantive policy questions that affect their interests; and, the Lower Colorado River Multi-Species Conservation Program that is getting underway has the potential to bring together a good number of interest groups, agencies, and stakeholders to deal proactively with endangered species issues along the lower main stem of the river. In addition, the Colorado River Management Work Group meets regularly to provide input to the BOR on the annual operating plan. Finally, the IBWC works on water management and water quality issues of concern to both countries in the border region of the basin and has an enhanced role under NAFTA. But there is no single entity that does or can serve as a forum for

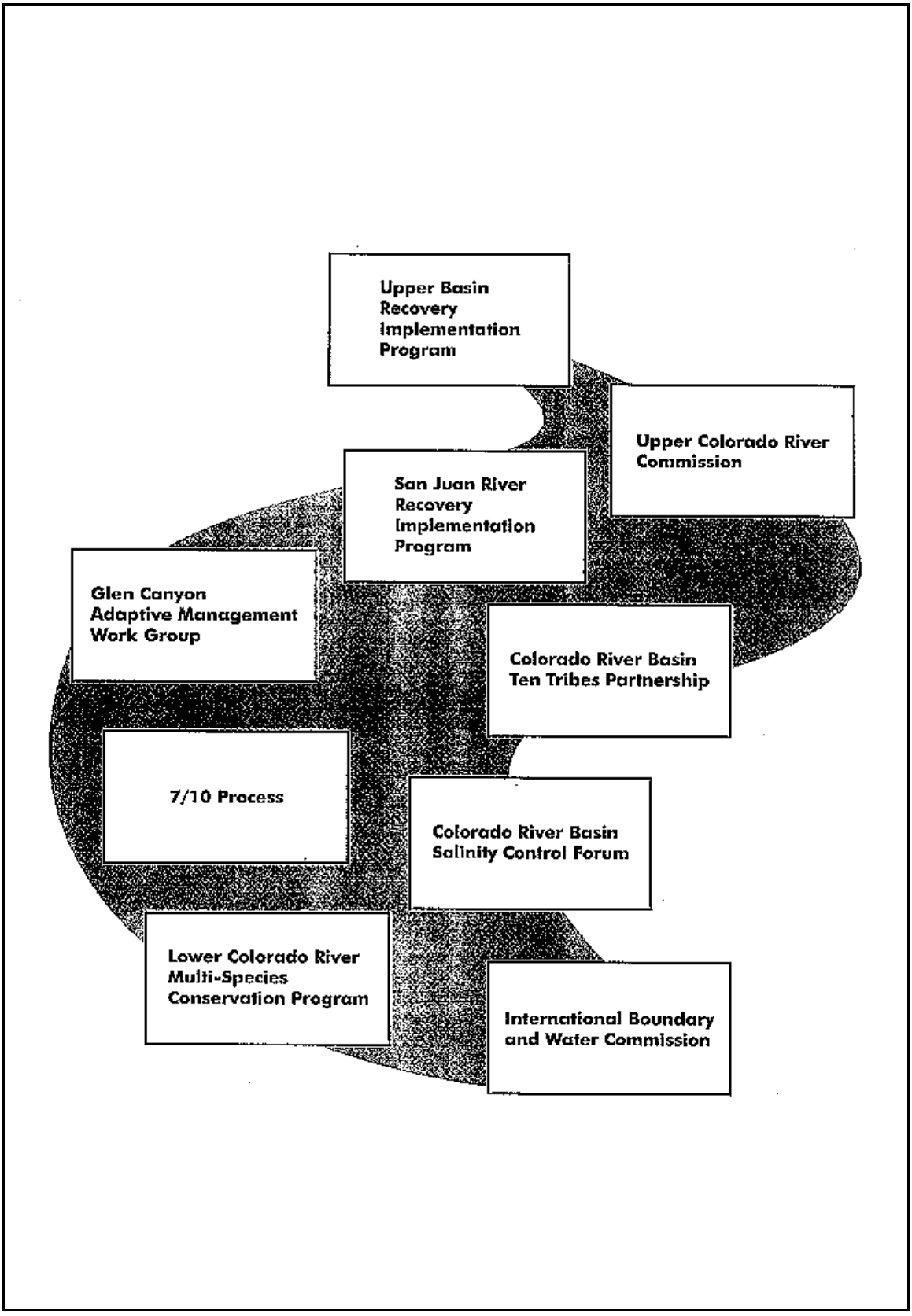

Figure 16.—Collaborative water management programs in the Colorado River Basin.

dealing with the many difficult, often overlapping issues in the Colorado River basin that require cooperation, consensus and political action if they are to be resolved over the next few decades.[36]

For the states to play a larger role in the future and decrease the federal presence in the basin, which seems to be their desire, they must step forward and help devise a system for sharing and eventually replacing federal governance. For many years, the West has relied on Congress and the federal bureaucracies to provide the money and personnel to meet water development and management needs, money for dams, distribution systems, Indian water settlements, or salinity control programs. Balancing the federal budget by 2002, or whenever, threatens to remove much of the discretionary funding for these and similar programs in the future. It will be necessary for the states and beneficiaries of the reclamation system to assume even more of the programmatic and funding responsibilities for water management in the basin in the next century.

Conservation organizations, who have learned not to rely so much on federal agencies to achieve results in ecosystem protection, are turning to local and watershed-based efforts to effect change, and this trend will most likely increase. Until fairly recently, it was primarily the federal agencies that drove efforts to protect and expand non-consumptive water uses and flow regimes for fish, wildlife, and recreation. In the future, more and more of these issues will be decided and implemented at the state and watershed level. The evolution of Habitat Conservation Plans on private lands and cooperative efforts for endangered species recovery programs between water users, conservationists, and agencies and the development of watershed councils and forums are examples of this trend toward designing regional and local solutions through cooperative efforts.

And there are many new interest groups that are now engaged in water management debates once left primarily to the states and "water buffalos," as they are fondly known. A number of national and regional conservation groups have emerged as major players in Colorado River water debates and newer ones such as the SCBD have served notice they intend to be fully involved in major Colorado River issues. The western cities have created the Western Urban Water Coalition, reflecting the major stake the cities have in western water policy and in the Colorado River basin in particular. The Ten Tribes have joined together to pursue issues of mutual interest in the basin. New recreational interests have been organized, including river guides and other outfitter organizations in both sub-basins. Trout Unlimited and the Federation of Fly Casters have been very active in recent years in both sub-basins to protect trout flows and habitat. And, more recently, bankers and other commercial interests have become involved in water policy issues, such as the financial health of the CAP, as they realize more and more that future economic growth and stability depends on sound water management.

[36] Perhaps the best model that exists is the Northwest Power Planning Council created by Congress in the Northwest Power Planning and Conservation Act of 1980. It has its critics, but the Council has provided a forum for debating issues and developing alternatives and, at least to some degree, working toward consensus in how the Columbia River basin can be better managed, particularly to enhance anadromous fish populations.

Border issues including the delta-upper gulf ecosystem, water quality standards, wastewater treatment, and others will be of greater significance as NAFTA matures. Representatives of Mexican interests are and will be involved in many of these issues in the future. The growing list of diverse interests that are now involved makes it clear that a more inclusive process for decision making and consensus building is both necessary and inevitable in the basin.

For the foreseeable future, some decisions, such as reservoir operations, surplus criteria, and how to meet the Mexican treaty obligation, will ultimately be made by the Secretary unless the law is substantially changed to remove that authority. Many believe the Secretary needs to retain this authority in order to exert leadership and make the hard decisions when necessary. The Secretary was designated by Congress in the BCPA and by other federal statutes, such as the ESA and NEPA, and as fiduciary to Indian tribes, to administer these federal laws and policies. His office is where the buck stops.

The degree of collaboration and consensus building in these decisions is extremely important, however, and even though the Secretary has extraordinary authority in the Lower Basin, the system is moving toward a more consensus-driven process. As stated by Gary Weatherford in his testimony before the Senate Water and Power Subcommittee:

> *Whether as a policy matter the Lower Basin ought to be the object of disproportionate Federal control of river management is a timely question... National and international interests will continue to justify an effective federal presence in the Lower Basin but not in the looming profile that inhibits or frustrates legitimate state, tribal, or local government roles and initiatives. A more proportionate federal profile could encourage greater state participation and responsibility in River management, in cooperation with the tribes, laying a stronger regional foundation for sustained integrated water management* (Weatherford, 1994).

The Colorado River Basin Coordinating Council

This process of moving toward "integrated management" could be given some structure to assist its evolution. The Secretary has broad authority under the CRBPA and could create an advisory committee -- or council -- which could be formally constituted and expanded by consent to include representa-tives of the basin states, Indian tribes, and other interests. A draft of an organizational chart (Figure 17) outlines one way a "Colorado River Basin Coordinating Council" (CRBCC) could look and function.

The CRBCC could serve as a clearinghouse for debate, policy initiatives, and consensus building. This Council would not have to be created by interstate compact, at least initially, but established informally, possibly through a Memorandum of Agreement, and later formalized by Compact or Congressional action.

The Colorado River basin has made progress in recent years in including more diverse interests in decision processes, such as the reoperation of Glen Canyon Dam, and more recently in the LCR MSCP, but it would seem that an institution that brought all the interests to the table on a regular basis is preferable to the traditional approach. As Figure 17 reflects, these issues could work their way up to the CRBCC from workgroups or subcommittees of federal and state agencies, water users, tribal members, conservation organizations, and other interest groups, where they would be discussed, debated, and modified as necessary to solve other problems and reach consensus.

The proposed CRBCC does not necessitate creating a massive new layer of bureaucracy, as some may contend. It would provide a forum for articulating long-term planning objectives, for consensus building and problem solving, and for discussion of major outstanding policy issues, such as drought management, Indian water rights settlement policies, the quantification and resolution of other federal reserved rights claims, interstate marketing concepts, deliveries to Mexico, salinity control alternatives, the allocation and use of tributaries, coordinating and funding endangered species recovery programs, and possible privatization of federal water and power facilities. In a real sense, this Council would be a way to transition to a new system of governance in the basin with more state and local control over the future.[37]

This is not a novel proposal. Others have argued for similar institutions, including a compact to create such a commission and various levels of authority for it (Getches, 1997; Weatherford, 1994; Getches, 1991). MacDonnell and Driver (1996) went further in recommending that a new basin commission take over management of all federal facilities, be responsible for Mexican water deliveries and be self-supporting from hydropower revenues and water delivery charges, among other things. This may eventually happen, but if so it will be an evolutionary process, and it could begin with the creation of a better institutional framework than now exists.

[37] This argument is cogently framed in a recent article by David Getches. See "Colorado River Governance: Shared Federal Authority as an Incentive to Create a New Institution." 68 U. Colorado Law Review, No. 3 (1997).

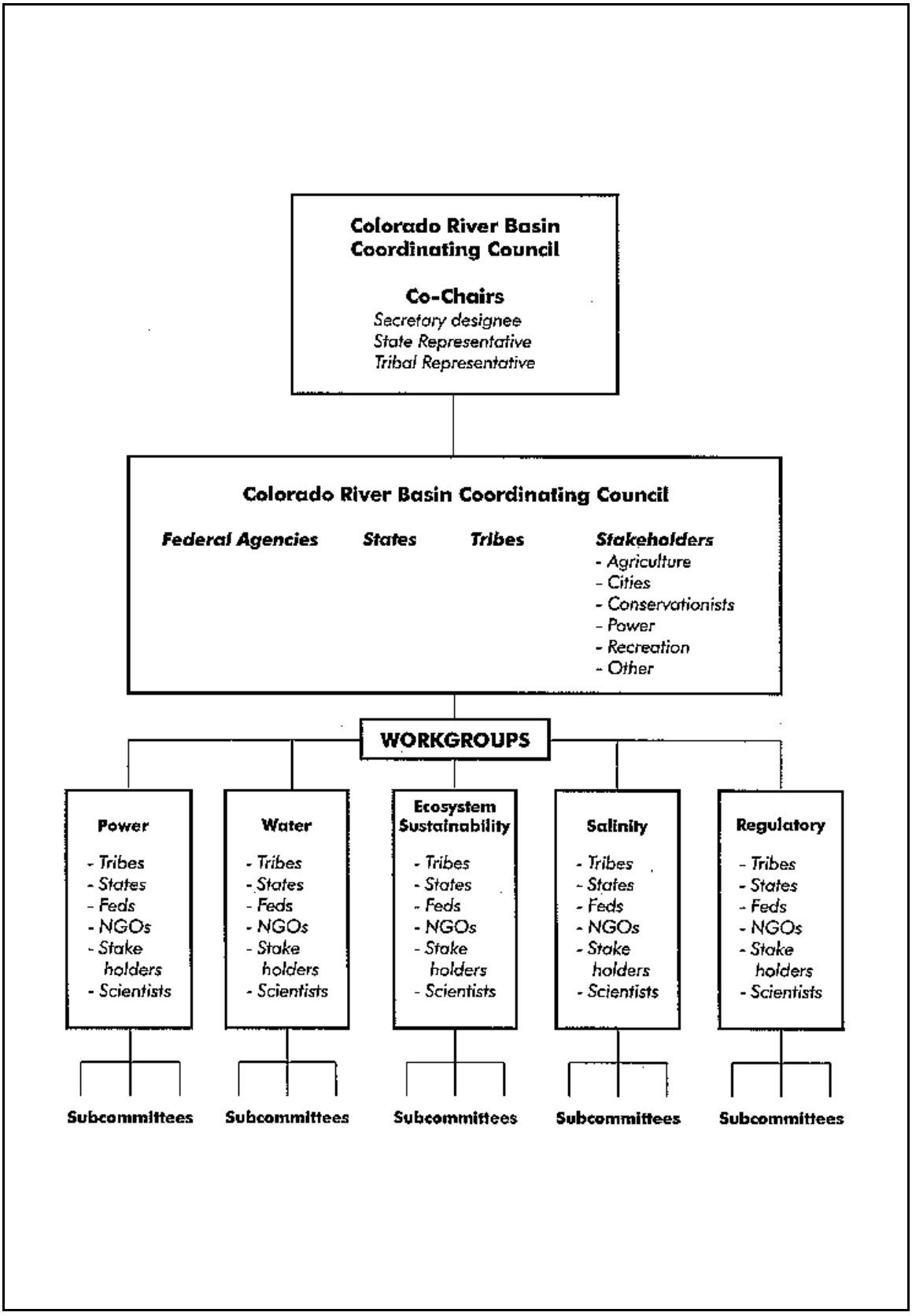

Figure 17.—Proposed framework of Colorado River Basin Coordinating Council.

Recommendation: The federal government should undertake a thorough review with the basin states and tribes over the next several years to determine how the various agencies could be reorganized to provide more efficient, cost-effective service in administering their programs without sacrificing the national interest or trust responsibilities. In addition, whenever feasible, federal agencies with water management programs and responsibilities should be organized along watershed or sub-basin boundaries.

This recommendation reflects a larger problem in the West as a result of multiple overlays of federal agency jurisdiction and involvement in water policy issues. Each agency has its own biologists, policy officials, and planners; the considerable inefficiencies and frustrations of dealing with the number of agencies and different offices of the same agency have been pointed out to the Commission by others. This is a difficult problem to solve, but federal budget cutting may force the issue and reform and reorganization of the federal natural resources bureaucracy could conceivably happen in the foreseeable future.

With respect to the Colorado River basin, as the maps in Appendix A demonstrate, the various federal agencies with major programmatic responsibilities are organized quite differently within the basin. For example, the BOR, FWS, and NPS have two sub-basin regional offices, whereas the EPA, NRCS, and USFS have three regions, which are all different. The BIA has five regions and the BLM has seven state offices. It would be preferable if agencies were organized around basin lines, or at the very least sub-basin boundaries, to assure closer coordination and accountability for what happens in the basin. The basin was divided politically by the Compact in 1922, but decisions about many issues affect the entire basin and should reflect a minimum of differences between representatives of the same agencies.

A good example of this is the Virgin River watershed. The Virgin River flows through three states (Utah, Arizona, and Nevada). There are many difficult water management issues in this watershed which require coordination and cooperation by all three states and the federal agencies, such as unresolved Indian water rights; dam proposals in Utah; flow requirements for endangered fish recovery; wild and scenic river proposals; reserved water rights for national parks; potential major diversions and pipelines by Nevada and Utah; salinity issues and others. Moreover, the water supply of the Virgin River has not been allocated between the three states. A compact commission or some other mechanism will be needed to do this at some point; the alternative is to file an original action in the Supreme Court. The various water development plans within the watershed make such an agreement imperative.

The many federal agencies should be coordinating their programs within the Virgin River watershed. There are three regional offices of the FWS with jurisdiction; three state offices of the BLM; two of the USFS; two of the EPA; two of the NPS, and the Lower Colorado Regional office of BOR. Any agency initiatives in the watershed, therefore, require coordination between these agencies and states. Any water management plan for the Virgin River must involve all three states, and reflect a *single position* from each of the federal agencies.

In the past few years, the term "ecosystem management" has been widely used and the FWS and other agencies have developed concept papers and held forums to discuss implementing this new mandate. The shift to ecosystem management needs to be more clearly communicated to the basin states and interests so there is a better understanding and acceptance of how this will impact basin interests.

It might be productive to streamline and consolidate agency functions along watershed and sub-basin lines wherever feasible to avoid duplicative or inconsistent decisions and policies and hopefully improve efficiency in water and resource management within the basin.

Recommendation: A centralized and integrated data center for the Colorado River basin should be established to collect and provide a comprehensive, reliable, scientific and economic database that is electronically available to all who need it.

Information used for resource management decisions in the Colorado River basin is collected by a broad range of agencies on the federal, state, and local levels. The fact that information is spread among so many sources has complicated the resolution of basin-wide issues and led to severe data gaps. In addition, reports produced by agencies are often difficult to obtain as publication outlets are limited, manuscript backlogs are large, and time to appearance of papers is long. Furthermore, many agency reports are interim in nature, funded by short-term contracts with time constraints that may necessitate less-than-final reduction and interpretation of data, and errors or premature conclusions may result (Minckley *et al.*, 1991).

There is a need for reliable data to be widely available from a common source. Consistent, comprehensive data on water use, economic and cost/benefit analyses, for example, is needed to improve the ability to plan for future water use in the basin and to identify opportunities for water efficiency improvements and reallocations (Pacific Institute, 1996).

One possible solution is to appoint a single entity to serve as a central repository for data and to publish information. The USGS could fill this role, incorporating ongoing research on such diverse subjects as hydrology, fish habitat, salinity control, and the economic impacts of the endangered fish recovery program. Such a suggestion is likely to meet with opposition, however, as many agencies are very proprietary about data. Another possibility would be the creation of a new entity, developed by resource agencies, conservation groups, and other interests, to serve as a data repository. To some extent, this effort has been undertaken in the basin by the Grand Canyon Monitoring and Research Center (GCMRC), a federal organization within the DOI, but not under any single agency. The GCMRC already stores considerable data collected through the Glen Canyon Environmental Studies. It is possible that the GCMRC could be expanded and refocused to cover the whole basin under the direct aegis of the Secretary with inter-agency staffing.

Another alternative would be to create a centralized access point to data, as opposed to a single repository for data. In this case, there would not be a single guardian for

data. Information would be distributed, allowing agencies to maintain control of the data they produce, reducing anxiety about confidentiality of data and methods.

The Internet provides a viable means to organize data on the Colorado River basin. In this decade, the Internet has become the repository of a measureless amount of information; tens of millions of people now tap into on-line resources each day. A vast amount of data on the Colorado River is now available on-line, and a centralized access point could be developed for the basin. Such an access point has already been created for the San Francisco Bay Delta area. The Bay Delta Internet Resource Center (BDIRC) is a World Wide Web site that provides the public with a comprehensive on-line library to information, reports, databases and other relevant material available via the Internet. The computer code used to create the BDIRC is public domain and could be modified relatively easily and cheaply into a comparable site for the Colorado River basin.

In the first phase of this effort, agencies would put "metadata" (data about data) on-line. For example, the USGS would indicate that it has developed an ARC/INFO GIS layer showing annual herbicide use by county for the entire Colorado River basin. While the layer itself need not be on-line, its availability would be made public and a contact name could be provided for further information. As the technology of the Internet continues to improve, it will become easier to move into the next phase of development of a data center, which would involve actually providing data on-line in a format that can be downloaded. Putting data on-line eliminates communications issues associated with different time zones, provides relief from many data requests from the public, and reduces paper work. A vast amount of data are already available this way, typically at no cost, directly from its source 24 hours a day, 7 days a week.

Creation of a centralized access point to data would be a fundamental step toward identifying gaps and redundancies. If, for example, two different data sources had generated estimates of precipitation for an area, both precipitation databases would show up under a general "hydrology" subject category.[38] Cross-referencing information in a variety of ways would help clarify where more or less information was needed and new compilations and collaborations could be developed and encouraged. Clearly, the water community in the Colorado River basin would benefit from the creation of a common entry point to data and, eventually, a common pool of data.

Recommendation: The Secretary, basin states and Indian tribes, with input from other interests, should agree on a plan for reservoir operation and surplus and shortage criteria that is equitable to all interests and meets federal statutory obligations and treaty obligations to Mexico.

[38] The BDIRC is organized into ten subject categories: 1) Agencies, 2) Agriculture, 3) Economy, 4) Education, 5) Environment, 6) Geography, 7) History, 8) Hydrology, 9) Legal Issues, 10) Recreation.

This recommendation highlights a process that is underway and needs to be completed in the near future. The difficulty to date in achieving agreement between the states stems from a number of concerns about protecting apportionments from risk if more than 7.5 maf a year is diverted in the Lower Basin. In 1991, California suggested that Lake Mead be operated to utilize what it considers excess storage to meet California's needs and avoid unnecessary flood control releases. In response, the other basin states insisted on protection against any shortages that might occur as a result of such reoperation. California would like to be able to continue diverting surplus water in excess of its 4.4 maf basic apportionment and keep the MWD aqueduct full while it implements a plan to live within that apportionment over a period of time. California argued that the failure of the federal government to augment the basin's water supply and to operate the YDP diminished the storage available by 6.5 maf between March 1988 and the end of December 1991 (State of California, 1991). And California and other states maintain that meeting the 1.5 maf treaty obligation to Mexico is a federal obligation. On the other hand, some environmental organizations are advocating operating changes in the reservoirs, such as lowering Lake Mead to protect nesting sites for the endangered southwestern willow flycatcher.

These are issues that must be addressed in the process of developing new criteria for how to determine surpluses and shortages and reservoir operation and must be defined within the context of Upper Basin delivery obligations, protecting apportionments, fulfilling trust responsibilities to tribes, and Mexican treaty deliveries. The Upper Basin states must be involved in these discussions as the "equalization requirement" for Lake Powell and Lake Mead under Section 602(a)(3) of the CRBPA is an important issue to the Upper Basin. While these are highly technical discussions, there is a need also to consider the impacts of these decisions on salinity, habitat and endangered species, the treaty water, flood control, and other concerns.

This process should also revisit the issue of whether or how it is possible to augment the river's water supply and should decide the future of the YDP (discussed below). If the YDP is operated, which is opposed by the BOR and the Administration, it could cost federal taxpayers over $300 million in 10 years, an untenable budgetary scenario in the current fiscal environment. Much cheaper water is most certainly available in the basin, and if it is now the federal government's obligation to provide the treaty water, it can do so by leasing or purchasing water on a willing buyer, willing seller basis. Nevertheless, the federal government and the states' responsibilities and roles in meeting the treaty obligation should be clarified in this process.

Recommendation: An interstate water bank should be established in the Lower Basin along the lines proposed by Arizona, with maximum flexibility for marketing and banking water, including tribal water.

Some of California's and Nevada's water supply problems could be solved with the implementation of the Arizona Water Bank's 100,000 af annual interstate component. This will require the adoption of rules and regulations, which are being drafted now by the BOR. As discussed in this report, the Lower Basin water bank

could become the means to store water in excess years in Arizona's aquifers by direct recharge programs or in-lieu use by farmers and others whose groundwater would then be banked for future use. This program might also alleviate some of the need for top water banking in Lake Mead, which risks flood control spills. Tribal involvement depends on whether tribes view this bank as being of any benefit to meet their objectives, which is still being discussed. There are other potential problems with the water bank from a water management and equity standpoint that were discussed earlier in the report.

The proposed Arizona Water Bank represents a breakthrough in efforts by Lower Basin states to create a mechanism to store water for periods of less supply and to allow some degree of interstate commerce. State control over transfers of apportionments and forbearance agreements seems essential, however, if there is to be any agreement. States fear losing control over state apportionments in a free market. The remaining obstacle seems to be how flexible the regulations will be and whether they will be satisfactory to all the states. Since the BOR is planning on issuing other regulations as well for the Lower Basin, there may be efforts to link these rules with other issues. The water bank rules should be considered on their own merits, and should allow for maximum flexibility for the banking of unused apportionments, surplus water, Indian water, and other available water in the Lower Basin.

Recommendation: The basin states and local water managers need to develop stronger conservation programs to maximize conservation and reuse potential and more clearly define and regulate reasonable beneficial use. In the lower Colorado River basin, the Bureau of Reclamation and the states, working together, need to more clearly define and regulate reasonable beneficial use.

Water conservation is the most effective tool in demand management and often the cheapest source of new water supplies. The reason it has not been employed very effectively is price. Water has always been very cheap in the basin and throughout the West. Federal reclamation water has always been subsidized, and reclamation law also includes an "ability to pay" policy for users. Many irrigation districts in the basin pay almost nothing for federal water and project repayment costs for agricultural water are interest-free. M&I water costs vary in the basin from a few dollars per acre-foot to several hundred dollars. The Congressional Budget Office reported that only about 19 percent of the actual cost of federal reclamation water is paid by users (North and Miller, 1987). A study cited earlier in this report (Gardner, 1983) underlines the fact that less water would be used in agriculture if the price were higher.

Cropping patterns contribute significantly to water use. Throughout the basin, much of the irrigation water supply is used to grow low-value, high water use crops such as cotton and alfalfa. In southern California, alfalfa and irrigated pasture account for 54 percent of the agricultural water used, which indicates that crop substitution and increased irrigation efficiency could produce significant conservation savings (Pacific Institute, 1996).

However, government-imposed regulatory programs to require conservation have had minimal impact. The Reclamation Reform Act requirements for all BOR contractors to develop and implement conservation plans (there are approximately 860) are virtually unenforceable, even though new criteria were adopted in 1989 and the plans must be updated every five years. The 1994 regulations proposed by BOR did include tougher conservation requirements and these regulations should be revisited, updated, and again proposed.

Nevertheless, regulatory conservation programs are not going to bring about major efficiencies in agricultural use, primarily because it is difficult to mandate what conservation expenditures are affordable. Funding for on-farm technical services, if available, and cost-share programs seem to work best. Farmers will implement conservation to save on costs, particularly energy costs, but it is difficult for government to dictate what other conservation is affordable in a given situation. It is safe to say that if water was priced higher, there would be additional conservation.

With the exception of Arizona, most states approach conservation as a voluntary and incentive-based program, although many local jurisdictions have implemented low-flow plumbing and landscape ordinances successfully. Arizona's groundwater law requires conservation in all sectors, but has had limited results that can be quantified.

Conservation initiatives should focus on financing extraordinary conserva-tion (beyond what a farmer would otherwise do because it is too costly) in exchange for the ability to market the conserved water. Such market transfers may be the solution for meeting urban needs in California and other states when surplus water is no longer available from the Colorado River. For example, SDCWA plans to pursue additional agreements with IID to free up, through conservation, as much as 500,000 af of water for its growing needs. Conservation transfers from the Imperial Valley should be encouraged as they also will help alleviate a serious and growing environmental and economic problem from the excessive drainage water flowing into the Salton Sea.

States have the authority to oversee and determine standards of beneficial use, but there are few cases where this has occurred. The "use it or lose it" premise of western water law has generally led to erring on the side of excessive use, with flood irrigation of low value crops using much of the basin's water. Yet, no one wants agriculture to disappear so that all the water can be used to grow cities. States *should* enforce beneficial use more aggressively than they now do throughout the basin, which might encourage marginal lands to be retired, reduce salinity impacts and provide more water for other uses.

Reuse

Reuse of treated wastewater must be a major component of future water supply planning in the Colorado River basin. Effluent is the only growing supply of water in the basin and it is currently underutilized. Reuse requires treatment to meet

water quality criteria for the intended use. As a result, it has been cheaper in many cases to discharge treated water into the ocean than to reuse it. Because potable use requires the most stringent treatment, non-potable uses are more common. As treatment technology advances, however, water reuse should become a more economically feasible option to meet many more water demands. Taking into consideration that potable water rates are on the increase, long-term projections show that reclaimed water is a cost-effective alternative to meet future demand.

A number of significant projects have already been implemented that have resulted in regulatory acceptance of application of recycled water for many uses that reduce demands on imported supplies. While landscape irrigation and groundwater replenishment have historically been the predominant uses for recycled water, agricultural irrigation, industrial applications and use for toilet flushing have the potential to dramatically expand the use of recycled water as a replacement of potable water supplies.

It is evident that there are significant quantities of unused water that can be used beneficially as a substitute for potable water supplies. Experience has shown, however, that cost and development of markets for recycled water are constraints to the economic viability of reuse. Unit costs of recycled water are typically higher in early years of operation until the full market develops. Increased public and regulatory acceptance of recycled water and improved treatment technologies are key to overcoming economic barriers that constrain expansion of recycled water use.

Long-term planning is required if reuse is to be implemented more successfully. The construction of the new International Wastewater Treatment Plant in Tijuana and the South Bay Ocean Outfall demonstrates that there is still a serious need to develop integrated water resource plans which fully consider the reuse of wastewater. The outfall has been designed to dispose of 195,000 af/yr[39] of treated effluent into the Pacific Ocean, which does not need the water or the nutrients. Most of this water originated in the Colorado River basin and should be reused within the basin. If water can be diverted from the river to Tijuana and San Diego, the resulting effluent is just as necessary as a water supply for reuse within the basin, including for environmental mitigation purposes. Municipal effluent and other wastewater is being recognized as a valuable water resource and efforts made by water planners to maximize its use in developing new integrated water resource plans.

Ecosystem Sustainability

Recommendation: Recovery plans for endangered fish in the Colorado River basin should be consolidated in one multi-species recovery plan and recovery goals more clearly defined. In addition, the three different recovery implementation programs in the basin should be coordinated.

[39] The outfall will have an average daily flow capacity of 174 mgd (equivalent to 195,000 af/yr) and a peak flow capacity of 333 mgd (Metropolitan Wastewater Department, 1997).

A new multi-species recovery plan is needed for the endangered big river fish that sets recovery goals and identifies and prioritizes recovery efforts. Such a range-wide plan will help focus the debate: where is the best habitat; where is the chance for success the highest; should the fish be recovered throughout the basin; how can these three recovery implementation efforts be coordinated; should funding be consolidated?

There are currently three separate programs for endangered fish in the basin. While customized approaches to recovery may be needed, based on the different conditions, status and abundance of habitat, and other factors in a particular sub-basin, there should be a single multi-species recovery plan. Furthermore, there should be a forum and on-going process in which all interests can review and discuss recovery plan issues with the FWS and other agencies.

The question of what constitutes recovery is a difficult one perplexing scientists and policy personnel alike. Recovery efforts should be oriented toward preventing extinction, stabilizing and improving viable populations in representative areas of the critical habitat in the basin. Progress toward recovery has to be reevaluated periodically and management efforts may be required for an indefinite period of time.

The LCR MSCP is still in the planning stage, but as proposed it will include all the various species at risk along the lower river, with the aim of preventing further listings and recovery of all listed species. The process of developing such a multi-species plan will not be easy nor without controversy, but the proponents of this approach have reached out to include the major stakeholders and interest groups and have worked hard to overcome some initial differences of opinion with environmental groups on how this fits within the ESA. The LCR MSCP represents a new approach to addressing endangered species, combining Section 7 and Section 10 actions, and should be evaluated as a potential model for ESA compliance in other western river systems.

Clearly, obtaining adequate funding for the three sub-basin programs will be more difficult in the future. Total funding needs will run into the hundreds of millions of dollars over the next decade and major capital expenditures are yet to come. Congress might well ask why there is not one budget for the federal side. In the next few years, as the federal budget goes through major readjustments, such an arrangement may be inevitable and discussions should begin to take place soon as to how duplication of effort and expense can be avoided. Funding sources for the various programs are different and power revenues, which are a potential partial source, are allocated differently in the basin. It may be that these programs have to proceed independently, but if there is one recovery plan for the four fish, recovery efforts, and possibly spending, should be coordinated. This is not currently being done.

Currently, there is also a bureaucratic wall between the two regions of the FWS that oversee these recovery plans; Region 2 and Region 6 do not seem to agree on fish recovery and there is limited cooperation. Region 2 in the Lower Basin has its own management plan which, as the report discusses, is a somewhat different approach

than that being implemented by the RIP in the Upper Basin. Region 6 has the lead on the recovery plan for the entire Colorado River basin, but the recovery team has no members from the Lower Basin with the exception of the Arizona Game and Fish Department. A basin-wide recovery team should be reconstituted representing all the various viewpoints and scientific expertise that exist in the basin.

Recommendation: The Secretary should establish a policy which allows for more public input into the development of reasonable and prudent alternatives under Section 7 of the Endangered Species Act. The FWS should develop policies that provide water development interests with accountability and more clearly defined, realistic mitigation requirements that will provide the maximum possible certainty for existing and planned water development projects.

One of the major problems identified by water users and others is the Section 7 consultation process between the FWS and other federal agencies. Until recently, these consultations were closed and the resulting RPAs announced summarily. This process has been opened up to some degree, but not enough. There is now an opportunity to comment on RPAs, as is being done with the Lower Basin Biological Opinion, but what should be done to avoid jeopardy, and at what cost, is still often decided by the two agencies. The RPA for the CAP, discussed in the report, is a classic example. A more inclusive process for Section 7 consultations should produce more consensus and buy in as to what needs to be done to avoid jeopardy under the ESA. This could be accomplished administratively or by rule making, but a uniformly consistent process should be implemented.

How the ESA is applied on the ground is a major source of frustration for water users, in the Upper Basin in particular. Decisions by agency biologists are subject to being revisited and changed. Water users want to know that once a decision is made it will stick. Yet it is difficult for agency biologists to say with certainty what will work and that a decision can't be revisited. The fact is, we don't know all that much about what these species need. Yet water users need to know how much water they can develop at some point. There is a definite need to improve the ESA process to provide some degree of certainty. One suggestion is to move toward a framework that allows for "adaptive management" of mitigation in the future as conditions change or new information becomes available, but that does not unreasonably subject the water development community to an open-ended process. This issue must be dealt with in the reauthorization of the law.

Recommendation: An environmental trust fund should be established with dedicated funding for endangered species recovery, habitat restoration, and environmental enhancement in the basin.

There is a need for a dedicated funding source for environmental enhancement and mitigation in the basin. The hydropower revenue "cash cow" should not be the only source. A number of organizations have recommended that an environmental trust fund be established, which could be financed from a number of sources, such as a surcharge on water transfers and for banked water. Agricultural water

apportionments converted for municipal purposes, for example, could include a surcharge to help finance environmental enhancement in the basin. With more than 20 million water consumers in the basin, even a $5 increase in annual water rates per consumer would produce a substantial fund. Creative uses of matching funds from sources like the National Fish and Wildlife Foundation (which is the repository for initial funding for the LCR MSCP) could be utilized to leverage dollars with local and private matches. In testimony before the Senate Water and Power Subcommittee in 1994, the Environmental Defense Fund (EDF) suggested that an ecological assessment of the restoration potential in the Lower Basin be conducted by the National Academy of Sciences to determine the scope of funding needed (Yardas, 1994).

The BOR reportedly considered creating an environmental fund in an early version of its proposed regulations for the Lower Basin, but the draft regulations stopped short and provided only for user fees to allow BOR to recoup its costs for administering apportionments. The Secretary should initiate discussions with public and private interests on the need for trust funds, how they could be used for environmental mitigation, and how they could be funded for both the Upper Basin and Lower Basin. Environmental restoration and enhancement was a low funding priority during the water development era, but should receive a higher priority in the next century as these values are incorporated into future water management decisions.

Recommendation: A Binational Commission should be established to review and make recommendations on the potential for restoration of the Colorado River delta and the environmental and economic benefits and costs of such restoration.

The possibility of restoring parts of the Colorado River delta/lower river ecosystem is an emerging issue. While it is not yet a high priority of the governments of the U.S. or Mexico, it should be noted that most environmental issues in the basin have generally percolated up from the grassroots before government got involved. Such is the case with this issue. Moreover, it is an opportunity for the two countries to work cooperatively to address a number of environmental and water management problems in this border region and to invoke the NAFTA process and resources to do so.

Mexican environmental groups call this the “white spot on the map” syndrome, meaning the delta and the lower river don’t even show up on the maps, which stop at the border, as part of the ecosystem. They argue that the delta would not have been allowed to deteriorate if the river was all in one country or at least the problems would have been addressed before now.

The reestablishment of the Cienega de Santa Clara has served as a catalyst for scientists and interest groups on both sides of the border to focus on this once great ecosystem and to begin to analyze the connection between the decline of the health of marine fisheries of the upper gulf and the lack of nutrients, sediment, and water since the main stem dams were closed. Some work has been done by scientists in both countries to analyze the biological resources, the decline of the marine

resources, and economic impacts, but more research is needed to determine the impacts of sediment and nutrient loss and the potential for restoration, as well as how water could be managed better to make a significant difference to the ecosystem and local economies. Is there water available that could be reused or used more efficiently for wetlands? Can some of the agricultural return flow and municipal discharges to the New River, which flows north into the already overflowing Salton Sea, be rerouted to the delta? Can the water from planned Mexicali wastewater treatment plant be used for these purposes? And can flood releases in high water years be coordinated and engineered by the two countries to recharge the upper gulf?

These are questions raised in recent years by the Pacific Institute report, Sandra Postel of the Global Water Policy Institute, Conservation International, EDF, and scientists from both sides of the border. The next step should be a comprehensive binational study to determine what restoration alternatives exist in the delta, at what cost, and with what likely effect. This will require binational consultations and an agreement with Mexico, and involvement by states and non-governmental organizations in both countries as well as other institutions such as the IBWC, to plan, fund, and implement this study. The delta may represent the best and most cost-effective opportunity for restoration of a major wetland in the Southwest and one that could again provide the functions of a river delta/tidal estuary/marine system and help restore the economies of the communities that once depended upon it.

In addition, this bilateral process could discuss linking protection efforts in both countries to protect and enhance the Pacific Flyway. The Delta is a significant winter and flyway habitat for a variety of waterfowl and neo-Tropical birds. The Bioreserve includes the upper gulf, delta, and greater Sonoran ecosystem, which extends into the U.S. and the lower Colorado River basin. Discussions between the two countries should focus on how they can cooperate to manage and restore this international ecosystem.

One issue of more immediate concern is to obtain a firm water supply for the Cienega. If the YDP is operated, the Cienega will lose a substantial portion of its water supply. It has done well on the highly saline Wellton-Mohawk discharge water, but this is not a firm supply. A decision needs to be made on what to do with the YDP, but if it is operated, a replacement water supply should be provided to the Cienega.

The Salton Sea: A Snapshot of Non-Sustainability

The growing environmental problems associated with the Salton Sea in the Imperial Valley highlight how multifaceted and complex a water resource management issue can become.

The Salton Sea is the largest lake in California with a volume of over 7 maf. It is a major stopover on the Pacific Flyway and provides winter habitat for a variety of migrating species of birds and waterfowl. At the south end a major wildlife refuge,

established in 1930, is temporary home to over 350 species. Once a major tourist attraction, millions of visitors flocked to its shores to enjoy the water recreation, fishing and boating the lake offered. Today there is no fishing or swimming and the marina is all but abandoned, as are many lakeside properties because of the very high water levels, salinity, and pollution. This past year, there was a major bird kill on the Sea, including a large percentage of the brown pelican population, which has been attributed to avian botulism; the FWS and California Department of Game & Fish are still investigating the causes of this contamination.

Since this is a closed basin, the Sea would have evaporated over time. However, over 1 maf/year flows into the Salton Sea, mostly from the New and Alamo rivers and discharged agricultural tailwater from the Imperial and Mexicali valleys. The New River is extremely polluted by untreated municipal sewage and other wastewater from Mexicali, a fast-growing border city in Baja California. Currently, the salinity level of the Sea reaches 44,000 ppm, which is more saline than seawater, due to the evaporation and highly saline inflow. EPA and the state are also concerned about levels of selenium in the sediments and in the inflow water, although the federal standard is not exceeded in the Sea. The State of California, environmental groups, and property owners are concerned that if the water quality continues to deteriorate the Sea will be too saline and polluted to support even wildlife.

IID points out that it is caught in the middle of the Sea's problems. Because each acre-foot of water IID uses contains a ton of salt, more water is needed to flush this salt from the soil. The high salinity of the Colorado River water leads to even higher salinity concentrations in the Imperial Valley and yet higher salinity by the time it reaches the Salton Sea.

EPA has been puzzling over what to do about this mess for years, but there has been little progress. The issues involve cross-border pollution, both point source and non-point source (the rivers flow north out of Mexico), salinity control, water conservation (can IID reduce its use and thus its discharges?), NAFTA (the siting of a new wastewater treatment plant near Mexicali), reuse (can this highly saline water be treated and reused), and ecosystem protection and restoration (can any of this water be transported to the delta for ecosystem restoration; can the fish and wildlife dependent on the Sea be protected?)

What can be done about it? Various ideas have been suggested, but none have taken hold. Local governments have created the multi-jurisdictional Salton Sea Authority to work with federal and state agencies on solutions to stabilize the salinity and water levels. Some contend that a reduction in agricultural tailwater from conservation within IID could lead to increased salinity levels. A new desalinization plant has been suggested and is being explored, as is dividing the lake with a dike and trying to restore the water quality of at least part of it for wildlife. The construction of a new wastewater treatment plant in Mexicali should also help reduce pollution in the inflow if not the salinity.

If this growing problem is to be resolved in the near future, it is going to take leadership and massive resources from both sides of the border. It is well beyond

the normal scope of issues delegated to the IBWC and should be added to the agenda of the proposed Binational Commission.

Salinity Control

Recommendation: The Secretary should commission a comprehensive study of alternatives to operation of the Yuma Desalting Plant and what should be done with this facility if it is determined not to be in the long-term interest to operate the Plant.

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. By the BOR's own estimates, the YDP is not needed for the next 20 to 25 years to help meet treaty salinity standards. This projection is based on a number of factors, but primarily because of the projected surplus water supply in the basin (Bryant, 1997). It now costs $6.8 million a year to be maintained in ready-reserve status and would cost $5.5 million a year (plus an initial additional cost of $8.7 million) to mothball. The Yuma Area Office of the BOR would like to operate the facility at one-third capacity (at an estimated cost of $12 million a year) but there is no present market for that water, which would cost $515 an af to produce. Moreover, new desalting membranes might be needed before the plant could go on line, which would cost at least $18 million.

While the basin states continue to strongly support operation of the YDP, it is difficult to see how such operation can be justified. The BOR has declined to request funds to operate the YDP because it can't be justified. Dan Beard, the former Commissioner of BOR, was asked when he took office when he planned to operate the YDP. His answer was "never." Since it is the obligation of the federal government to meet the treaty salinity standards, the Secretary should explore cheaper ways to do it.

Although it may have seemed like the technological answer to the Mexico salinity issue in the early 1970s, operating the YDP is a decision that needs to be revisited and other alternatives explored. The BOR could lease or purchase water rights, including agricultural or Indian apportionments, enter into fallowing agreements, or purchase and retire marginal lands. One suggestion is to exchange the power needed to run the YDP for the water rights needed to make up for its inoperation (Wahl, 1989). The drainage water from the Wellton-Mohawk Project could continue to be bypassed through the MODE canal to the Cienega, assuring that this wetland survives.

The Secretary, in consultation with the states and other interests, should commission a study to explore these and other alternatives as to what should be done with the YDP. Part of the facility may be useful as a water treatment plant and there may be other commercial or salvage value. It is time for the federal government and the states to decide whether the YDP should ever be operated.

Recommendation: Future salinity control programs should emphasize on-farm irrigation management, reuse and conservation, fallowing agreements, and retirement of marginal lands.

Without question, salinity in the Colorado River basin is and will continue to be a major economic and environmental issue in the next century. Currently, the economic impacts of salinity are estimated at close to $1 billion a year.

The salinity standards adopted by the Colorado River Basin Salinity Control Forum and approved by EPA are currently being met at the three measuring points on the river (Hoover, Parker, and Imperial Dams). And although the latest projections contained in the 1996 triennial review indicate that the standards will be met through 2015. However, there are danger signs that this might not hold true if funding targets slip, and depending on other factors such as climate and flow. And the BOR's model projections show that salinity at Imperial Dam will increase sooner than projected and exceed standards as soon as 2003 (Bryant, 1997). The BOR's Yuma Area Office has discounted these projections on the basis that there was insufficient data to calibrate the model.

Mexico is already complaining about the quality of deliveries at the SIB and may object if NIB deliveries begin to exceed the maximum of 145 ppm over the Imperial Dam level, especially if that level is at or exceeding the U.S. EPA approved numeric criteria at Imperial Dam.

Over the past few years, funding has declined and future budget cuts have to be anticipated which would impact salinity control programs. The new Farm Bill (P.L. 104-127) consolidated the USDA Colorado River Salinity Program in the new Environmental Quality Incentives Program (EQIP) and lumped the appropriations for it with three other voluntary conservation programs. Congress appropriated $200 million for EQIP, but USDA has not allocated this money among projects. There is a waiting list of applicants for these funds, which require cost-sharing, and the difficulty will be in prioritizing projects that will be most cost-effective.

In the coming years, the states and federal government should analyze whether salinity control dollars are more effective if spent on reducing irrigation of marginal lands which require excessive flushing of salts, through either voluntary sales or fallowing agreements. The CRBSCF, BOR, and EPA should begin to develop a plan which incorporates a water rights acquisition strategy to reduce salinity.

Indian Water Rights

Recommendation: The federal government should develop a more effective strategy and establish priorities for settling and implementing Indian water rights claims in the basin.

As discussed in this study, there are a number of major outstanding Indian water rights claims in the basin that have not been settled. Some, such as the claims of the Gila River Indian Community, remaining claims by the San Carlos Apache Tribe, and the Navajo and Hopi in the Little Colorado River watershed, are in litigation as part of the Arizona General Stream Adjudication. The constitutionality of the Arizona Adjudication Statute, as revised several years ago, has been attacked

by the tribes and is probably going to be reviewed by the State Supreme Court and possibly the
U.S. Supreme Court. Some claims have not been litigated, and some claims that have been settled are on hold for lack of funding or other problems in implementing the settlements. Major examples of the latter include the Ute tribes in Colorado and the Tohono O'odham and San Carlos Apache Tribe in Arizona. In the past four years, there has been only one settlement approved by Congress, the Yavapai-Prescott Apache Settlement in 1994.

There has been considerable criticism of the DOI role in effectuating and facilitating settlements in recent years, although significant funding has been provided for that purpose. Tribal representatives are clearly frustrated with the priority given to water settlements by the Administration and the lack of funding available for evaluating claims and litigation support. With more projected funding cuts, the prospects don't look much better for the immediate future. Clearly, obtaining the funding needed to both negotiate and settle these claims and to implement settlements is significant. Cost-sharing of settlements, which now require a larger local contribution, has been an inhibiting factor as well. The lack of strong DOI leadership in the settlement process has reached the point that tribal advocates are questioning whether the DOI is still committed to a settlement strategy. Litigation of these rights will take much longer and will be more costly for all concerned. The Gila River Adjudication, initiated in large part to quantify the rights of Arizona tribes in state court, has dragged on for 18 years, costing millions of dollars, with no end in sight. However, there is currently little incentive for non-Indian users to settle; they are using their water and may rather litigate for years than settle.

The tribes' water rights are similar to mineral, oil, and gas resources held by the tribes; they are important assets for the economic sustainability of the Indian communities. It is therefore essential that the Indian communities be able to utilize those rights on the reservation or receive the market value of the water by leasing the water rights to other users. It has been nearly
90 years since the *Winters* decision and there is a limit to the tribes' patience.

This and future administrations need to send a strong signal to the tribes in the basin -- and throughout the West -- that the federal government is committed to the settlement process and that it will give it high priority and provide the funds and personnel needed. One alternative is to establish a separate Settlement Commission outside DOI to provide a single focal point for completing settlements and developing new funding strategies for implementing them. The other alternative is for tribes to more aggressively litigate these claims, possibly changing the "risk analysis" by non-Indian users.

Recommendation: The basin states and tribes should agree on a plan for integrating tribal water use, banking, and leasing of tribal water in state and interstate water marketing systems.

How tribal water use is integrated into water management in the basin will be an enormous challenge over the next few decades. Tribes have their own management authorities governing on-reservation use and are not subject to state regulation of

water use. In many cases, federal regulations govern water use under contracts with the BOR, such as with tribes in Arizona that receive CAP water.

The magnitude of Indian water rights and how they will be used in the future are significant issues for the states. It is anticipated, for example, that in Arizona over 40 percent of the CAP water supply could end up being allocated to tribes to settle claims. However, a fair pricing mechanism for tribal CAP water must be established if CAP water is to be acceptable. Tribal representatives argue that CAP water should not cost more than other water the tribe would otherwise have diverted. This is a major issue for tribes in Arizona, such as the Gila River Indian Community.

The Arizona tribes have also objected to the fact that there is no Indian representation on the CAWCD Board that administers the project. The CAWCD Board is elected under state law from the three counties in the project service area (which includes some reservations), and it is not likely that tribal members could win an election. Yet some mechanism to include tribal concerns in the operation of the project seems reasonable.

Many tribes are interested in pursuing off-reservation leasing of undeveloped settlement water as a source of revenue for economic development on the reservation. Given the lack of federal appropriations to finance Indian water delivery infrastructure, water marketing may be the only mechanism available to tribes to finance construction costs for on-reservation uses. Some settlements have authorized off-reservation use, but often limited it to certain areas within the state. Tribal water is considered part of the states' total apportionment and states take a dim view of transfers of any apportionment out of state. New concepts such as forbearance agreements may get around Compact restrictions.

A potential partial solution could be adoption of an integrated tribal/state water bank and marketing institution along the lines of that proposed by the Ten Tribes Partnership (Appendix D). The proposal suggests that tribes can work with the states to develop a consensus on marketing of tribal water and that tribal water could be used to meet demands in the Lower Basin. The Ten Tribes believe using tribal water to meet this need eliminates the risk to states' apportionments. The proposal by the Ten Tribes to develop a leasing program in conjunction with the basin states and the Secretary is a dramatic first step. If the Lower Basin states ignore this proposal and rely on surplus water, which includes unused tribal water, this inequity can only lead to increased friction between the Indian and non-Indian governments in the basin.

Conclusion

Fourteen years ago, a group of scholars came together at Bishop's Lodge, near Santa Fe, New Mexico, the site where the Colorado River Compact was drafted some 60 years earlier, to reflect on what had happened since and to provide some wisdom and guidance for the future (Weatherford and Brown, 1986). Most of the recommendations that appear above probably appear in one form or another in the proceedings of that symposium. It was perhaps best summed up by Gilbert White, a

participant and one of the true authorities on western water, who wrote then of a "new confluence of views":

> *A great stream like the Colorado can flow a long distance without any significant input from tributaries. Then it can be joined by a new tributary with fresh flow downstream from headwaters. We are at such a point in the flow of thought about the Colorado. After a long reach in time, during which the main channel has changed only a little, it is swelled by a rush of new perspectives on resources, needs, values and technologies originating in diverse social and economic landscapes. The basin is physically different than it was in 1922; its national setting has changed; its population is different; and perceptions of it have altered. These inputs are mingling with the views long implicit in the "Law of the River."*

One suspects that Professor White would still agree with this philosophical assessment today. Perhaps even more so.

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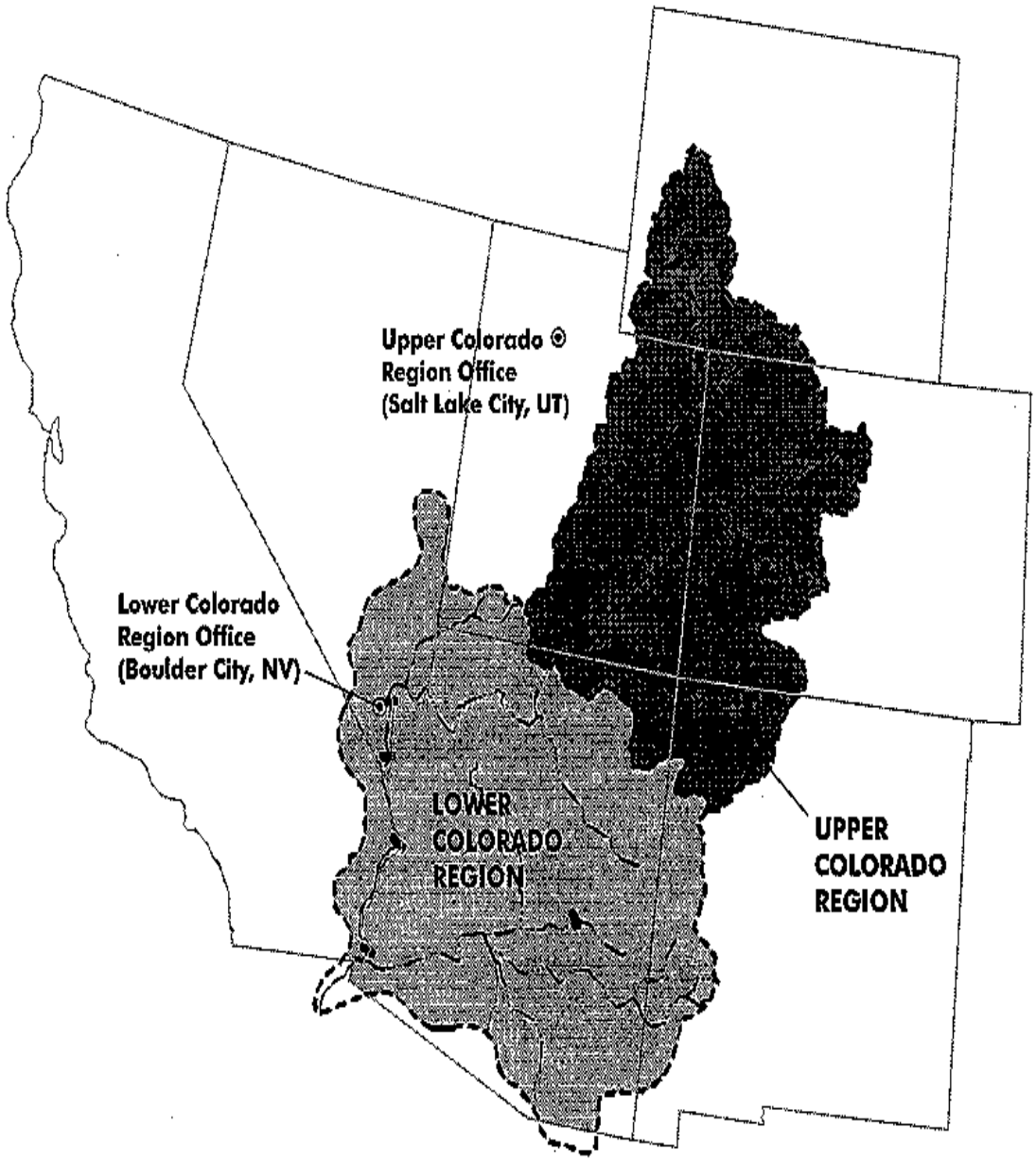
Appendix A

Federal Jurisdiction Within the Colorado River Basin

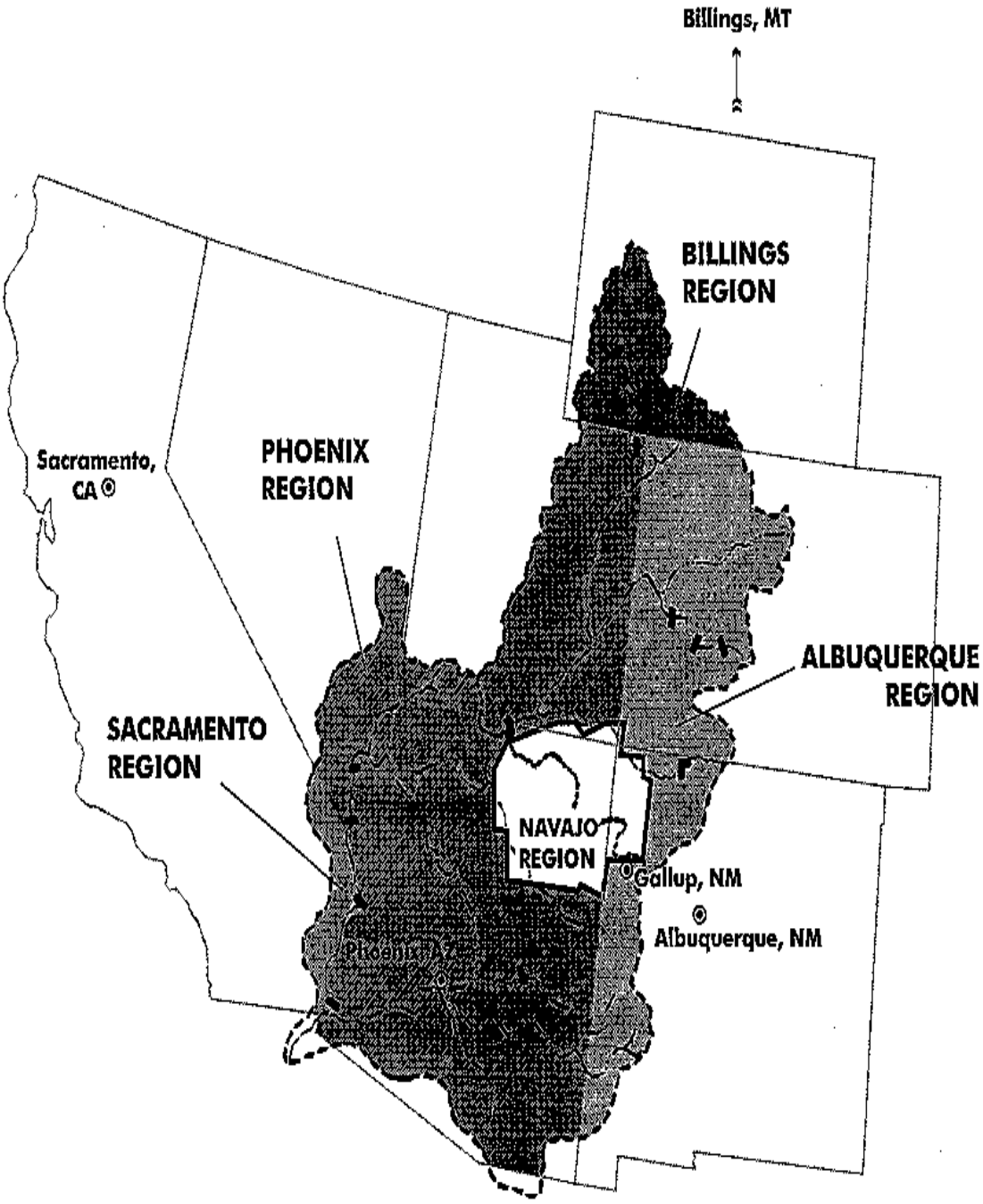
Bureau of Reclamation

MISSION: To manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.



Bureau of Indian Affairs

MISSION: To enhance the quality of life, to promote economic opportunity, and to carry out the responsibility to protect and improve the trust assets of Indian tribes and Alaska Natives.



Bureau of Land Management

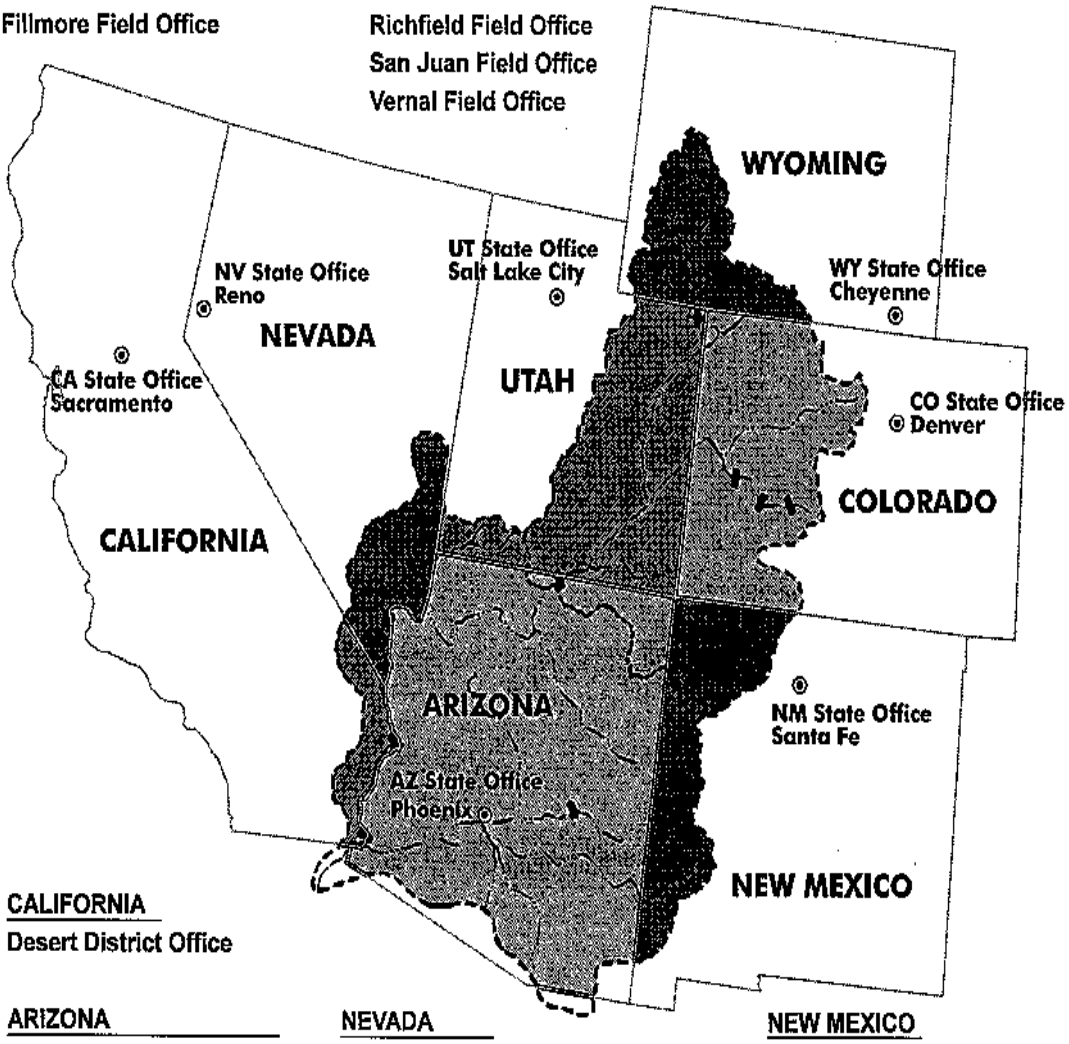
MISSION: To sustain the health, diversity and productivity of the public lands for the use and enjoyment of present and future generations.

FIELD AND DISTRICT OFFICES IN THE BASIN:

UTAH
Cedar City Field Office
Dixie Field Office
Escalante Field Office
Fillmore Field Office

UTAH (continued)
Kanab Field Office
Moab Field Office
Price Field Office
Richfield Field Office
San Juan Field Office
Vernal Field Office

WYOMING
Rawlins District Office
Rock Springs District Office



CALIFORNIA
Desert District Office

ARIZONA
Arizona Strip Field Office
Havasu Field Office
Kingman Field Office
Phoenix Field Office
Safford Field Office
Tucson Field Office
Yuma Field Office

NEVADA
Ely District Office
Las Vegas District Office

COLORADO
Craig District Office
Grand Junction District Office
Montrose District Office

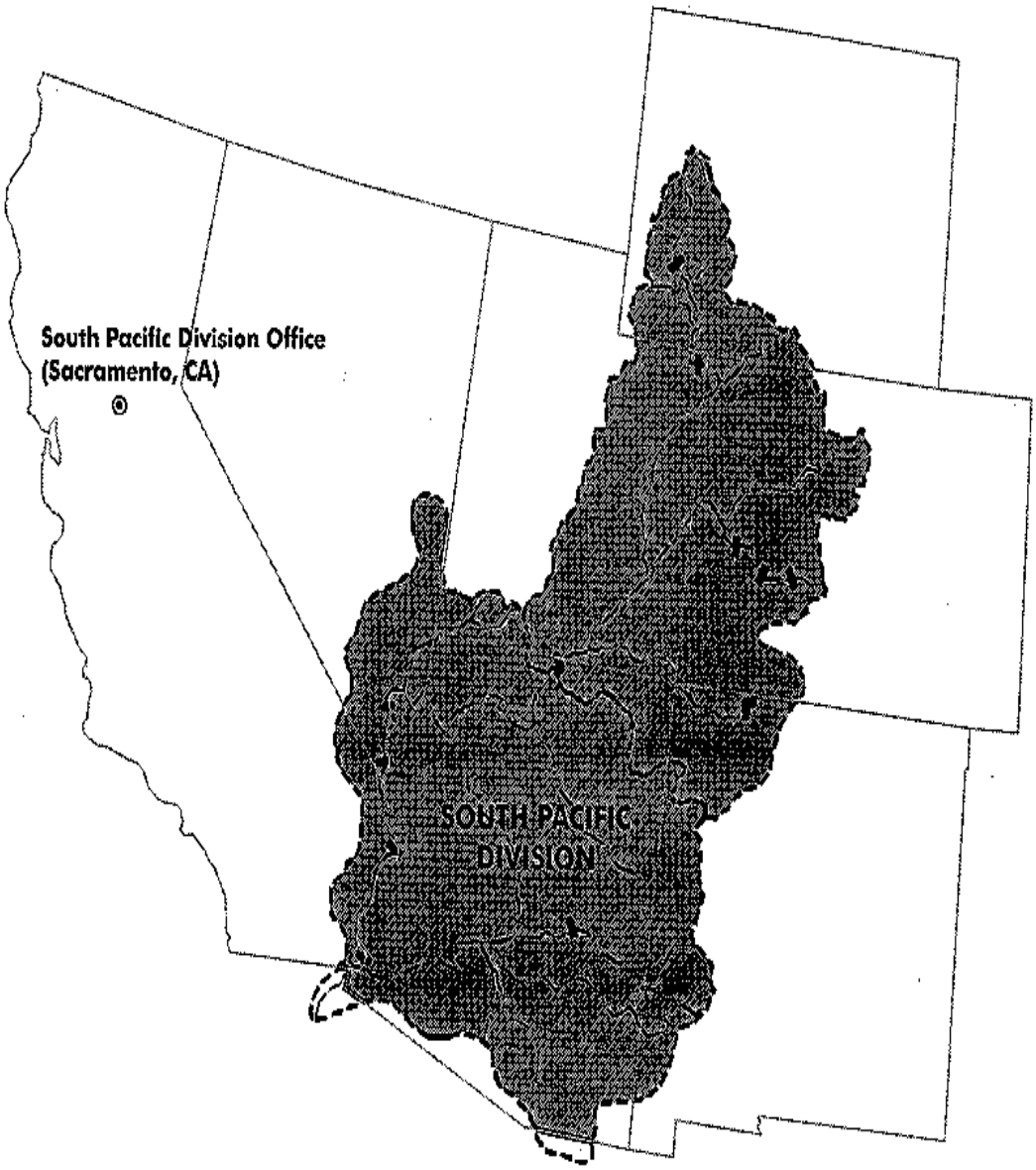
NEW MEXICO
Albuquerque Field Office
Farmington Field Office
Las Cruces Field Office
Socorro Field Office

Army Corps of Engineers

MISSION: To investigate, develop, and maintain the nation's water and related environmental resources; construct, operate and projects for navigation, flood control, major drainage and beach restoration and protection, related hydropower development, water supply, water quality control, fish and wildlife conservation and enhancement, and outdoor recreation; respond to emergency relief activities directed by other federal agencies; and administering laws for the protection and preservation of navigable waters, emergency flood control and shore protection.

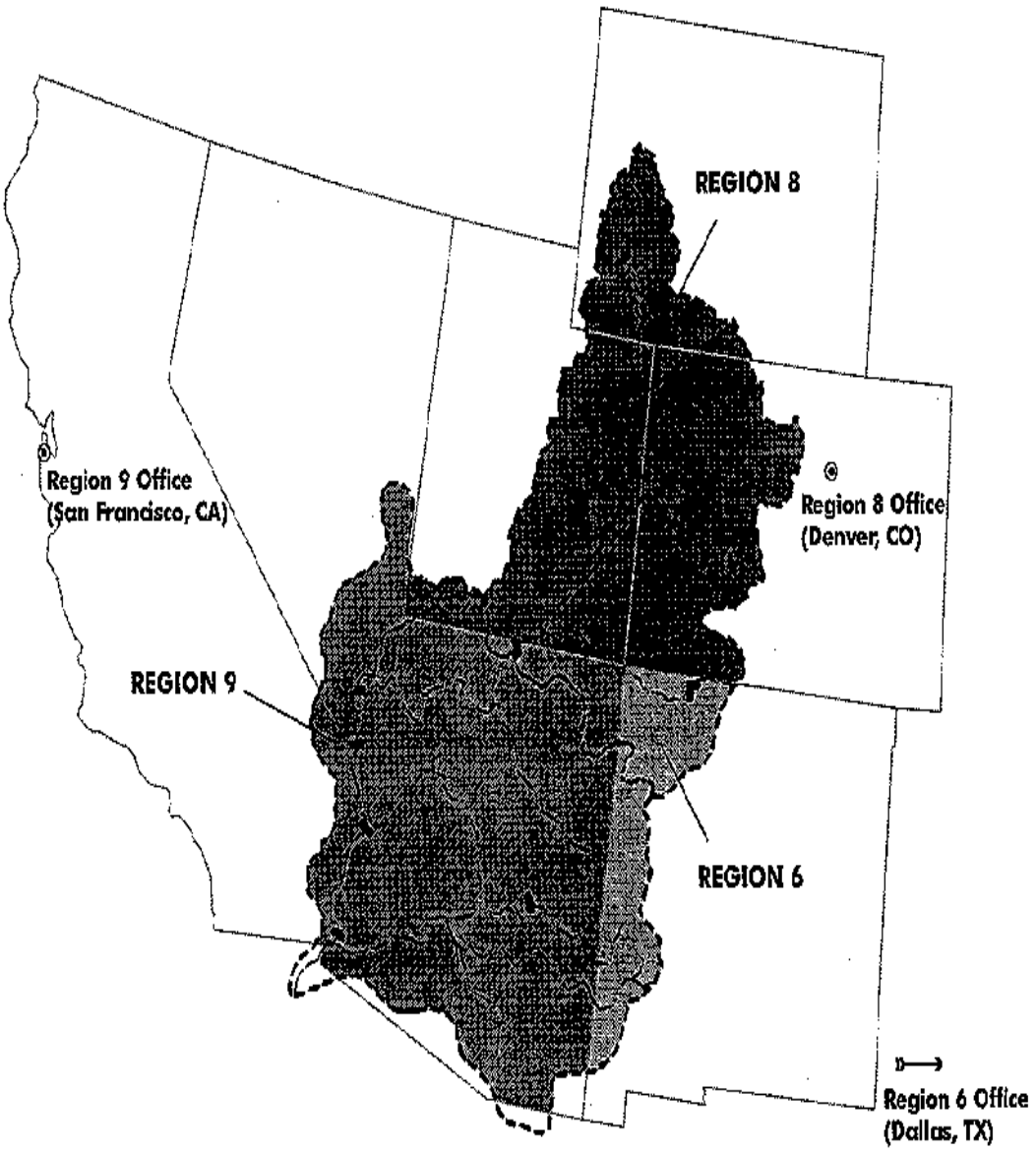
DISTRICTS IN THE SOUTH PACIFIC DIVISION:

Sacramento District
San Francisco District
Los Angeles District



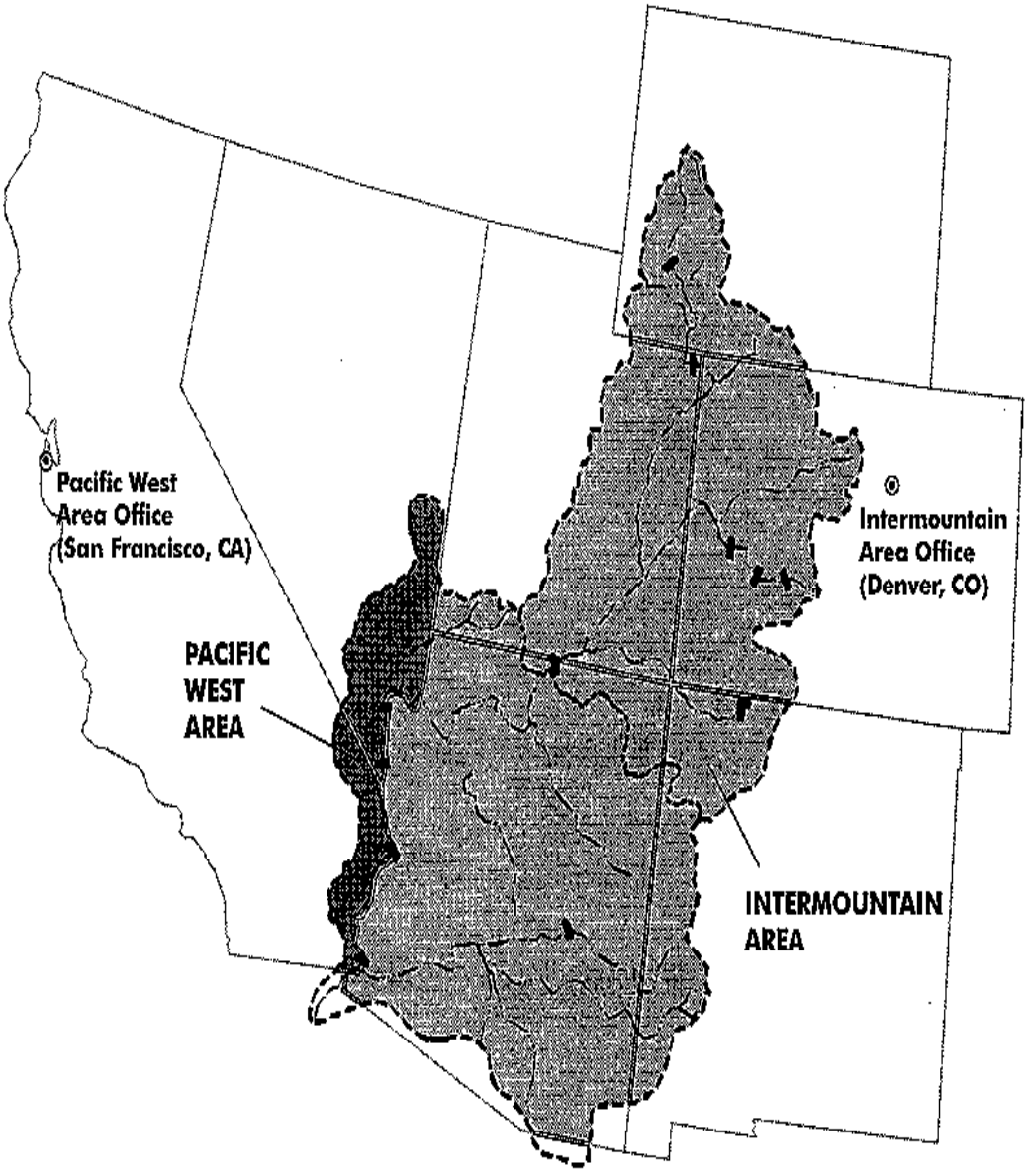
Environmental Protection Agency

MISSION: To solve the nation's urgent environmental problems and to protect the public health.



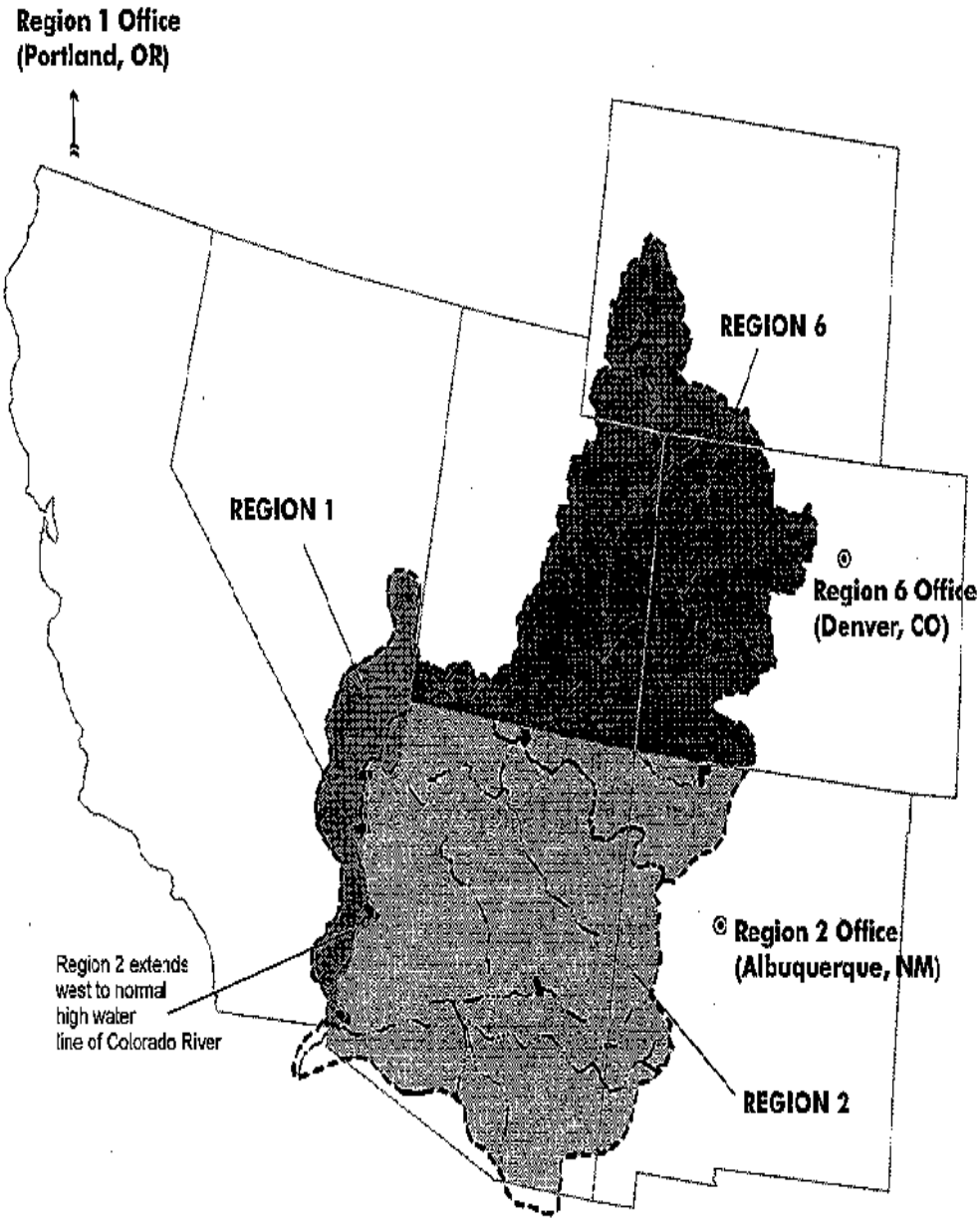
National Park Service

MISSION: To conserve unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The Service is also responsible for managing a great variety of national and international programs designed to help extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.



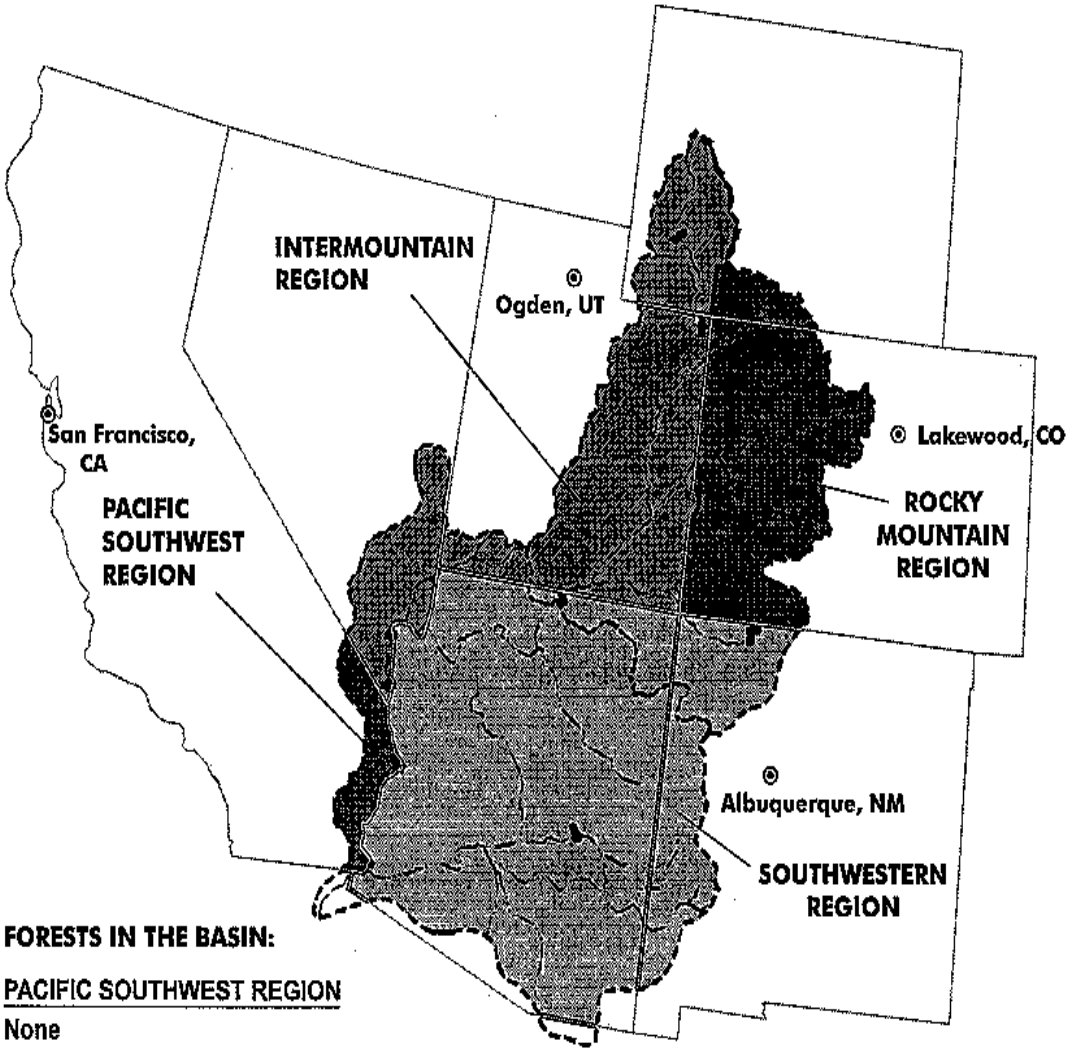
U.S. Fish & Wildlife Service

MISSION: To conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people.



U.S. Forest Service

MISSION: To achieve quality land management under the sustainable multiple-use management concept to meet the diverse needs of the people.



FORESTS IN THE BASIN:

PACIFIC SOUTHWEST REGION

None

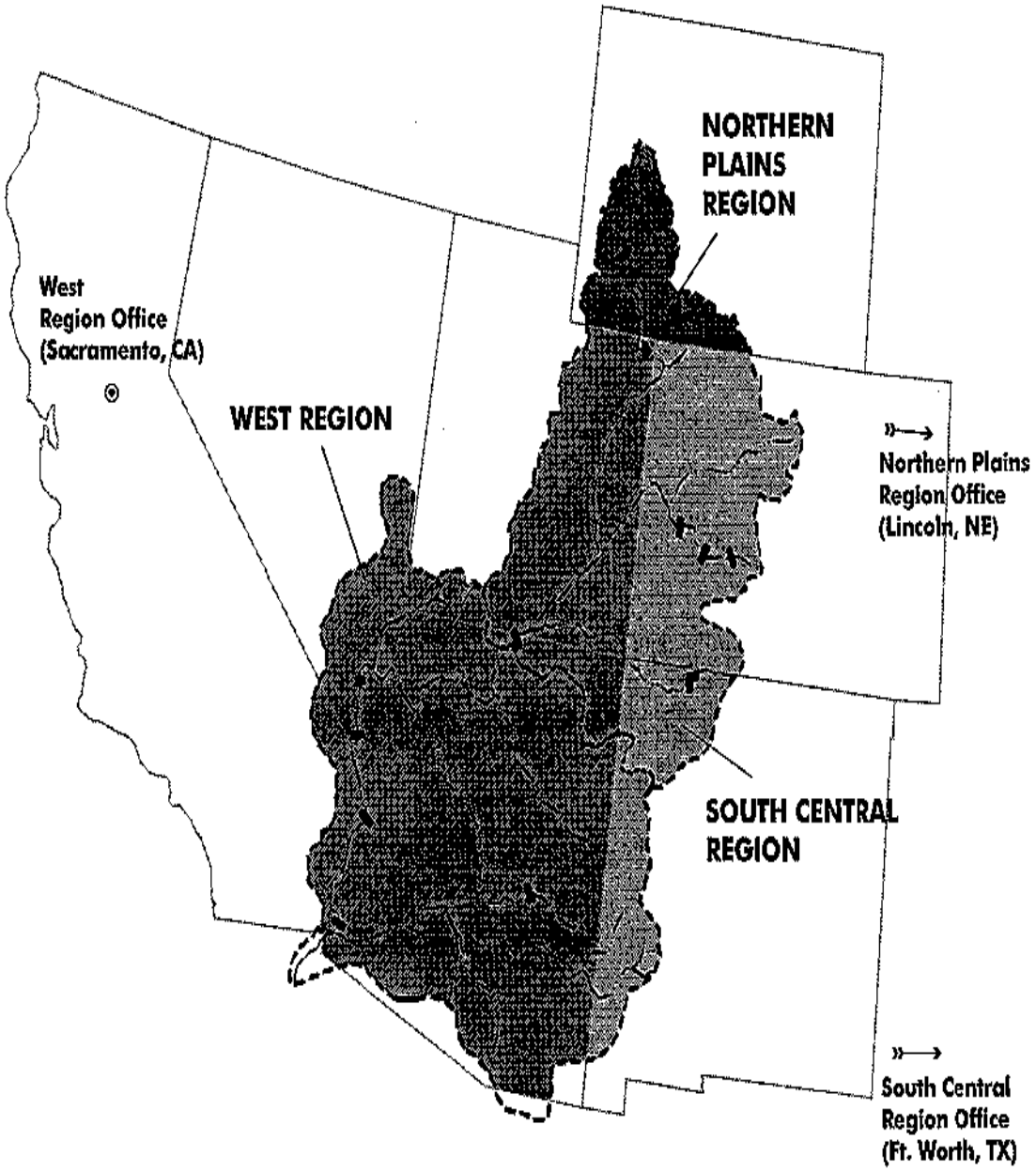
INTERMOUNTAIN REGION	
Ashley	Toiyabe
Bridger	Uinta
Dixie	
Fishlake	
Manti-La Sal	

ROCKY MOUNTAIN REGION	
Arapaho	San Juan
Grand Mesa	Uncompahgre
Gunnison	White River
Medicine Bow	
Routt	

SOUTHWESTERN REGION	
Apache	Gila
Carson	Kaibab
Cibola	Prescott
Coconino	Sitgreaves
Coronado	Tonto

Natural Resource Conservation Service

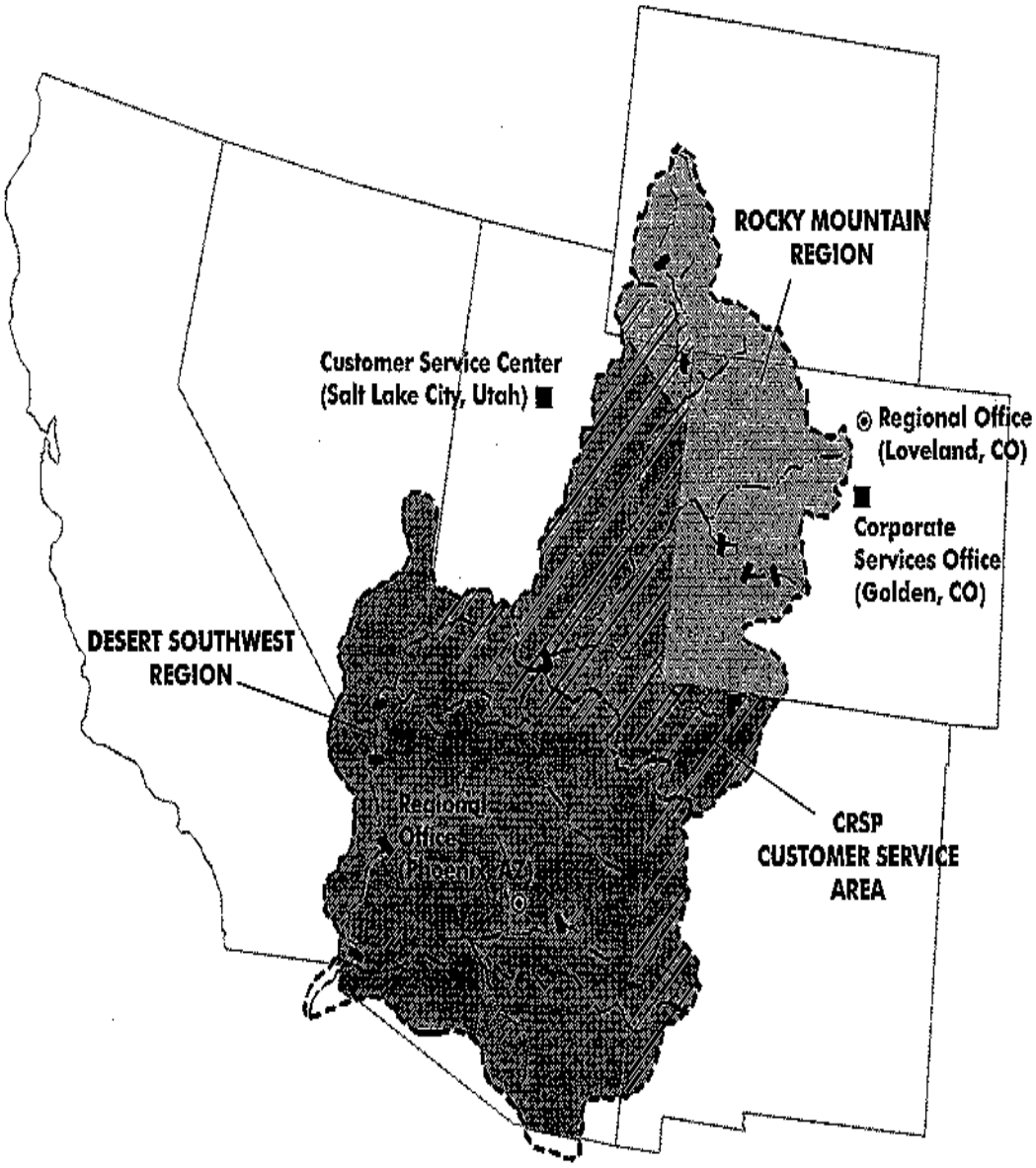
MISSION: To work hand-in-hand with the American people to conserve, improve, and sustain natural resources on private lands.



U.S. Department of Energy
Western Area Power Administration

MISSION: The Department of Energy, in partnership with its customers, is entrusted to contribute to the welfare of the Nation by providing the technical information and scientific and educational foundation for technology, policy, and institutional leadership necessary to achieve efficiency in energy use, diversity in energy sources, a more productive and competitive economy, improved environmental quality, and a secure national defense.

Western Area Power Administration (WAPA) markets and transmits reliable, low-cost electric power, provides related services and encourages energy efficient management in an environmentally sound manner. Hydroelectric power is marketed from 55 powerplants operated by the Bureau of Reclamation, the U.S. Army Corps of Engineers and the International Boundary and Water Commission.



Appendix B

Major Components of the Law of the River

Appendix B

Major Components of the Law of the River

- The River and Harbor Act, March 3, 1899.
- The Reclamation Act of June 17, 1902.
- Reclamation of Indian Lands in Yuma, Colorado River, and Pyramid Lake Indian Reservations Act of April 21, 1904.
- Yuma Project authorized by the Secretary of the Interior on May 10, 1904, pursuant to section 4 of the Reclamation Act of June 17, 1902.
- Protection of Property Along the Colorado River Act of June 25, 1910.
- Warren Act of February 21, 1910.
- Patents and Water-Right Certificates Acts of August 9, 1912 and August 26, 1912.
- Yuma Auxiliary Project Act of January 25, 1917.
- Availability of Money for Yuma Auxiliary Project Act of February 11, 1918.
- Sale of Water for Miscellaneous Purposes Act of February 25, 1920.
- Federal Power Act of June 10, 1920.
- The Colorado River Compact, 1922.
- The Colorado River Front Work and Levee System Acts of March 3, 1925; June 21, 1927.
- The Boulder Canyon Project Act of December 21, 1928.
- The California Limitation Act of March 4, 1929.
- The California Seven Party Agreement of August 18, 1931.
- The Rivers and Harbors Act of August 30, 1935.
- The Parker Dam Power Project Appropriation Act of May 2, 1939.
- The Reclamation Project Act of August 4, 1939.
- The Boulder Canyon Project Adjustment Act of July 19, 1940.
- The Mexican Water Treaty, February 3, 1944.
- Gila Project Act of July 30, 1947.
- The Upper Colorado River Basin Compact of October 11, 1948.

- Consolidate Parker Dam Power Project and Davis Dam Project Act of May 28, 1954.
- Palo Verde Diversion Dam Act of August 31, 1954.
- Change Boundaries, Yuma Auxiliary Project Act of February 15, 1956.
- The Colorado River Storage Project Act of April 11, 1956.
- Water Supply Act of July 3, 1958.
- Boulder City Act of September 2, 1958.
- Report of the Special Master, Simon H. Rifkind, *Arizona v. California,* et al,. December 5, 1960.
- United States Supreme Court Decree, *Arizona v. California,* March 9, 1964.
- International Flood Control Measures, Lower Colorado River Act of August 10, 1964.
- Southern Nevada (Robert B. Griffith) Water Project Act of October 22, 1965.
- The Colorado River Basin Project Act of September 30, 1968.
- The National Environmental Policy Act of 1969.
- Criteria for the Coordinated Long Range Operation of Colorado River Reservoirs, June 8, 1970.
- Supplemental Irrigation Facilities, Yuma Division, Act of September 25, 1970.
- Minutes 218, March 22, 1965; 241, July 14, 1972 (replaced 218); and 242, August 30, 1973, (replaced 241) of the International Boundary and Water Commission, pursuant to the Mexican Water Treaty.
- The Endangered Species Act of 1973.
- The Colorado River Basin Salinity Control Act of June 24, 1974.
- The Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977.
- United States Supreme Court Supplemental Decrees, *Arizona v. California,* January 9, 1979, and April 16, 1984.
- Hoover Power Plant Act of August 17, 1984 (98 Stat. 1333).
- The Grand Canyon Protection Act of 1992.
- The Numerous Colorado River Water Delivery and Project Repayment Contracts with the States of Arizona and Nevada, cities, water districts, and individuals.
- Hoover and Parker-Davis Power Marketing Contracts.

Appendix C

Letter of Dec. 9, 1996, from Six States to California

Text of letter may be requested from the Commission office.

Appendix D

Position Paper of the Ten Tribes with Water Rights In the Colorado River Basin

Submitted to the Seven States in the Colorado River Basin

Text of position paper may be requested from the Commission office.