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Colorado River Law: Its Development and Impact on the Operations of Glen Canyon Dam

(U.S.) Bureau of Reclamation, Salt Lake City, UT

Jan 89

U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
NTIS®

ECO901

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. GCES/33/87	2.	3 PB89-143523

4. Title and Subtitle

Colorado River Law: Its Development and Impact on the Operations of Glen Canyon Dam

5. Report Date: January 1989

6.

7. Author(s): David L. Wegner

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
Bureau of Reclamation
Upper Colorado Region
P.O. Box 11568
Salt Lake City, UT 84147

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address
Glen Canyon Environmental Studies
Bureau of Reclamation, Upper Colorado Region
P.O. Box 11568
Salt Lake City, UT 84147

13. Type of Report & Period Covered: Final

14.

15. Supplementary Notes
Prepared in cooperation with the Glen Canyon Environmental Studies

16. Abstract (Limit: 200 words)

This report describes the legal framework for the development of water in the Colorado River Basin, present Federal management of the Colorado River Basin, and the subsequent relationship to the operation of Glen Canyon Dam. Early development history of the Colorado River Basin from 1870 to present, laws, compacts, and negotiations which define the allocation of Colorado River water between the seven Colorado River Basin states are presented. Future constraints to the management of available Colorado River water are discussed.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement
No restriction on distribution.
Available from National Technical Information Service, Springfield, VA 22161

19. Security Class (This Report): UNCLASSIFIED

20. Security Class (This Page): UNCLASSIFIED

21. No. of Pages: 21

22. Price

COLORADO RIVER WATER LAW: ITS DEVELOPMENT AND IMPACT ON THE OPERATIONS OF GLEN CANYON DAM

The management and operation of Glen Canyon Dam and the Colorado River Storage Project is defined by physical, legal, and system components. The determination of alternative flow opportunities for the operation of Glen Canyon Dam requires that the logic and boundaries for management be defined. The development of the water law for the Colorado River is briefly outlined from the initiation of irrigation in the early 1900s through the Colorado River Basin Salinity Control Act of 1974.

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INTRODUCTION

The Colorado River is the dominant river system in the southwestern United States. Over 20 million people depend upon it for drinking water, irrigation, electricity, and recreation. The river drains approximately one-twelfth of the continental United States as it flows from the Rocky Mountains to the Gulf of California. The Colorado River has figured prominently in the development of the area and is the lifeline of the Southwest.

The Colorado River has been regulated and manipulated since the 1800s, but the laws, treaties, compacts, agreements, and management mandates that define the operation of the river have often been in conflict. Today, the management and manipulation of the Colorado River is reflected by a myriad regulations, referred to as the "Law of the River."

It is the objective of this report to outline the history, laws, compacts, negotiations, and debates that have led to the present management and operation of the dams of the Colorado River Basin. The information presented addresses the basic laws which guide the Department of the Interior and the seven Colorado River Basin states in the management of the Colorado River system. It is not meant to be an in-depth analysis and interpretation of these laws or a delineation of all the facts, figures, and documents. Instead, it is to provide the Glen Canyon Environmental Studies research

group with the background information necessary to understand the complexity of the operations of Glen Canyon Dam.

Several references have been used in the development of this report (Meyers 1967, Nathanson 1978, Olson 1926, U.S. Department of the Interior 1974, Weatherford and Brown 1986). The discussion presented here represents a consolidation of the information from these documents.

SYSTEM DESCRIPTION

The Colorado River Basin comprises 244,000 square miles and includes portions of seven western states (Wyoming, Colorado, Utah, New Mexico, Nevada, Arizona, and California) and Mexico. The basin is a geographic composite of high mountains and deserts. Thirteen major reservoirs and dams are managed to control the release and passage of water through the system. In addition, the state of Colorado has several trans-basin diversions which transport water to the eastern slope of the Rockies. The Central Utah Project will transport water from the Colorado River Basin to the Great Basin for use in the Salt Lake City area. The Central Arizona Project will allow for the diversion and transport of Colorado River water to the Phoenix and Tucson metropolitan areas.

The basin is drained by two major rivers: the Green River which originates in the Wind River Mountains in Wyoming and the Colorado River which begins in the Rocky Mountains in Colorado. These rivers join in southern Utah, flow southwesterly through Lake Powell, the Grand Canyon, and the deserts of Arizona, Nevada, and California, and eventually terminate in the Gulf of California. Along its 1,400 mile course, the Colorado River is fed by nine major tributaries. It ranks sixth in size among the nation's rivers.

Colorado River water is diverted for many uses and reuses. It has been stated that the Colorado River is one of the most over-appropriated and heavily utilized rivers of the world. Today, the reservoirs on the tributaries and mainstem store over 60 million acre-feet (maf) of water, produce over two million kilowatts of power, and annually export over five maf of water for use outside of the basin.

APPROPRIATIVE VERSUS RIPARIAN WATER RIGHTS

To gain perspective into the forces that have shaped the present legal framework for the Colorado River and the operation of Glen Canyon Dam, it is necessary to understand the concepts of the development of water law in the American West. United States water law in the early 1800s was based on the laws and customs that had been established by eastern and midwestern settlers who had sufficient water for their requirements. They did not need to put strict controls on how water was managed or used. The rights to use the water were based on the English Riparian Rights Doctrine which stated that any landowner had a right to use of water that flowed across his land as long as he returned it with its quantity and quality undiminished. The intent of the **Riparian Doctrine** was to keep the water in the stream to protect navigation and enhance the stream's ability to provide power.

The fact that water supplies of much of the western United States were limited, the water was needed away from the river channel, and the Federal Government owned the majority of Western land required that a modified means of water allocation be developed. During the late 1800s and early 1900s users who did not have direct access to or supply of water acquired it simply by diverting what they needed and putting the resource to a beneficial use. After numerous court arguments, it was determined that the "first in time, first in right" concept of appropriating water would be the guiding principle in the allocation of western water resources (Lavendar 1982).

An **appropriative** water right is based on having physical control and providing beneficial application of the water resource. An important aspect of this concept is that long-term storage is considered an acceptable exercise of an appropriative right. Rights to the use of the water are based on the date of initial appropriation and the application to a beneficial use.

In 1879, the U.S. Supreme Court recognized the rights to the Colorado River and reiterated that the appropriative doctrine was the primary legal tool for deciding rights (Lavendar 1982). The Federal Government of the United States still retains the sovereign power to control the water but the rights to use the water has been divided among the Colorado River Basin states based on negotiated compacts and agreements.

The management of the primary mainstem and tributary dams and reservoirs of the Colorado River system is the responsibility of the U.S. Department of the Interior in consultation with the seven Colorado River Basin states. The Secretary of the Interior is the defined Federal water master of the Colorado River. The Bureau of Reclamation (BOR) provides the primary management functions.

DEVELOPMENT OF THE COLORADO RIVER BASIN AND THE "LAW OF THE RIVER"

The development of the water resources of the Colorado River followed a much different path than that of the rest of the country. Since the Colorado River was the main source of water in the basin, many people were dependent upon it, but the cost of development and political requirements were greater then any one individual, group, or state could provide. To compensate for limited individual development ability, water user groups and other political associations were organized to work for water development of the Colorado River. The resulting coalitions, compromise, and agreements form the framework of today's Colorado River water law, the "Law of the River."

The development of the Colorado River Basin can be separated into several distinct periods of action and frameworks for management and operation.

1870-1900. The first documented use of Colorado River water was in 1877 when water was diverted by farmers in the Palo Verde area of Arizona. Several years later, farmers in the Yuma Valley and Imperial Valley started to divert water directly from the Colorado River to irrigate their crops. The acres of land requiring water increased as people settled the West and gained ownership of land through the Homestead Act of 1862, the Pacific Railway Act of 1864, and numerous land development schemes. In the late 1800s, approximately 80,000 acres of land were irrigated. By the 1980s, the number of acres had risen to over 500,000. This period of time also marked the completion of Major John Wesley Powell's historic voyages through the Grand Canyon and the initial discussions of how the waters of the Colorado River Basin should be managed.

1900-1910. During the early 1900s, major changes were initiated in the Colorado River Basin that had far-reaching effects on the future legal and institutional management of the Colorado River. The Federal

Government responded to pressures from several western states to initiate studies on determining the amount of irrigable lands in the Colorado River Basin. John Wesley Powell, Director of the U.S. Geological Survey, initiated studies that identified the amount of Colorado River Basin lands that could be irrigated, where reservoirs could be built to store the basin water, and where the water to fill the reservoirs was to come from. Powell did not believe that there was enough water in the Colorado River Basin to support the amount of land that the states wished to irrigate. The Colorado River Basin states feared the Federal Government was becoming too involved in the future management of western water.

Initially, the basin states held to their positions and limited the Federal Government's action. However, the economic depression of the 1890s, the lack of actual western development, and the large scale development prospects in the lower Colorado River Basin all combined to focus the need for a coordinated basin states approach. In 1902, with the backing of President Theodore Roosevelt, the **Reclamation Act of 1902** was passed, and the Federal Government became a major player in the development of the Colorado River Basin and the rest of the West. The Reclamation Act allowed for the creation of federally subsidized irrigation projects in the West and was the first step toward the development of federally sponsored water projects in the Colorado River Basin.

The U.S. Reclamation Service (Reclamation) was established in 1902 under the U.S. Geological Survey with the purpose of exploring the feasibility of irrigation projects and the development and management of the Colorado River. Two early initiatives set the tone and process that Reclamation would follow in subsequent years. The first initiative in the Colorado River Basin was the Yuma Project. This project, which eventually led to the building of the All-American Canal and Laguna Dam, was funded by bonds issued by a group of Yuma area people called the Yuma Water Users Association and were based on assessments levied to each of its members.

Equally important was the development of multi-purpose dams and control structures. The Roosevelt Dam on the Salt River in Arizona was initiated prior to the enactment of the Reclamation Act, but due to financial and hydrological problems it had not been completed by 1902. With the passage of the Reclamation Act, the area water users saw an opportunity to complete their

project. Contracts for the dam's completion were made between the Salt River Valley Water Users Association and Reclamation. Roosevelt Dam represented the first storage reservoir for Reclamation and was also the first project to use hydropower revenues as a means of repaying the cost of the project. From this point on, hydropower was always considered in any Reclamation multi-purpose dam project.

Control of the highly variable annual flow of the Colorado River was necessary. J.P. Lippincott, the first chief of Reclamation, directed the writing of a report that outlined the potential lower river dam sites. Lippincott, with the assistance of the Assistant Chief Engineer, Arthur Powell Davis (nephew of Major John Wesley Powell), identified the opportunities for diversion of irrigation water along the Arizona-California section of the river. Their recommendations were to initiate a study of two projects: (1) a storage dam in the Boulder Canyon area and (2) Laguna Dam, a structure to divert water from the Colorado River to irrigable land in California and Arizona.

The importance of Native American rights to the waters of the Colorado River Basin was determined by the Supreme Court in 1908 with the settlement of the United States v. Winters lawsuit. In this decision, the Supreme Court ruled that when the United States established the reservations, they had also reserved enough water to convert the Native Americans to an agricultural way of life. These rights to the water were "reserved" until the Native Americans could make use of them. The priority date for such "reserved rights" was determined to be that of the establishment of individual reservations. The 1908 Winters Doctrine court decision continues to play an important role in Colorado River politics.

1910-1925. The early irrigation development of the Colorado River took place in California and Arizona. In 1900, the California Development Company claimed 20,000 acre-feet (af) of Colorado River water and began diverting it, through Mexico, to the Imperial Valley (Salton Sink) area of California. After a series of corporate struggles, the water distribution system was purchased by the Southern Pacific Railroad.

In August 1905, the Colorado River breached the distribution canal and flowed uncontrollably into the Imperial Valley of California, eventually creating the landlocked Salton Sea. It took until February 1907 to close the breach in the canal. The farmers understood

the need for a dependable water supply for crops, but also realized that the high cost to secure the supply could not be borne by any individual. In 1911, the farmers formed the Imperial Irrigation District and purchased the Southern Pacific Railroad's Colorado River water right.

Reacting to a need for a coordinated approach to Colorado River Basin development, an organizational meeting of the seven Colorado River Basin states (and originally Texas and Oklahoma) was held in 1917. Representatives of the Colorado River Basin states met to discuss the use of water supplies of the Colorado River and its tributaries. The state representatives formed an organization called the **"League of the Southwest,"** with the primary purpose to work for the development of the resources of the Colorado River.

The League worked diligently on water issues from 1920 to 1924 and were instrumental in initiating negotiations for the Colorado River Compact. At the urging of the Imperial Irrigation District and state of California, A.P. Davis, Acting Chief of Reclamation, revived studies of the irrigation canal for the Imperial Valley (the All-American Canal), and Congress authorized money to collect field data to evaluate canal options and potential Colorado River storage sites.

Their efforts led to the completion of the **Fall-Davis Report** (named for Secretary of the Interior Albert Fall and Arthur Powell Davis), which recommended that the All-American Canal be built from the Colorado River to the Imperial Valley and that a "high storage dam be built at or near Boulder Canyon" (S. Doc. 142, 67th Congress). The report suggested that the dam be a multi-purpose facility, combining storage, flood control, irrigation, and power generation. In April 1922, a congressman and a senator from California, Phil Swing and Hiram Johnson, introduced a bill to implement the report's recommendations. The bill did not have enough support and was defeated (Cong. Rec., 67th Congress, 2nd Session 1922).

The early 1920s was a volatile time in the history of Colorado River politics. While the Lower Basin states (California, Arizona, and Nevada) were trying to gain approval for the All-American Canal and the Boulder Canyon Dam, the Upper Basin states (Colorado, Utah, Wyoming, and New Mexico) were concerned that the Lower Basin states were gaining an advantage in the appropriation and rights to the Colorado River water. Of further concern was a Supreme Court ruling in a

Wyoming water rights case that determined that the rule of priority of use applied regardless of state lines.

Congress was not amenable to appropriate any money for Colorado River Basin development until agreements on future land use and basin water allocation had been reached. In 1921, a Colorado River Commission was authorized by separate acts of Congress and the legislatures of the seven Colorado River Basin states with the express purpose to negotiate the apportionment of the Colorado River. In 1922, the Commission was charged by Congress with the development of a Colorado River Basin compact, and Herbert Hoover, Secretary of Commerce, was appointed chairman.

The Commissioners met over a nine-month period, but could not agree upon apportionments among the seven states. An agreement could not be reached on individual state apportionments; however, a compromise was negotiated for the division of water between the upper and lower sections of the basin. After 27 meetings, an agreement was reached and the **Colorado River Compact** was signed on November 24, 1922, at the Bishop Lodge in Santa Fe, New Mexico. By the end of 1923, the Compact had been ratified by six of the seven basin states. Arizona was not to ratify the Compact until February 1944 after a series of court cases.

The Compact divided the water between the Upper and Lower Colorado River Basins and defined Lees Ferry as the official accounting location, or Compact Point. Each basin was apportioned the right to 7.5 maf of water per year from the Colorado River system based on an assumed annual basin yield of 15 maf. (Later years proved the 15 maf yield estimate to be higher than the average.) In addition, the Lower Basin was given the right to increase its use by one million acre-feet in any given year. Water for the country of Mexico was to come out of annual surpluses and if insufficient, the burden of deficiency would be equally borne by both basins. The Upper Basin could not cause the flow at Lees Ferry to be depleted below 75 maf for any period of ten consecutive years.

Concurrent with the negotiations for the Colorado River Compact, studies were completed that outlined the potential development of the lower Colorado River. Extensive congressional review of the proposals was initiated and led to the reintroduction (in 1925) of the Swing-Johnson legislation for the Boulder Canyon Dam.

1925-1940. The **Boulder Canyon Act** (45 Stat. 1064, 43 U.S.C.) was finally passed on December 21, 1928, and the prospect of a control dam on the Colorado River became a reality. The primary purposes of the Boulder Canyon Project included: flood control, improvement of navigation, regulation of flows, storage and delivery of water for reclamation and other beneficial uses, and generation of power. The Act officially approved the Colorado River Compact, authorized the building of the All-American Canal, and Boulder Dam and Powerplant, and authorized the investigation of possible reclamation projects in every basin state but California.

A requirement of the Act was that before it could become effective, the state of California had to adopt legislation that would set a limit on its use of Colorado River water. This constraint to project enactment was lifted with the passage of the **California Limitations Act** in June 1929. This Act limited California to 4.4 maf of water per year plus one-half of all surplus water.

Upon enactment of the California Limitations Act, contracts were immediately initiated with California municipalities and agencies for the power and water available from the Boulder Canyon project. These contracts would provide revenue for repayment of the dam and powerplant and provide for operation and maintenance costs. In 1930, California agreed to purchase all the electricity and thereby underwrite the cost of the dam and powerplant. Boulder Dam (later renamed Hoover Dam) construction began in 1931 and was completed in 1935. Lake Mead water storage began on February 1, 1935, and power generation began on September 11, 1936. The 50-year power contracts were initiated on June 1, 1937.

1940-1970. The country of Mexico felt that it was being left out of the official division of Colorado River water and that a formal recognition of its right was necessary. In 1939, the Rio Colorado Irrigation District, a group of northern Mexican farmers, was organized in the Mexicali Valley to assist Mexico's claim for Colorado River Water. In 1941, the Mexican ambassador presented the United States with a draft treaty for the division of the waters. The U.S., eager to satisfy Mexico and retain it as an ally during World War II, ratified and proclaimed official the **Mexican Water Treaty** in 1944.

The treaty guaranteed the country of Mexico a minimum of 1.5 maf of Colorado River water annually. Davis Dam

was authorized to be built to reregulate the flows in the river and the **International Boundary Water Commission** was established to administer the water transfer. In the event of an extraordinary drought, Mexican deliveries will be reduced in the same proportion as the consumptive uses in the United States.

The Upper Basin states were concerned that the Lower Basin was developing at a much quicker pace and that the application of Colorado River water to Lower Basin beneficial uses and the Mexican Treaty could force them to relinquish some of their water. Their concern prompted them to organize an Upper Colorado River Commission to study the allocation of water among the Upper Basin states and to develop a plan for the development of the water resources of the Upper Colorado River Basin.

The need for Upper Basin storage was envisioned when the Colorado River Compact was negotiated in 1922. The allocation of Colorado River Water between the Upper and Lower Basins was contingent upon the Upper Basin delivering the water. In order to achieve the delivery requirements, Upper Basin storage was necessary. Developing the storage required an agreement on water allocation among the Upper Basin states.

An **Upper Colorado River Compact** was negotiated in 1948 among the five Upper Colorado River Basin states. The compact stipulates that Colorado would receive 51.75 percent, New Mexico 11.25 percent, Utah 23 percent, and Wyoming 14 percent. In addition, Arizona is granted 50,000 af annually. An interstate agency was organized to facilitate the coordination between the states with the Upper Colorado River Commission serving as the entity to facilitate Upper Colorado River Basin water decisions.

The Upper Colorado River Commission immediately initiated the study of potential water developments in the Upper Basin. Project reports were prepared in 1951 and 1952. These reports were the basis for the development of the **Colorado River Storage Project (CRSP) Act** (43 P.L. 84-485, 70 Stat. 105). The CRSP Act passed on April 11, 1956, authorized four major storage units in the Upper Colorado River Basin and eleven participating water projects. The participating projects used revenues generated from the hydroelectric plants to help repay the costs of irrigation features that were beyond the ability of the water users to pay. The CRSP purposes were defined as: (1) to regulate the flow the Colorado River, (2) to store

water for beneficial consumptive use, (3) to provide for the reclamation of arid and semiarid land and flood control, and (4) to generate hydroelectric power as incidental to the other project purposes.

From 1957 to 1963, construction of the storage projects was initiated and completed. Construction of Glen Canyon Dam, the key regulatory feature and primary revenue producer, began on October 1956 and was completed in September 1963. The Filling Criteria were established for Glen Canyon Dam by the Secretary of the Interior, Stewart Udall, on July 19, 1962. Glen Canyon Dam officially began to store water in Lake Powell on March 13, 1963, and the filling criteria remained in effect until June 1980 when they expired as Lake Powell reached its full storage capacity of 27 maf.

During this same period, the state of Arizona was attempting to gain authorization for the Central Arizona Project (CAP). Arizona had been trying since it ratified the Colorado River Compact in 1944 to develop the waters of the Colorado River for its use. The Bureau of Reclamation (BOR) prepared a report in 1947 that determined that the transport of Colorado River water to central Arizona was feasible from both an engineering and financial point of view. Congressional consideration of the Central Arizona Project began in the 78th Congress but made little progress until the 90th Congress. At that time, it was determined that no further study would be done until the waters of the Lower Colorado River Basin were either adjudicated and made binding or a mutual agreement as to their use could be made.

In order to further their cause for the Central Arizona Project, Arizona initiated a suit against California in 1952 requesting that Arizona's right to Colorado River water be accepted at 3.8 maf of water. A special water master of the courts was appointed to determine what the Arizona appropriation should be.

In 1964, after eleven years of review, the U.S. Supreme Court decreed that if sufficient mainstem water were available to satisfy the 7.5 maf per year consumptive use in the Lower Basin, then Arizona would be apportioned 2.8 maf per year plus all of the water in its tributaries. California was apportioned 4.4 maf per year; Nevada, 0.3 maf per year. If surplus water exceeded the allocated 7.5 maf level, then California and Arizona would be apportioned 50 percent of the surplus, and the United States would have the right to contract with Nevada for 4 percent of Arizona's share.

In addition, five of the 25 Native American reservations in the Lower Basin were allocated future water rights under the Winters Doctrine. The five reservations were the Chemehuevi, Cocopah, Fort Yuma, Colorado River, and Fort Mohave.

In 1968, during the 90th Congress, Public Law No. 90-537, the **Colorado River Basin Project Act**, was signed into law. The law authorized the CAP; gave California and existing Arizona and Nevada water users priority over CAP water users; assumed the Mexican Water Treaty as a national obligation; established priorities for the coordinated long-range operation of the major Colorado River reservoirs (operating criteria); gave states the right to sue the United States if the Federal Government fails to comply with the "Law of the River;" and established Federal electrical capacity at the Navajo Powerplant, a feature of the CAP. The Navajo Powerplant was added both to generate electricity for the purposes of the CAP and as a trade-off for dams that had been recommended in the Grand Canyon.

The Operating Criteria for the major Colorado River reservoirs included meeting the following priorities: the treaty with Mexico, an Upper Basin guarantee of providing 7.5 maf of water per year to the Lower Basin, carry-over storage given preference to meet the 7.5 maf target, and parity in storage between Lake Mead and Lake Powell.

The Section 602(a) of Public Law 90-537 is important to the operation of Glen Canyon Dam. Specifically, if the Upper Basin forecasted storage is less than the 7.5 maf requirement, or if Lake Powell active storage (water than can be delivered downstream) is less than Lake Mead active storage, then a minimum release schedule of 8.23 maf will be followed. However, if the forecasted storage is greater than the 602(a) requirements, operations at Glen Canyon Dam should be regulated to release water from Lake Powell to Lake Mead as long as Lake Powell has greater storage than Lake Mead, or, if Lake Powell storage is equal to Lake Mead, or to avoid spills from Lake Powell. Within the annual and monthly releases set by BOR, daily releases are scheduled by Western Area Power Administration (WAPA) to meet contractual obligations to power customers.

The Operating Criteria were issued in June 1970 by the Secretary of the Interior. They have as their objective the release of a minimum of 8.23 maf per year at Lees Ferry and require that a reservoir operating plan

be developed by the Secretary each year after consultation with the seven basin states and that a review of the criteria is made every five years.

The last Federal legislation impacting the management of the Colorado River occurred on August 30, 1973, with the agreement between the country of Mexico and the United States on the quality of water to be delivered to Mexico. Minute 242 of the International Boundary and Water Commission set annual salinity levels based on water being diverted to Imperial Valley. The agreement with Mexico precipitated the passage of the **Colorado River Basin Salinity Control Act** in June 1974 (P.L. 93-32, 88 Stat. 266).

The congressional acts, compacts, contracts, court decrees, treaty, and administrative regulations which comprise the "Law of the River" establish the maximum amount of water available for use within each state in the Colorado River Basin.

The actual quantity of Colorado River water available for allocation each year may be more or less than the established ceilings, since the shares are an apportionment of a total supply. These shares are dependent upon annual runoff quantities, available storage space in the reservoirs, and extent of use and depletion by the basin states.

ANNUAL MANAGEMENT OF THE COLORADO RIVER

The overall management of the Colorado River is the joint responsibility of the Federal Government, through the Secretary of the Interior, and the seven Colorado River Basin states. The Secretary of the Interior is the designated water master of the Colorado River. BOR has been given the responsibility to perform the actual management of the river system in consultation with the Colorado River Basin states. Since 1977, WAPA, U.S. Department of Energy, has been responsible for marketing of the electrical energy and capacity developed at the dams. The management of the natural and recreational resources of the Colorado River is the responsibility of a variety of Federal and state offices. Included are the National Park Service, the Fish and Wildlife Service, the Bureau of Land Management, the Bureau of Indian Affairs, the U.S. Forest Service, and the seven Colorado River Basin states.

BOR prepares an Annual Operations Plan (AOP) for the Colorado River and consults on it with the states. The

AOP takes into account available reservoir storage, operation targets, maintenance requirements, and special operation needs.

The operating criteria for reservoirs of the Colorado River system were set in Public Law 90-537, the Colorado River Basin Project Act. The criteria are reviewed formally every five years by the Secretary of the Interior in consultation with the seven Colorado River Basin states. Management of the operation of Glen Canyon Dam on a monthly, daily, and hourly basis is based on meeting the defined annual criteria, avoidance of spilling or bypassing water, and on providing, as an incidental objective, for the generation of hydropower.

The annual goal in the management of Lake Powell is to have a full reservoir (27 maf) by July of each year. Based on historical knowledge of average runoff, a target volume of 22.6 maf, or 4.5 maf of available storage, is strived for on January 1st of each year. With the availability of over 4 maf of storage and the capability to pass 1.1 maf of water through the eight generators each month, the objective of a full Lake Powell by July can be met without having to spill or bypass water. Studies are currently on-going to determine the risk of spilling or bypassing water.

Monthly volumes of water passed through the Glen Canyon Dam powerplant are a function of meeting the annual obligations, achieving reservoir storage targets and providing for the generation of hydro-electricity. BOR determines the annual and monthly release volumes, The monthly volumes are then managed daily, hourly, and by the minute by WAPA, within the constraints of the defined operating criteria.

Any changes in the criteria of operation for Glen Canyon Dam must go through a consultation process with the Colorado River Basin states. If, after development of the operation changes and impacts, it is determined that a modification of the operational criteria is required, a formal review process will be initiated.

FUTURE CONSTRAINTS TO USES OF THE COLORADO RIVER

While the "Law of the River" identifies the apportionment of Colorado River water, there are many areas where the future of the Basin water is uncertain. Significant areas of future conflict include the determination of the actual amount of Mexican water

delivery owed by the Upper Basin states, Operating Criteria of Upper Basin reservoirs, Native American water rights, inter-basin transfer of water, and depletion allowances.

Mexican Water Delivery. The Mexican Water Treaty of 1944 requires a delivery of 1.5 maf of water annually of Colorado River from the United States. The treaty requires that the Upper Basin states satisfy one-half of the delivery obligation that cannot be met from surplus water. The Lower Basin believes that there is no surplus and that the Upper Basin should supply an additional 750,000 af per year plus delivery losses. The Upper Basin contends that there is no shortage and that sufficient water exists to meet all obligations.

Present Upper Basin water-supplies allow for the annual minimum release of 7.5 maf plus the 750,000 af Mexican Treaty requirement, minus 200,000 af provided by the flows from the Paria River. This constitutes the 8.23 maf operation release. The issue of the Mexican Water Delivery requirements will require additional negotiation, but the present water depletion levels in the Upper Basin, do not pose an immediate need to refine the allocation requirement.

Native American Water Rights. Water rights for five Native American reservations along the Colorado River below Lake Mead were defined in 1963 by the U.S. Supreme Court. In the suit Arizona v. California (March 9, 1964, 376 U.S. 340), the Court determined that "enough water was reserved to irrigate all the practicably irrigable acreage of the Reservations." The Native American reservations involved in the definition of allowable irrigable acreage are the Cocopah, Chemehuevi, Colorado River, Fort Mohave, and Fort Yuma. These reservations represent five of the 25 reservations in the lower Colorado River basin.

At question is the amount of water that the tribes hold as a function of their prior rights to water within the Colorado River Basin, defined as the "Present Perfected Right." All Tribal water rights are to be met out of Arizona's and California's apportionment. The conflict arises in years when the flow of the Colorado River is below 7.5 maf. During these years, the Present Perfected Rights are to be satisfied first, giving the Native American tribes priority over Arizona's CAP and limiting California to 4.4 maf.

Operating Criteria for the Upper Basin Reservoirs. With the filling of the major reservoirs of the Upper

Colorado River Basin during the early 1980s, the ability to store excess water within the Basin has been reduced and the probability of having to bypass water around the powerplant at Glen Canyon Dam has been increased. Specific target elevations and volumes have been defined for each reservoir on the Upper Colorado River Basin. Operational management targets and levels must now be established and included in the management philosophy of Glen Canyon Dam to avoid bypassing of water during the runoff period.

Inter-basin and Trans-basin Water Transfers. Inter-basin and trans-basin diversions of water within the Colorado River system have been a part of the development of the Colorado River Basin from the very beginning. The Big-Thompson Project in Colorado initiated the diversion of Colorado River water to the Eastern slope of Colorado as early as 1937. Metropolitan Water District began withdrawing Colorado River water in 1941 and transporting it to the Los Angeles Basin.

In 1982, a proposal was made for the transfer of water from the Yampa River Basin (a tributary of the Green River) to the City of San Diego, California. The initial proposal was for San Diego to lease the water for a specified number of years. The involved basin states have rejected the proposal, but as water pressures increase in the Lower Basin, similar alternative water movement scenarios will again be proposed.

Depletions in the Upper Basin. The proposed development of the water resources of the Upper Colorado River Basin has been slowed due to the drop in the requirements of the energy industry, over-estimation of water needs, and a slower economy. The full development of the water of the Upper Colorado Basin is predicted to occur somewhere around the year 2040.

Each state has developed long-term goals for water development. However, the actual amount of water that is available for development and depletion is less than the original 7.5 maf defined by the Colorado River Compact. Due to the overestimation of available water supply, the actual amount of water that would be available during a dry year is in the range of 5.8 to 6.3 maf. As yet, this is not a problem for any state, except New Mexico which has already reached its depletion limit defined by the Compact.

Consultation with the Seven Basin States. The Secretary of the Interior is responsible for the overall management of the Federal dams on the Colorado River.

The responsibility is defined and articulated throughout the legal mandates and court decisions which compose the "Law of the River." A key area of importance is that the Secretary of the Interior must consult with the seven Colorado River Basin states prior to enacting any operational changes at the dams. This is to ensure that the basin states have an opportunity to review the proposed changes and potential impacts prior to enactment. If the Secretary fails to comply with this, the states can enjoin the Secretary from making the change.

Any operation change at Glen Canyon Dam will require a consultation period with the Colorado River Basin states prior to initiation of any National Environmental Policy Act review.

Priorities of Operation. The balancing of the releases of water from Glen Canyon Dam to meet downstream water allocations, power generation, environmental requirements, and recreation needs will continue to be an area of discussion. Early development of the Colorado River was based primarily on the societal and development needs of the seven basin states. Power generation was added to the appropriate facilities as a means to repay the cost of construction, support other projects, and to provide for operation and maintenance needs. The environmental and recreation aspects were not fully articulated into the management of the operation of the river system.

The Secretary of the Interior, as overall manager of the Colorado River dam system, must make the determination of which aspects of operation take priority in management. Conservation of water is of primary importance. The balancing of the remainder of the issues will require the development of an adaptive and flexible approach to management, an approach which will require consultation with the seven Colorado River Basin states and the other resource management entities in the Colorado River Basin.

Water Quality. The water quality of the Colorado River was originally focused on the levels of salinity associated with the Mexican water deliveries. Water quality standards have not been set by each of the seven basin states. Instead, in 1973, the states addressed the basin salinity problem by establishing the Colorado River Basin Salinity Control Forum. The Forum represents the states of the Colorado River Basin and has set salinity standards for specific locations in the Colorado River. The Colorado River Salinity

Control Act of 1974 and the revisions of 1978 focus the efforts of salinity control at construction of salinity control projects and a desalinization plant.

Additional water quality problems have been identified in the Colorado River Basin. The effects of agricultural return flows and natural sources of selenium, boron, and other minerals and metals will need to be addressed in the future.

The handling of these and other future water quality impacts go beyond the jurisdiction of the Salinity Control Act. Future control will also be focused through interpretations of the Clean Water Act, the Endangered Species Act, the Fish and Wildlife Coordination Act, and other appurtenant state and Federal legislation.

SUMMARY

The Colorado River is the thread that ties the Colorado River Basin together. Its development has been molded around the negotiation and development of laws, compacts, treaties, and agreements that define the amount of water that flows down the river channel.

While a great deal of tradition has defined the operation of the River, we are entering a volatile time in its management. The era of development of the major storage and irrigation projects has ended. The future management of the river will depend upon integrating the "Law of the River" with the quantity of basin water, the other demands on the Colorado River, and coordination between the states and the Federal Government.

How will Colorado River operation decisions be made in the future? How will managers of the often conflicting goals resolve the differences? These questions and many more like them are being formulated and asked today. The Colorado River is the lifeblood of the American Southwest. Directly and indirectly it impacts all the people of the Southwest. Its development as a usable and consistent resource has been accomplished by people who believed in the expansion of the resources and economic worth of the Colorado River Basin. Today, the management of the Colorado River has increased in difficulty as additional environmental and recreational factors have been added to the equation.

The resources of the Colorado River are limited. Limited by the actual amount of water available and

limited by the legal and management concerns. Change in the Colorado River Basin is inevitable. The challenge for the decision-makers and managers is to develop a flexible and adaptive program that allows the Department of the Interior and the Colorado River Basin states to meet their legally mandated obligations and allow the interaction of the other aspects of operations, the environment, recreation, and other natural resource components into the process.

The challenge is to develop an adaptive management plan that allows for evaluation of trade-offs and determination of opportunities to maximize the integration of operations and the other resources of the Colorado River.

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