BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Colorado River Basin Water Problems: How To Reduce Their Impact

Unless Federal, State, and local governments begin to work together, the Colorado River Basin--an area embracing parts of seven Southwestern States--will not be able to cope with a probable water shortage soon after the year 2000.

GAO recommends that the Congress establish a task force to determine how the parties involved should cooperate to improve the supply and quality of water in the Colorado River Basin.

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-133053

To the President of the Senate and the
Speaker of the House of Representatives

This report describes the numerous water problems existing within the Colorado River Basin and discusses the need for the States and the Federal Government to work together to solve these problems.

We made our review to demonstrate the severity of the basin's water problems and to suggest solutions in view of the probable water shortage that will occur soon after the year 2000. The information in this report may be useful to the Congress in considering new methods of managing the basin's water resources.

Copies of this report are being sent to appropriate House and Senate committees; the Director, Office of Management and Budget; the Administrator, Environmental Protection Agency; and the Secretary of the Interior.

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

COLORADO RIVER BASIN WATER PROBLEMS: How to Reduce Their Impact

D I G E S T

The Colorado River Basin is in trouble.

Soon after the year 2000, there will not be enough water to serve the region's booming population, sustain its rapid industrial growth, and support its fertile agricultural lands. Even before 2000, the water is likely to become too salty for many uses. (See pp. 1, 3, 6, and 26.)

These problems are likely to occur despite the millions of dollars the Federal Government has spent on water resource projects in the seven-State area. Many of these complex water problems can be solved if Federal, State, and local governments work as partners to manage the region's water. Cooperation, long-range planning, financial resources, and a decision-making body are needed soon to find cost-effective solutions to the region's problems.

GAO recommends that the Congress establish a task force, consisting of the principal State and Federal executive agencies and representatives of water users, to determine the type of organization best suited to meet the basin's needs and protect the rights and interests of all concerned. (See pp. 54 and 55.)

COOPERATION AND BASINWIDE PLANNING NEEDED

The basin consists of 242,000 square miles of land drained by the Colorado River in California, Wyoming, Utah, Colorado, New Mexico, Arizona, and Nevada. Water resource planning and management has been and continues to be fragmented and crisis oriented because the States and Federal Government are reluctant to cooperate on basinwide problems.

For example, salinity control projects were not proposed or recommended by the States until the salinity level threatened future

water development. Then the response was to rush to build anything that might possibly reduce the salinity level. Today, almost 5 years after the basin's salinity control program was authorized, it is doubtful that salt in the river will be reduced as much as predicted because at least 6 of 17 projects in the program may be in trouble. (See pp. 28 to 30, 42, and 44 and 45.)

HOW MUCH TIME DOES THE BASIN HAVE?

It depends who you ask. The U.S. Bureau of Reclamation estimates that the basin will run out of water for future growth in 2020. Others are less optimistic, foreseeing an impending water shortage around 2000. (See pp. 6 and 7.)

Actually, a solution is needed before then. It takes at least 30 years to plan and construct a water storage or distribution facility. Therefore, the planning and decisionmaking organization GAO envisions should have been in operation in 1970 if the most pessimistic estimates are valid, or need not be established until 1990 if the optimistic estimates are accurate. (See p. 49.)

HOW MUCH WATER IS THERE?

It's difficult to say. Data on riverflow is limited and is not an accurate basis for projection of future supplies. Answers differ, depending on what base years are used to project how much water is normal for the basin. Predicting the future supply is even more difficult when considering future demands on the basin's water. Litigation over Indian water rights may involve as much as one-third of the basin's water. (See pp. 6 to 8.)

WHAT ABOUT THE SALINITY QUESTION?

Water salinity levels--the amounts of dissolved solids or salts--present the basin with one of its most pressing and

difficult problems. As early as 1961, increasing salinity levels began to threaten development of the Upper Basin, were damaging crops in the Lower Basin, and were the subject of intense negotiations with Mexico.

In 1974, the Congress authorized a salinity control program. In a departure from normal water resource legislation, the Congress did not require the salinity control projects to meet standard cost-benefit criteria. (See pp. 25 and 27 to 29.)

This program was intended to maintain the salinity at 1972 levels at least through 1990. However, recent studies indicate that some of the projects will not reduce the salinity level as much as anticipated, and there are no firm plans for controlling salinity after 1990. Construction costs for the major desalination plant designed to meet the U.S. commitment to supply freshwater to Mexico have almost tripled. GAO recommends that the Congress temporarily defer funding for this plant until the Bureau reevaluates its feasibility as well as alternatives which may provide a more economical solution. (See pp. 25, 26, 30, 31, 38, and 43.)

ARE THERE OTHER WATER PROBLEMS IN THE BASIN?

Certainly. In addition to water supply and salinity problems, the Bureau and States have not been able to agree on how much water should be retained in reservoirs, criteria for determining a water shortage, how the reservoirs should be managed during a shortage, and how water shortages should be allocated among the States to meet the commitment to supply water to Mexico. GAO believes that these problems can be solved through cooperation among all the parties. (See pp. 17 and 18.)

AGENCY COMMENTS AND GAO EVALUATION

The Department of the Interior did not object to GAO's recommendation that the Congress appoint a State-Federal task force to study the issues and recommend the type of

organizational and decisionmaking entity needed to achieve basinwide planning and management of the water resources.

However, the Environmental Protection Agency and the States disagree. The Agency prefers strengthening existing organizations, and the States believe existing management is adequate.

GAO continues to believe that a basinwide entity with authority is needed to plan and manage the basin's water resources. This is because severe and complex issues are facing the basin and because existing entities have tended to focus on individual issues, rather than dealing with supply, quality, water rights, etc., on a comprehensive basis. (See pp. 54 and 55.)

Most of the agencies commenting on the report did not believe funding should be deferred for the desalination plant, primarily because of the potential loss of water in a water-short area and the need to meet a national obligation for improving the quality of water to Mexico. However, in light of the increased cost of the plant, GAO believes that other, less costly alternatives may exist and should be evaluated before proceeding with construction. (See pp. 44 and 45.)

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ABBREVIATIONS

Bureau	Bureau of Reclamation AGC 00076
CAP	Central Arizona Project
EPA	Environmental Protection Agency AGC00024
GAO	General Accounting Office

DA-CE AGC 00305

GLOSSARY

Acre-foot	Volume of water that will cover an area of 1 acre to a depth of 1 foot (43,560 cubic feet).
Appurtenant Water	Water that flows over, under, or borders on Federal reserved lands.
Aquifer	Layers of soil or rocks bearing subsurface water (underground reservoirs).
Augmentation	Supplementing the usable water supply in a river through human efforts.
Consumptive use or depletion	Water that is diverted from a surface stream or ground water aquifer and not returned to the stream or aquifer for future use.
Dependable water supply	The amount of water that can be depleted annually over a long period of time, without lowering the levels of ground water or surface water storage.
Desalination	Removing salt and other impurities from water.
Overdraft	Withdrawals from an aquifer exceed the amount of water recharge.
Phreatophyte	A deep rooted plant that obtains its water from the water table or the layer of soil just above it.
Salinity	The total of all dissolved solids or salts present in freshwater, measured in terms of parts per million or milligrams per liter. These measurements are essentially the same.
Water salvage	Saving water for beneficial uses that would normally be lost to human use.
Water shortage	Available water supply is not sufficient to satisfy the legal rights to water and/or meet demands.

CHAPTER 1

INTRODUCTION

Since the turn of the century, the Federal Government, primarily through the Bureau of Reclamation, has spent hundreds of millions of dollars in planning, constructing, operating, and maintaining water facilities in the Colorado River Basin. Originally, facilities were constructed to reclaim arid and semiarid lands in the seven basin States through irrigation. (The basin States are California, Wyoming, Utah, Colorado, New Mexico, Arizona, and Nevada.) Later, these facilities were expanded to include power generation; flood control; municipal and industrial uses; recreational activities; providing water to Mexico; and fish, wildlife, and environmental protection. Although 1977 was one of the driest years on record, the basin States were able to receive their normal, or close to normal, amount of Colorado River water because of these facilities.

The Bureau of Reclamation has planned water projects for irrigation, power, and other beneficial uses. Existing water facilities make available for consumptive use between 70 and 80 percent of the river water available to the United States in the basin. Other projects are currently being planned to develop the remaining water resources.

DESCRIPTION OF THE BASIN

The Colorado River originates in the Rocky Mountains of Colorado and Wyoming, flows southwest about 1,400 miles, and empties into the Gulf of California. It drains an area of 242,000 square miles in seven States, which represents one-twelfth of the area of the United States, excluding Alaska. The basin has climatic extremes of year-round snow cover and heavy precipitation on the high peaks of the Rockies and desert conditions with very low precipitation in southeast California and southwest Arizona. The Colorado River is controlled by several dams and reservoirs. The Glen Canyon Dam and Lake Powell store most of the Upper Basin's water and control releases to the Lower Basin. The Hoover Dam and Lake Mead store most of the Lower Basin's supply and control the amount of water released to Lower Basin users.

Most land in the river basin belongs to the Federal Government, as shown in the following table.

Ownership	Percent of ownership	
	Upper Basin	Lower Basin
Federal	60	52
Private	20	18
Indian trust	15	18
State/municipal	5	12
	100	100

ALLOCATION OF THE WATERS AMONG THE STATES

The Colorado River has been described as the most regulated river in the United States. It is regulated in accordance with numerous laws, compacts, court decrees, and agreements, collectively known as the "Law of the River." (See app. I.)

In 1922, the seven States in the region agreed to divide the waters of the Colorado River system into an upper and lower division. The States of the upper division are Colorado, New Mexico, Utah, and Wyoming; while the States of the lower division are Arizona, California, and Nevada. Arizona, New Mexico, and Utah receive water from both divisions. The map on page 4 shows the boundaries of the divisions (hereinafter referred to as sub-basins). The agreement, or Colorado River Compact, provided for apportioning annually 15 million acre-feet (maf) of consumptive use of water equally between the two sub-basins. The division point is at Lee Ferry in Arizona just below Glen Canyon Dam. In addition to the 15 maf allocation, the Lower Basin was given the right to increase its use by 1 maf a year, and the compact provided for the possibility of a water treaty with Mexico. (See p. 56.) The compact also provided that at least 75 maf would be delivered to the Lower Basin in any consecutive 10-year period. The source of the additional 1 maf allocated to the Lower Basin and the obligations of each basin to fulfill the Mexican Water Treaty commitment are matters of dispute among the States.

In 1944 the United States entered into a treaty with Mexico whereby the United States would deliver 1.5 maf to Mexico annually. This increased the amount of water allocated out of the river to 17.5 maf annually. In 1973 an agreement was reached under an interpretation of the treaty to require the United States to deliver water having a salinity content only somewhat higher than that of the waters reaching Imperial Dam.

In 1948 the four Upper Basin States, plus Arizona, entered into the Upper Colorado River Basin Compact, which apportioned rights to the Upper Basin water among the States. The Boulder Canyon Project Act of 1928 (43 U.S.C. 617) apportioned 7.5 maf of the Lower Basin's allocation among the three Lower Basin States; however, the States did not agree with the amounts. After much controversy, the Supreme Court confirmed the allocations in its Arizona v. California decree of 1964 (376 U.S. 340).

In summary, as a result of the compacts, the Boulder Canyon Project Act, the Mexican Water Treaty, and the Supreme Court decree, the Colorado River waters have been apportioned as follows:

--Each sub-basin is entitled to consumptively use 7.5 maf annually.

--In the Lower Basin the 7.5 maf was apportioned as 4.4 maf to California, 2.8 maf to Arizona, and 300,000 acre-feet to Nevada.

--In addition, the Lower Basin has been allocated 1 maf which has not been divided among the Lower Basin States.

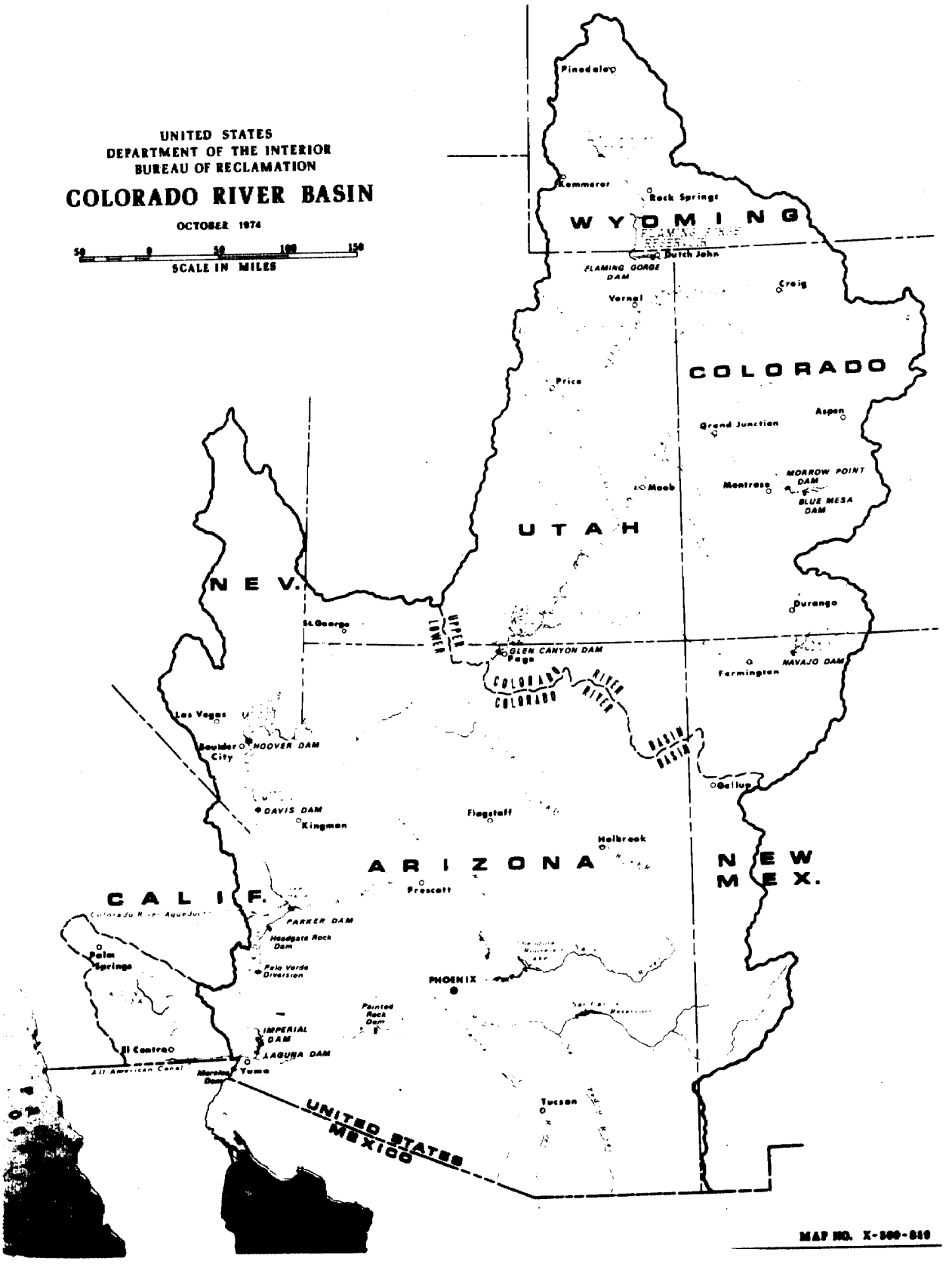
--The Upper Basin's entitlement apportioned 50,000 acre-feet to Arizona; the remainder of the 7.5 maf apportioned 51.75 percent to Colorado, 11.25 percent to New Mexico, 23 percent to Utah, and 14 percent to Wyoming.

--Under the treaty with Mexico, the United States is obligated to deliver 1.5 maf annually to Mexico.

--Five Indian reservations along the Colorado River have a grant of rights to divert about 1 maf, to be deducted from California and Arizona's entitlement.

COMPETING NEEDS FOR WATER

Demands for water in both sub-basins have been mainly for agricultural, municipal, and industrial use to serve the mushrooming population, sustain the traditionally high industrial growth rates, and support some of the Nation's most fertile agricultural lands. Recently, demands have increased for water to use in developing energy resources. The Nation's largest reserves of coal, oil shale, tar sands, and uranium are located in the Upper Basin. Development of these resources will depend on many factors, including availability of water. Historical water use patterns may


UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER BASIN
OCTOBER 1974
SCALE IN MILES
WYOMING
COLORADO
UTAH
NEV.
ARIZONA
NEW MEX.
CALIF.
Pinedale
Kemmerer
Rock Springs
Dutch John
FLAMING GORGE DAM
Vernal
Craig
Price
Grand Junction
Aspen
Montrose
MORROW POINT DAM
BLUE MESA DAM
Moab
Durango
St. George
GLEN CANYON DAM
Page
Farmington
NAVAJO DAM
COLORADO RIVER
Las Vegas
Boulder City
HOOVER DAM
Gallup
DAVIS DAM
Kingman
Flagstaff
Holbrook
Prescott
PARKER DAM
Headgate Rock Dam
Palm Springs
Parker-Davis Diversion
PHOENIX
Painted Rock Dam
IMPERIAL DAM
LAGUNA DAM
El Centro
All American Canal
Yuma
Tucson
UNITED STATES
MEXICO
MAP NO. X-500-819

be altered if these resources are developed because part of the water may have to come from current users.

During recent years national concern has grown over the use of water for the preservation of fish and wildlife and for recreation. Some feel these uses of water will be given even higher priority in the future.

SCOPE OF REVIEW

Many of the facts we cite in this report were taken from reports issued by the Bureau of Reclamation, U.S. Water Resources Council, Environmental Protection Agency (EPA), Upper Colorado River Commission, National Water Commission, the seven basin States, the U.S. Geological Survey (USGS), and various agencies of the Department of the Interior. Appendix II lists the principal reports, documents, and studies we used in preparing this report. We also obtained information from congressional hearings and from the books, records, and reports of the Bureau of Reclamation at Salt Lake City, Utah; Boulder City, Nevada; Denver, Colorado; the Bureau of Indian Affairs at Phoenix, Arizona; and EPA in Washington, D.C. In addition, we interviewed water resources officials in the seven States and Department of the Interior agencies, the Congressional Research Service, environmental groups, EPA, and USGS.

CHAPTER 2

WATER SUPPLY IS INSUFFICIENT TO MEET FUTURE DEMANDS

Most authorities agree there will be a future water shortage in the basin. The question is when and how bad. Many feel that the basin as a whole will experience a surface water shortage sometime after the year 2000. Others say it will occur sooner and be more severe than projected by the Bureau of Reclamation.

Immediate actions are needed if a projected water shortage in the basin is to be avoided or impacts minimized. Although some measures have been taken to salvage and conserve water, not enough has been done and these steps will only postpone, not prevent, the shortage. Efforts to increase supply have not been promising to date and we believe plans should be developed and implemented now to minimize the adverse effects of future shortages. The primary issues that need to be addressed are:

--The need for water plans which reflect the different supply estimates and present a number of alternative strategies for minimizing effects of supply deficiencies;

--the need to reduce ground water overdrafts;

--the impact of Indian and Federal reserved water rights on the water system;

--the need to specify the criteria for declaring water shortages and reservoir storage and operation during low-flow periods; and

--the need to increase efforts to conserve and supplement the water supply.

BUREAU'S PLANS AND DECISIONS MAY BE BASED ON OPTIMISTIC ESTIMATES OF THE ANNUAL WATER SUPPLY

Important decisions are being made--or not being made--based on estimates of future water supply in the basin that are questionable and may be optimistic. The Bureau of Reclamation estimates future supplies from actual records and estimations for a period that may not reflect the long-term average. Water supply estimates made by others are based on both longer and shorter periods and result

in forecasts of a more severe shortage that will occur sooner than the 2020 Bureau projection.

Most decisions concerning the need for and type of Federal projects and programs have been based on the Bureau's water supply estimates. Studies to measure the Colorado River water supply generally start with an estimate of the "virgin" or undepleted flow at Lee Ferry, Arizona, which is the most universally used indicator of the river's water yield. Estimates for the years 1896 to 1922 were made from records of the flow at other points on the mainstream and its major tributaries and estimates of the depletions in the Upper Basin. Since 1922 the flow has been measured by USGS gauges located upstream from Lee Ferry. According to the Bureau, the virgin flow at Lee Ferry has ranged from a maximum flow of 24 maf in 1917 to a low of 5.47 maf in 1977; the long-term average has been about 14.8 maf.

Many decisions involving river development have been based on varying estimates of annual virgin flows, primarily because of conditions present when decisions were made. The following are examples of estimates used when important decisions were made.

Event	Period on which estimates were based	Years	Average annual virgin flow Lee Ferry (maf)
Colorado River Compact negotiations	1903-1921	19	18.0
Studies for the Boulder Canyon project	1897-1928	32	16.9
Upper Colorado River Compact	1914-1945	32	15.6
1956 Colorado River Storage Project Act	1914-1947	34	15.5
1968 Colorado River Basin Project Act	1906-1967	62	15.0
Long-term average	1906-1977	72	14.8

The Colorado River water was divided among the States based on flows in excess of the long-term average. The Bureau's records indicate that the highest flows occurred prior to 1929. It is interesting to note that the 1922

Colorado River Compact was being negotiated during the wettest 10-year period of record (18.8 maf from 1914 to 1923). Records indicate that the negotiators considered the average flow at Lee Ferry to be between 16 to 18 maf which is considerably greater than any other period after that time, including the Bureau's estimated long-tern annual average of 14.8 maf and the period of actual record from 1922 to 1977, which averaged 13.7 maf.

Bureau estimates challenged by several groups

Considerable disagreement exists about future annual river flows. Some people contend that because of the highly variable historical flows, it is almost impossible to predict accurate future average annual virgin flows.

The estimate of 14.8 maf, which the Bureau currently uses in studies and planning for future water development, is one of the more optimistic predictions we noted. As shown below, several other groups estimate the Colorado River's average annual virgin flow as significantly less--up to 1.3 maf less.

--Upper Colorado River Commission officials stated that they consider the gauged records for the 1922-77 period as the more reliable and accept the estimate of 13.7 maf as the future annual virgin flow.

--Engineers from the Lower Basin States testified before the Congress during hearings for a 1968 act 1/ that the virgin flow of the river was between 13.7 and 14.0 maf annually.

--Researchers at the Laboratory of Tree Ring Research, University of Arizona, have used tree ring data to reconstruct the Colorado River's flow for a 450-year period. Using this data, they estimate the river's mean annual flow to be 13.5 maf ± .5 maf. The tree ring studies show that the period 1930 to 1977 is a normal period when viewed in the context of the past few centuries. Using the Bureau's historical data for this period, the average annual virgin flow was 13.2 maf.

1/Colorado River Basin Project Act; Public Law 90-537, 82 Stat 885 (1968), (43 U.S.C. 1501).

The Bureau told us that while tree ring hydrology has future potential, it has not yet been proven reliable.

SUFFICIENT WATER FOR PRESENT BUT NOT FUTURE DEMANDS

As discussed in chapter 1, the Upper and Lower Basins were allocated 7.5 maf each by the 1922 compact and Mexico was allocated 1.5 maf by the 1944 Mexican Water Treaty for a total allocation of 16.5 maf. 1/ Based on most projections of future virgin flows, these allocations substantially exceed the river's dependable water supply.

During the period 1971 to 1975, Bureau records show that, in addition to the water being stored (see app. IV), an average of 12.3 maf of Colorado River water was used for the following purposes.

Type of use	Upper Basin	Lower Basin	Mexico	Total
	(maf)			
Basin exports (note a)	0.69	4.69	-	5.38
Irrigated agriculture	2.19	1.58	-	3.77
Water to Mexico	-	-	1.61	1.61
Reservoir evaporation losses	0.53	0.73	0.01	1.27
Municipal & industrial	0.12	0.09	-	0.21
Wildlife and recreation	0.02	0.04	-	0.06
Total	3.55	7.13	1.62	12.30

a/Includes irrigation, municipal, and industrial water.

The Bureau estimates that by 1990 the Lower Basin States and Mexico will be using an average annual 9.5 maf of mainstream water, including losses, with the Upper Basin using 5.3 maf if presently planned development occurs. (See chart, p. 11.) The Upper Basin's water use rate beyond 1990 is highly conjectural, depending largely upon the uncertain development of the area's huge reserves of oil shale and coal.

1/As stated in chapter 1 and appendix 1, the 1922 Compact, the Boulder Canyon Project Act, and the 1964 Supreme Court decree in California v. Arizona indicate that the Lower Basin was allocated 7.5 maf from the Colorado River mainflow. The source of the additional 1 maf allocated to the Lower Basin is not clearly identified in these documents.

Although the Upper Basin States were apportioned 7.5 maf a year, the Bureau estimates for planning purposes that these States will only be able to consumptively use a maximum of 5.8 maf annually sometime after 2030 because this is the estimated amount remaining when the downstream commitments are made. The Bureau considered a number of factors in arriving at the 5.8 maf estimate including:

--The average annual flow would be 14.8 maf.

--At least 8.25 maf of water a year will be delivered to the Lower Basin. This amount includes the Lower Basin's annual allotment of 7.5 maf, plus .75 maf to meet one-half of the 1.5 maf water commitment to Mexico.

--The reservoirs will be operated so that storage levels do not fall below the minimum power pool. 1/

A major dispute exists between the Upper and Lower Basins over supplying the 1.5 maf commitment to Mexico. The Colorado River Compact states that any required delivery of water to Mexico shall be supplied first from water surplus to the basic apportionment from the Colorado River system (7.5 maf to the Upper Basin, 8.5 maf to the Lower Basin) and if the surplus is insufficient, the burden of such deficiency shall be borne equally by the two basins.

The Lower Basin States contend that there is no surplus and the Upper Basin's share of the Mexican treaty delivery oligation is one-half of the total obligation of 1.5 maf plus one-half of the losses incurred in delivering the water from Lee Ferry to the Mexican border. The Upper Basin States believe that surplus water exists in the Lower Basin and therefore they are not required to release any water to meet the Mexican treaty obligation.

The Bureau has stated that the annual release of .75 maf in addition to the required 7.5 maf is not meant in any way to prejudice the position of either the Upper or Lower Basin interests with respect to required deliveries at Lee Ferry pursuant to the "Law of the River." However, until this is settled otherwise the use of .75 maf as a depletion charge to the Upper Basin is strictly for planning purposes to ensure that projects are designed and operated on the basis of the best possible firm yields of the Colorado River.

1/The lowest level of reservoir water storage at which power can be generated.

Upper Basin State officials believe that the Upper Basin should be allowed to deplete in the range of 6.3 maf to 6.5 maf annually. The principal difference between the estimate of the Upper Basin States of 6.3 and the 5.8 maf estimated by the Bureau is the .75 maf depletion charge to the Upper Basin for planning purposes.

Although the Upper Basin may not reach the estimated 5.8 maf amount by the year 2030, a comparison of the Bureau's estimates of average long-term water supply of about 14.8 maf with future projected depletions for the total Colorado River indicate that the river is approaching the point when the natural water supply will be inadequate to meet all the demands placed on it. Future depletions, as estimated by the Bureau, are presented in the following table.

	Annual use		
	1975	1990	2000
	- - - - (maf) - - - -		
Upper Basin	3.61	a/ 5.29	a/ 5.50
Lower Basin	6.21	7.28	7.37
Mexico	1.66	1.51	1.51
River losses below Hoover Dam	.67	.73	.73
Total	12.15	14.81	15.11

a/Upper Basin officials stated that these depletions may be overstated because of the administration's current position on future development.

Using a mathematical simulation model and assuming an average annual virgin flow of about 14.8 maf, the Bureau has conducted several studies of how the Colorado River and its storage reservoirs are operated. These studies involved analyzing 13 different water supply sequences for the historical period 1906 to present and were modified to reflect projected depletions in future years. Some of the earlier studies showed that sufficient water would be in the river system to meet basin water demands until sometime after 1985 when the Central Arizona Project (CAP) is scheduled to make initial deliveries. After this period, the river will probably not yield enough water under normal circumstances to meet all basin demands, the Mexican treaty obligations, and river system losses. More recent Bureau studies indicate that a shortage of water could occur as early as 1992 and probably would occur prior to 2023. However, these studies

also show that prior to 1985 there is a high probability that the reservoirs will be near or at full capacity and the Bureau will be required to make releases in excess of what is required downstream to provide for future flood storage.

Many State and Federal officials believe that significant shortages probably will not occur until sometime after the year 2000. The exact timing and the availability of water to meet additional Lower and Upper Basin demand will depend on the rate of development in the Upper Basin and actual runoff that occurs in the future. Some State officials believe that the Upper Basin States will develop their water resources at a much slower rate than the Bureau is projecting.

As noted previously, many experts project the future supplies to be less than the 14.8 maf Bureau estimate. If these estimates are correct, the shortages will occur much sooner than the Bureau predicts and will be more severe. Bureau officials stated that any initial downward adjustment in the estimated water supply would not have any significant impact on Upper Basin planning. This is because Upper Basin planned development of 5.8 maf is based on about 14 maf rather than the long-term average virgin flow of 14.8 maf. The approximate 1 maf difference consists mainly of variable high flows that do not recur on a consistent enough basis to be considered a part of the firm supply for the projects being planned and therefore would be passed to the Lower Basin as surplus flows.

However, Upper Basin development would be affected by future average virgin flow of less than 14 maf. For example, an annual flow of 13.5 maf based on tree ring data would leave 5.25 maf for consumptive use in the Upper Basin, assuming an 8.25 maf delivery to the Lower Basin. This is compared to the Bureau's estimate of 5.8 maf for Upper Basin consumptive use.

The use of storage facilities will delay the shortage beyond the time when demand meets virgin supply, but at that point new consumptive uses can only be undertaken by shifting water away from then-current uses, by conservation, or by augmenting the supply of water in the river.

GROUND WATER DEVELOPMENT HAS CAUSED PROBLEMS IN SOME AREAS

Surface water in the basin can meet most of the present demands; however, some areas, mainly in Arizona, have relied

heavily on ground water 1/ as a supply. One effect of this has been that significantly more ground water is taken out than is replenished (overdrafting) and thereby reducing existing water supplies.

The Central Arizona Project was designed to reduce Arizona's dependence on ground water by delivering Colorado River water to central Arizona. Unfortunately, the CAP water supply will not be sufficient to eliminate the overdrafts. Unless the water supply available to CAP is increased, farmland will have to be reduced significantly to balance water supply and use by the year 2020, assuming a median growth rate in nonagricultural activities. 2/ Conservation measures and strong ground water laws could also help reduce the overdrafts. Arizona has taken the first steps toward a strong ground water law.

In many areas of the Upper Basin, the U.S. Geological Survey has reported that opportunities exist to use ground water more effectively and reduce the effects of future shortages by managing surface and ground water as one total supply. Ground water stored in aquifers during wet periods could be used to supplement surface water, particularly during low-flow periods.

A more detailed discussion of ground water is contained in appendix III.

INDIAN AND FEDERAL RESERVED WATER RIGHTS NEED TO BE QUANTIFIED AND SETTLED

Claimed Indian and Federal reserved water rights in the Colorado River Basin may affect future water demands. However, these rights have generally not been quantified or settled to the satisfaction of those concerned. Indian and Federal reserved water rights and the doctrine of prior appropriations, which is generally followed to allocate water rights in Western States, represent two inconsistent water rights doctrines. For example, the doctrine of prior appropriations is based on water rights accruing to those who first put the water to beneficial use. However, unlike appropriative water rights, Indian and Federal reserved rights are based on

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1/Subsurface water in completely saturated spaces between soil particles or rocks is considered ground water.

2/Arizona State Water Plan, Phase II, prepared by Arizona Water Commission, Feb. 1977.

the reservation and ownership of land from the public domain and are not dependent upon actual diversion and use.

Settlement of these claims may involve withdrawal of water rights from present users, since in many cases the water now claimed has been appropriated by other users. Continued delays in quantifying and settling these claims will increase tensions and uncertainties, may cause economic and social disruption, and could block further growth and development in certain areas of the basin. By memorandum dated July 12, 1978, the President directed the Federal agencies to initiate efforts leading to quantification of Indian and Federal reserved rights. The Indian and Federal reserved water rights controversy is the subject of another GAO report. 1/

Quantity of Indian reserved water rights may be substantial

The controversy over Indian reserved water rights and entitlements in the basin is acute. Water rights reserved on Indian reservations were addressed in 1908 in the case of Winters v. United States, 207 U.S. 564 (1908). In brief, the Court pointed out that the American Indians had granted to the Federal Government certain rights to vast landholdings which were capable of supporting their historical way of life. In return for the Indians' giving up their rights and agreeing to move to reservations, the Government assumed certain treaty obligations which could not be taken away by State actions.

It was the Court's opinion that reservations in the West were valueless without water to support the way of life envisioned by the tribes and the Federal Government. The Court realized that it would not be possible for Indian tribes to settle on the reservations and become productive citizens if they were denied sufficient water to fulfill their reservation's purposes.

After 55 years of debate over the legal principles articulated in the Winters case, the Supreme Court concluded in the case of Arizona v. California, 373 U.S. 546 (1963) that:

--The Government intended to deal fairly with the Indians by reserving for them waters without which their lands would have been useless.

1/"Reserved Water Rights for Federal and Indian Reservations: A Growing Controversy in Need of Resolution," (CED-78-176, Nov. 16, 1978.)

--The United States reserved the water rights for the Indians in the amount needed for purposes of the reservation effective as of the time the Indian reservations were created.

The Court also concluded that the Winters doctrine provided that sufficient water was reserved for both the present and future needs of the Indians for the purposes of the reservation.

Reservation for future uses constitutes a significant departure from Western water law, which appropriated water to those who first put it to beneficial use rather than to those who owned the land. This departure has caused considerable consternation among and opposition from the States and non-Indian water users. Because there is no well-defined measure of the amount of water reserved for Indian and Federal uses and because these rights have not been inventoried and quantified, the States and non-Indian water users do not know how much water remains available for appropriative use.

Quantification of Indian reserved water rights raises many controversial issues. For example, certain Indian attorneys have concluded that any quantification of Indian water rights must be flexible enough to accommodate future water uses necessary for economic development of Indian reservations. State attorneys and officials, on the other hand, feel that Indian water rights should be quantified on the basis of uses reasonably foreseen at the time the reservation was established. Otherwise, they argue that the magnitude of the water rights remains open ended and ever increasing.

State officials are also concerned that the reservation doctrine does not provide compensation to existing water users who may be adversely affected by Indian reserved water rights. These officials believe that any solution to the problem should include Federal compensation to existing water rights holders who lose their rights because of this doctrine.

The National Water Commission made a similar recommendation in its 1973 report "Water Policies For the Future." The report recommended that the United States either provide an alternative water supply to non-Indian users or, if this proves infeasible, compensate previous users for impairment of their rights initiated prior to the 1963 decision in Arizona v. California. The report recommends the latter if the previous users had no notice of the Indian rights at the

time they commenced development or if they did not realize supplies were inadequate to serve both Indian and non-Indian users.

Justice Department officials conversely believe that the Federal Government should not pay for rights it already owns. One State official said that the transfer of water from existing users to satisfy Indian claims would destroy the investments made by current water users. He believes a more logical approach might be to compensate the Indians rather than existing users for the loss of water rights.

Several Indian tribes in the basin are claiming Winters rights to large quantities of Colorado River water or are claiming Colorado River water to satisfy claimed Winters rights in other streams. These tribes contend that the Federal Government failed to protect their water rights and has allowed the basin States to allocate their share of the water to other users. Examples of Indian Winters doctrine claims in the basin are listed in appendix VII.

The amount of Federal reserved water right claims is uncertain

The reservation doctrine applied in the Winters case was thought to be a special rule of Indian law as late as 1963 when, in Arizona v. California, 373 U.S. 546 (1963), the Supreme Court reaffirmed the viability of the reservation doctrine and specifically applied it to Federal reservations. The Court upheld U.S. claims to Colorado River water and some of its tributaries for use on non-Indian Federal reservations.

National forests, national parks, Federal rangelands, military establishments, and fish and wildlife refuges are examples of Federal reservations to which this doctrine applies. These Federal reservations and federally owned lands comprise the majority of the landholdings in the Colorado River Basin (60 percent in the Upper Basin and 52 percent in the Lower Basin).

Depending on several factors, the amount of reserved water for Federal lands could vary significantly. The reservation doctrine reserves that amount of appurtenant, then-unappropriated water needed to accomplish the purpose of the reservation. The amount of Federal reserved water for consumptive and nonconsumptive uses has not been identified. Although about 61 percent of all surface water in the 11 Western States originates on Federal reservations, the Public Land Law Review Commission's 1967 final report indicated that less than 1 percent of all surface water used in these States is used on Federal lands.

The water rights for these non-Indian reservations, for the most part, have not been quantified. There are many uncertainties related to this doctrine. For example, may the nature and place of reserved water use on the reservation be changed and, if so, are there any limitations applicable? Another concern is what reserved rights, if any, attach to

--lands acquired from private sources that are within the confines of national parks and forests or

--the naval oil shale reserves for purposes of oil shale development?

State officials in both the Upper and Lower Basins have stated that water requirements for non-Indian Federal reservations will not be significant. One official believed that the Federal claims will be significant, but not upheld.

CRITERIA ARE NEEDED FOR OPERATING STORAGE RESERVOIRS DURING SHORTAGES

With water shortages a certainty in the future, procedures must be decided upon to minimize the impact. Although reservoirs can provide a source of water during shortages, procedures for operating the nine reservoirs in the basin are incomplete. First, the conditions that must exist to declare a water shortage have not been clearly identified. In addition, the amount of water that should remain in the Upper Basin reservoirs for use in shortages has not been determined, nor has an agreement been made on how much water to release to the Lower Basin and Mexico if a shortage occurs. This lack of procedures creates uncertainty as to how the reservoirs will be operated during a water shortage, and thus how much water will be available for use during a shortage. Bureau officials said that these deficiencies have not been corrected because the seven basin States cannot agree on how to handle them and do not believe that agreement needs to be reached at this time.

The Secretary of the Interior in 1970 promulgated "Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs." The criteria are to be used to determine the amount of water to be (1) released from Lake Powell and Lake Mead to the Lower Basin and Mexico and (2) stored in the Upper Basin reservoirs to protect the Upper Basin's use requirements.

However, in establishing the operating criteria, the Secretary did not formally quantify the amount of Upper Basin storage that should be maintained for future periods. This

amount is the storage considered sufficient to meet future releases to the Lower Basin without impairing the Upper Basin's consumptive uses. Also, the criteria state that after the Central Arizona Project becomes operational, the Secretary shall determine when water supply is insufficient to satisfy annual consumptive use requirements in the Lower Basin. However, they do not state what water supply conditions must exist in the river and storage reservoirs that would cause the Secretary to declare a water shortage, nor do they state how the Secretary would make releases from Lake Mead during a water shortage.

These conditions have never been formally stated or quantified because the Bureau has never been able to reach an agreement on them with the basin States. The Upper and Lower Basin States disagree over the amount of Upper Basin storage to be retained and their respective obligations in supplying the Mexican treaty allocation. (See p. 10.)

The Bureau met with the seven basin States in June 1978 to instigate studies addressing reservoir operating criteria and other issues, but the States said that such studies would be premature at that time. For example, Arizona believes that a shortage will not occur for many years and that more specific operating criteria can best be decided closer to the time the shortages occur, as decisions can be based on conditions pertinent at that time.

Since Bureau officials could not reach an agreement with the seven basin States, they believe the States would bring suit if specific criteria are set and that it is better to remain flexible on these matters. These officials prefer waiting until firm operating criteria can be agreed upon by the seven basin States or until a water shortage necessitates an agreement. If legal action is brought after a shortage is imminent, however, mitigating actions may be delayed while the suit is pending.

If the Secretary waits until a shortage occurs, he and the State water officials may be forced to make decisions on a crisis basis that are not in the best interests of the States, Nation, or basin as a whole. Water officials responsible for planning solutions to future shortages need to know how much water will be available for use in both sub-basins and the States so proper decisions can be made. If plans are made without information on the operating criteria, projects may be built that are not needed or that will never have sufficient water to meet project purposes. Water users also need to know what the operating criteria will be, so their plans can be based on reliable water supplies. Very

costly actions may be needed during a crisis, as has occurred in other parts of the West, that could be avoided if the operating criteria were known in advance.

FURTHER EFFORTS ARE NEEDED TO SALVAGE, CONSERVE, AND AUGMENT THE WATER SUPPLY

The Congress, the Bureau, and the States have suggested and/or pursued solutions to the predicted water shortage in the basin. Such solutions have involved water salvage, conservation, and various augmentation methods. Overall, very little progress has been made through these programs to deal with the predicted shortages. Although some programs, such as water salvage, have had limited success, more needs to be done. The areas where opportunities exist to increase or use the available water supply better are summarized below and discussed in detail in appendix V.

Water salvage program has had limited success

The Bureau undertook programs for water salvage 1/ and ground water recovery along and adjacent to the Colorado River and was able to salvage about 569,000 acre-feet annually by

--dredging the river channel,

--removing vegetation along the river bank,

--constructing Senator Wash Dam to improve control of the flow of water to Mexico by reducing excess deliveries, and

--installing wells near the border to reduce the flow of ground water to Mexico.

The Bureau estimates that another 125,000 acre-feet of water will be salvaged annually by the current program of installing additional wells along the Mexican border. Bureau officials also estimate that 191,000 acre-feet of water could be salvaged annually through additional dredging and vegetation removal programs. However, the Bureau has stopped pursuing the dredging program and none is planned for the future because of environmental, fish, and wildlife concerns.

1/Water salvage is saving water for productive use that normally would be lost.

In response to our draft report, Bureau officials from the Lower Basin stated that in an effort to salvage additional water, the Bureau has entered into a contract with Arizona State University to perform research on replacing existing vegetation--mainly salt cedar--growing along the river with vegetation that would improve the environment for the wildlife while consuming significantly less water.

Conservation measures could reduce the impact of the shortage

Conservation practices have not reached their full potential in the Colorado River Basin. Conservation efforts in the basin have been related primarily to irrigation, involving onfarm improvements, reducing losses in the water delivery system, and controlling the amount of water used on crops. These efforts may delay the water shortage. Bureau and State officials stated, however, that conservation along the main stem of the Colorado River will have little impact on conserving the water supply.

Water conservation may reduce the amount of water consumed by nonagricultural vegetation, flowing into deep underground aquifers from which pumping may be economically impracticable, or evaporating into the atmosphere. EPA officials (in a recent report) pointed out that a strong basinwide conservation program may be the most cost-effective method of dealing with salinity.

In response to past recommendations of GAO 1/ and others, the Bureau is investigating ways to make irrigation more efficient. Opposition exists, however, to some conservation measures because of their costs and the lack of incentives to conserve. In addition, several officials from the Federal Government and basin States believe that there are few opportunities to conserve water in the basin. This is because generally water conservation is successful only in areas which are off the Colorado's mainstream and there are few such areas in the basin. On the mainstream, they contend the majority of water wasted by inefficiency returns to the river for reuse.

1/"Better Federal Coordination Needed to Promote More Efficient Farm Irrigation," RED-76-116, June 22, 1976. "More and Better Uses Could Be Made of Billions of Gallons of Water by Improving Irrigation Delivery Systems," CED-77-177, September 2, 1977.

Efforts to increase the Colorado River's water have not solved the shortage problem

Water salvage and conservation programs can only delay, not prevent, water shortages from occurring in the Colorado River Basin. Augmenting the flow of the river seems to be the best method of avoiding the predicted shortage. However, results have not been very promising.

Methods available to augment the water supply include weather modification, vegetation management, desalting geothermal brines and sea water, and importation of water from other river basins. However, only preliminary investigations of these techniques have been made--they generally have not been proven. Environmental, social, political, or legal constraints will have to be overcome for each of these techniques. The costs of obtaining water from these sources are estimated to range from $2 to over $1500 an acre-foot, depending on the technique used.

Weather modification has potential but has not been proven

Although the outcome of existing weather modification projects is not clear, the Bureau and National Weather Modifications Advisory Board believe there is strong evidence that precipitation in the basin can be increased significantly. The Bureau's program has shown that the process of cloud seeding is more complex than originally thought, but the Bureau believes it is still technically and economically feasible. They estimate that stream flow in the basin could be increased by about 1.6 maf annually, at a cost of about $3 an acre-foot.

Vegetation management could save 1.5 maf a year

Preliminary estimates by the U.S. Forest Service Extension at Arizona State University indicate that the water yield can be augmented by 1.5 maf a year through vegetation management. This technique involves changing harvest patterns in commercial forests to permit increased snowpacks and thereby increase water runoff and streamflow. The procedure is estimated to cost from $2 to over $50 per acre-foot, depending on location, and has not been proven on a large scale.

Desalination has great potential but is costly

Techniques of desalting geothermal brines and seawater have been demonstrated and proven, but to date they are too expensive to use in increasing the basin's usable water supply. For example, the Bureau's program to desalinate geothermal water from reservoirs in the Imperial Valley in California has demonstrated that expensive fresh water can be produced. The estimated costs vary from $1,200 to $1,500 per acre-foot for producing 50,000 acre-feet of fresh water. Because of these high costs and low water yields, the Bureau has terminated its geothermal investigations in the Imperial Valley but is still investigating other possible locations in the basin.

Importing water into the basin may not be possible

Importing surplus water from areas outside the Colorado River Basin may be technically possible, but not economically, socially, or politically feasible. Although this solution could solve the basin's supply problems for years to come, the Bureau has not studied the prospects of importing water from the Columbia River Basin because of a 10-year moratorium on such studies in the 1968 Colorado River Basin Act. The moratorium was recently extended another 10 years in the Bureau of Reclamation Safety of Dams Act. An interesting sidelight is that several States export portions of their allocated water from the basin.

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A controversy may develop over the rights to the water produced under an augmentation program. Some State representatives believe that any increased runoff resulting from weather modification, vegetation management, or water salvage will accrue to the States and not to the Federal Government. If this is true, any water produced as part of the augmentation program could not be used to satisfy the national obligation to meet the commitment to Mexico and help meet any demands and commitments for additional water in the basin, as stated in the 1968 Colorado River Basin Project Act. (See app. V, p. 75.)

CONCLUSIONS

The Bureau estimates a water shortage will occur in the basin around 2020; yet this estimate could be optimistic. Despite the as yet unanswered questions on severity and timing of the water shortage, much could be done to delay

or alleviate its adverse impact. Standardized water facility operating procedures to be used during periods of shortage, additional efforts to conserve available water, and augmentation of existing supplies would all help.

The amount of water which will be available during an average year is of crucial importance to the basin. An overly optimistic estimate will lead to a gradual depletion of the stored water and eventually require cessation of deliveries to some users, while a pessimistic estimate will result in less than optimum development of the basin. We recognize that exact predictions of the amount of water in the basin are impossible to make, and for that reason we tend to believe the best estimate would be based on actual metered flows rather than on the less precise estimates of water available in years past. Because the metered flow data indicates an average annual flow of about 13.7 maf--an amount significantly less than the 14.8 maf figure the Bureau is using--we believe its estimate is very optimistic.

While the Bureau recognizes that a water shortage could be much more severe than predicted, most of its plans and programs are based on this optimistic prediction. In our opinion, because the estimate is extremely crucial, all reasonably reliable estimates should be considered during the planning process to determine the effect the supply variation (including reserved water for Indian and Federal lands) would have on study results. We believe this would provide a better basis for managing the basin's water resource and allow for possible contingency planning where deemed necessary. When dealing with a resource as important as water, such analyses should be mandatory.

Since everyone agrees that a water shortage is going to occur at some future time, we believe it is only reasonable to have an established plan of how the water facilities will be operated during a shortage. Water users need to know how the reservoir will operate during a shortage so that they will know the impact of the shortage on their water deliveries and establish their own contingency plans. At a minimum, they need to know what the criteria are for declaring a shortage, how much water will be released during the shortage, at what levels the reservoirs will be maintained, and how much water each basin must provide for the Mexican water treaty commitment.

We believe that in any area of impending water shortage, maximum effort should be made to conserve and augment the existing water supplies. Yet some of the Bureau's programs for salvage and augmentation have been canceled or have had limited success due to environmental consideration, and many of its conservation programs are failing because of legal

and economic constraints. In our opinion, the Federal, State, and local water agencies are not doing enough to resolve the issues surrounding water augmentation and conservation. We believe additional study and research should be conducted in these areas.

RECOMMENDATIONS TO THE SECRETARY OF THE INTERIOR

We recommend that the Secretary of the Interior direct the Bureau to develop a series of water management plans which reflect various supply estimates and present a number of alternative actions. We recommend that these plans be coordinated with all the basin's water managers. The Bureau and others could then be better prepared for the predicted shortages in the event that the less optimistic estimates are correct.

We also recommend that the Secretary amend reservoir operating criteria by stating (1) the conditions under which he will declare a water supply shortage, (2) the amounts to be released during a shortage, (3) the reservoir storage levels to be maintained in low-flow years, and (4) the amount of water each subbasin must provide for the Mexican water treaty commitment.

In addition, we recommend that the Secretary of the Interior direct the Bureau to develop a comprehensive plan specifying the conservation, water salvage, and augmentation techniques that will be used to prevent or minimize the adverse effects of shortages. This plan should identify factors that will interfere with implementing the plan and address how they will be resolved.

AGENCY COMMENTS AND OUR EVALUATION

The Department of Interior disagrees that the Bureau is using an overly optimistic estimate of water supply in the basin. In discussing our draft report, the Bureau pointed out that it analyzed most of the available data before deciding to use the 1906-1977 time frame as the basis of its estimate. The Bureau believes that estimate is the most reasonable estimate of available water in the basin.

We recognize that any statement concerning the amount of water available in the Colorado River Basin, regardless of how it is derived, will be nothing more than an estimate. However, because of the significant adverse social and economic impact that will result when the Basin's development exceeds its long-term water supply, we continue to believe plans for future development and use of water should consider the varying projections of the amount of water that will be available.

CHAPTER 3

CURRENT SALINITY CONTROL PROGRAM MAY NOT BE COST EFFECTIVE IN ACHIEVING DESIRED RESULT

As Colorado River Basin waters are increasingly put to use and consumed, the salinity 1/ of the remaining river water is expected to increase. Although estimates of the extent of damage vary widely, the Bureau of Reclamation foresees economic losses to agriculture and municipal and industrial users of the water due to increased salinity.

The current program for controlling salinity in the basin principally includes setting salinity standards for the basin and possibly constructing 17 salinity control projects. However, it appears this program will not achieve its desired objectives because

- --the 4 projects which have been authorized for construction may not be economically or technically feasible;
- --some of the 13 projects, which have not yet been authorized for construction, appear to have limited potential and are not being seriously considered; and
- --the salinity standards that have been set may not be met when the river's water supply is fully developed.

In spite of this knowledge, no specific long-range plans are being considered to control salinity in the basin after 1990. Although some additional measures are being studied, their impacts on salinity reduction are not known.

In addition to the program to control salinity in the basin, measures are underway that are intended to decrease the salinity of the water going to Mexico. In 1974, several measures to control the salinity of water going to Mexico were authorized by the Congress. Their cost has risen sharply, and more economical alternative solutions should be considered.

1/Salinity, in freshwater, is the total of all dissolved solids or salts present and is measured in terms of parts per million or milligrams per liter. These measurements are essentially the same.

SALINITY LEVELS ARE HIGH IN THE COLORADO RIVER

Historically, the Colorado River's salinity concentration has been higher than that of most other major rivers. The river's 1976 average annual salinity ranged from about 50 milligrams per liter (mg/l) of total dissolved solids in Colorado and Wyoming to 823 mg/l at Imperial Dam in Arizona, the last diversion point in the United States. For comparison, the maximum recommended under EPA's drinking water standard is 500 mg/l.

Increases in salinity result from two basic processes--salt loading (adding salts) and salt concentration (reducing water supply). Salt loading results both from natural runoff and from such activities as irrigation. Salt concentration results when (1) water is lost through evaporation or (2) water of lower salinity than that in downstream water is diverted from the basin. Both increase salinity downstream because the remaining salt is carried in less water. Investigations indicate that the causes of salt concentration increases in the Colorado River are, in order of importance: (1) natural sources, (2) irrigation return flows, (3) evaporation and plant growth, (4) out-of-basin exports, and (5) municipal and industrial sources.

Although various levels of salinity have been projected for the Colorado River, all studies agree that salinity will increase markedly if it is not controlled. The Bureau estimated that without control measures, salinity at Imperial Dam will increase from its present 823 mg/l to about 1,214 mg/l by the turn of the century. The Bureau estimates a cost to agricultural, municipal, and industrial users of the water to be $230,000 1/ for every 1 mg/l increase in salinity at Imperial Dam. Adverse effects of salinity increases would be felt primarily in the Lower Colorado River Basin.

PROGRAMS TO SOLVE THE SALINITY PROBLEM ARE COSTLY AND MAY NOT WORK

The current salinity control program is very costly, may reduce salinity less than expected, and is designed to maintain salinity at 1972 levels at least through 1990. However, there are no specific long-range plans to control salinity in the basin after 1990. The estimated cost for 4

1/Bureau officials stated that this estimate is currently being updated and reevaluated and should significantly increase when a new value is available.

of 17 1/ projects in the program is $279 million, $154 million more than the 1974 authorized cost. As the water is developed and put to use, the river's salinity increases, requiring more salinity control projects.

In response to the growing salinity problem and the possibility that EPA would set salinity standards that prohibit further development, the seven basin States recommended in 1972 that:

--A salinity policy be adopted for the Colorado River system to maintain salinity concentrations in the river at or below levels then (1972) found in the lower main stem.

--Salinity be treated as a basinwide problem that needs to be solved to maintain Lower Basin water salinity at or below present levels while the basin continues to develop its compact-apportioned waters.

The States identified the Bureau's Colorado River Water Quality Improvement program as the best method for implementing the above objectives. The comprehensive, 10-year program set forth plans to control 16 salinity sources and included provisions for related basinwide planning.

The Congress enacted the Colorado River Basin Salinity Control Act (Public Law 93-320, June 24, 1974) to help solve the basin's salinity problems and to meet a water quality commitment to Mexico. Title I was authorized to improve the quality of water going to Mexico downstream from Imperial Dam. Title II authorized measures to improve water quality upstream from Imperial Dam.

Specifically, title II directed the Secretary of the Interior to implement the salinity control program recommended by the States and provided for:

--Construction, operation, and maintenance of four salinity control works in the Colorado River Basin, including Paradox Valley and Grand Valley in Colorado, Las Vegas Wash in Nevada, and Crystal Geyser in Utah.

1/This includes 16 projects in the original program plus the Meeker Dome project, added later.

--Completion of feasibility investigation and planning for another 12 salinity control projects identified by the Bureau.

--Undertaking research on additional methods.

Costs not considered in authorizing upstream projects

According to Bureau officials, the four upstream salinity control units were authorized for construction before appropriate feasibility studies were completed and were justified on the basis of social and political pressures rather than for economic reasons. The social and political justifications were based generally on the fact that water quality in the Lower Basin will continue to deteriorate as undeveloped Upper Basin water resources are used unless salinity control measures are instituted.

During the congressional hearings for this Salinity Control Act, the administration recommended against authorizing the upstream projects for construction because adequate feasibility studies had not been completed. Spokesmen for the seven States testified in support of constructing the four projects.

According to a Bureau official, the Bureau has been unable to justify the overall program on an economic basis, even though some individual projects may be so justified. Cost-effectiveness has been an objective but not a requirement. In effect, the total cost to remove salt from the river would be greater than the benefits to the Lower Basin.

Costs for upstream projects have increased significantly

Since passage of the 1974 act, the four authorized projects have experienced a 123-percent increase in estimated costs. Based on April 1973 prices, the act authorized $125.1 million plus future inflation for construction of the four title II projects. As shown in the following table, the cost of these projects have risen to $279 million, an increase of about $154 million from June 1974 to January 1978. Inflation represents about $62 million, or 40 percent, of the increase in estimated cost.

Project title	Authorized cost 1974	Estimated cost 1978 (notes a & b)	Increase	Percentage increase
	------(000 omitted)------			
Paradox Valley unit	$ 16,000	c/ 49,934	$ 33,934	212
Grand Valley unit	59,000	d/ 169,670	110,670	188
Las Vegas Wash unit	49,600	e/ 56,481	6,881	14
Crystal Geyser unit	500	f/ 2,690	2,190	438
Total estimated costs	$125,100	$278,775	$153,675	123

a/Does not include preauthorization investigation costs, which are currently estimated to be $893,000

b/Does not include interest during construction.

c/January 1977 costs.

d/Costs are as of January 1978 and include costs for onfarm improvements not funded by Public Law 93-320.

e/April 1976 costs.

f/July 1975 costs.

Questionable economic and technical feasibility of upstream projects

The Bureau has not presented to the Congress information on how much money would be saved (damages avoided) by the four authorized projects and has not computed a benefit-cost ratio because they say it is not required by Public Law 93-320. As shown in the next table, we computed the cost-effectiveness of the four projects. The annual equivalent costs 1/ were based on information provided by the Bureau. The annual benefits were computed by multiplying $230,000 2/ times each mg/l reduction in the salinity level at Imperial Dam. The results

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1/Annual equivalent costs are all construction, operation, and maintenance costs discounted over the life of a project and presented on a yearly basis.

2/Annual benefits would be the avoidance of economic damages of $230,000 cost by each mg/l increase in salinity at Imperial Dam. This figure is currently being reevaluated by the Bureau.

show the estimated cost for three of the projects are significantly greater than the estimated benefits.

Projects	Salinity reduction at Imperial Dam	Annual equivalent cost	Annual reduction in damages	Extent that cost exceeds reduction in damages
	(mg/l)	(000 omitted)		
Paradox Valley	18.2	$ 3,507	$4,186	$ (679)
Grand Valley	43	10,824	9,890	934
Las Vegas Wash	9	8,727	2,070	6,657
Crystal Geyser	0.3	234	69	165

Construction of salinity control projects delayed

All four authorized projects have been subject to delays. The Bureau has decided to delay construction of the Crystal Geyser unit because of high cost and the minor impact it will have on reducing salinity at Imperial Dam (0.3 mg/l). Completion estimates for the Grand Valley, Paradox Valley, and Las Vegas Wash 1/ projects have been extended 21, 36, and 48 months, respectively. Bureau officials reported that these schedule delays were caused by delays in completing definite plan reports. They said that delays in completing the report were due to (1) conflicts in priorities between salinity control projects and water resource development projects, (2) lack of sufficient manpower to meet schedules, and (3) requirements to add fish and wildlife mitigation measures to some projects.

The problem is compounded by the fact that recent Bureau studies have disclosed certain technical and feasibility problems with each of the projects. For example, current information on the status of the Las Vegas Wash unit indicates that it will not reduce salinity levels as much as initially

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1/In light of recent developments (as discussed in this section), the Bureau is also delaying construction of the Las Vegas Wash to study the project further.

anticipated. The estimated annual equivalent costs increased from $4 million to $8.7 million, while the project's impact at Imperial Dan declined from a reduction of 13 mg/l to 9 mg/l. (See p. 82.) The annual equivalent cost for this project has increased from about $305,000 to $970,000 per mg/l. Based on annual benefits of $230,000 per mg/l for salinity reduction, the economic feasibility of the project is highly suspect.

As a result, some of these projects do not appear as feasible as initially anticipated. However, the Bureau and basin States contend that economic feasibility is not a condition for approval. These projects are further discussed in appendix VI.

Feasibility of other 12 projects not known

Although feasibility studies generally have not been completed on any of the other 12 salinity control projects, preliminary results indicate that the economic and technical feasibility of four of these is questionable.

The proposed plans on 2 of the 4 projects--Colorado River Indian Reservation and Palo Verde Irrigation District--involve implementation of onfarm improvements and canal and lateral lining programs. Preliminary study results show that these projects will have little if any impact on reducing the river's salinity. Bureau officials said that the potential of these two units appears limited.

The proposed plan for the two remaining projects--LaVerkin Springs, and Glenwood Dotsero Springs--is for desalting water, which involves high energy, construction, and operating costs. An example of such high costs is the proposed Yuma desalting plant as shown on page 38.

SALINITY CONTROL PROGRAM NOT CONSIDERED ADEQUATE FOR MEETING BASIN STANDARDS

Although salinity standards have been set at various points along the river, it is doubtful that the standards will be met when the river's water supply is fully developed. One Bureau study shows that the salinity level during the period 1990 to 2000 will exceed the standards by 90 to 120 mg/l with currently planned development. The Bureau study indicates that some additional action, such as more salinity control projects, supplemented water supply, or new management steps, will be necessary to meet the established salinity standards.

EPA interpreted the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) as requiring water quality standards for salinity in the Colorado River. As a result, in November 1973 the seven basin States established the Colorado River Basin Salinity Control Forum to deal with this matter. In 1975 the States developed basin salinity standards and an implementation plan for controlling the river's salinity, which EPA approved in November 1976. Based on forum studies, salinity standards were established at the following locations along the river:

Location	Salinity standard (mg/l)
Below Hoover Dam	723
Below Parker Dam	747
At Imperial Dam	879

Major components of the implementation plan included

--prompt construction and operation of the 4 salinity control units authorized by the Colorado River Salinity Control Act of 1974,

--construction of 12 other units specified in the 1974 act or their equivalents,

--the objective of no return of dissolved salts to the river from industrial uses, and

--the reformulation of previously authorized but unconstructed Federal water projects to reduce the salt-loading effect.

Because of low cost-effectiveness and/or limited potential for reducing salinity in the river, the forum in August 1978 revised the implementation plan to defer construction of the Crystal Geyser unit and 2 of the 12 projects authorized for feasibility investigations--Colorado River Indian Reservation and Palo Verde Irrigation District unit. Construction of one additional salinity control unit--the Meeker Dome unit--and inclusion of areawide water quality management plans were added as principal components of the implementation plan. These water quality management plans are being developed by the individual basin States to conform with requirements of section 208 of the ~~1977~~ Clean Water Act of 1977 (Public Law 95-217). Because these plans have not been fully developed, it is not known what the impacts will be in controlling salinity in the basin.

In the August 1978 report, the forum concluded that the established salinity standard at Imperial Dam can be maintained through 1990 if all the measures in its salinity control plan are fully implemented. It is doubtful however that all salinity control projects authorized for construction or investigation by the 1974 act will be implemented. One Bureau study has concluded that based on the current plans for Upper Basin development, the forum's salinity control program will not be adequate to maintain the established water quality standards through the 1990 to 2000 time period even if fully implemented.

In order to provide some early perspective of projected salinity levels in the river, the Bureau compared estimates of future salinity levels with the results of one of several analyses made by the forum. This was part of a draft of a comprehensive environmental statement covering reclamation activities along the entire Colorado River.

While the method of analysis used by the forum and the Bureau were similar, the forum used different input assumptions for virgin flow and water depletion rates than the Bureau. The Bureau assumed a virgin flow of 13.9 maf and a moderate 1990 depletion level of 13.5 maf, while the forum used a virgin flow of 15 maf and 1990 depletion rate of 12.6 maf.

The virgin flow assumed by the forum approximates the 14.8 maf estimate the Bureau used for planning purposes, while the 13.9 maf the Bureau used for this study was based on hydrologic records for the period 1941-74, since this is the only period having extensive concurrent runoff and quality data. Further, 13.9 maf also closely approximates the 13.7 maf virgin flow during the period of actual record from 1922-77. The Bureau's study concluded that in order to attain the adopted salinity standard of 879 mg/l by 1990 and beyond, additional salinity control measures, supplemented water supply, or new management steps to control use would be necessary.

State representatives said the forum's implementation plan contemplates the use of other measures, including the use of saline water for industrial purposes whenever practical, programs by water users to cope with higher salinity water, improvements in irrigation systems and irrigation management to reduce salt pickup, and various other Federal and non-Federal programs for controlling salinity. For example, a September 1977 EPA-contracted study identified 12 potential management actions that could be taken by

State and local agencies to control salinity in the river. These actions include

--establishing irrigation water and land use controls;

--promoting conversion of land from irrigated agriculture to other uses through State economic incentives when highly saline return flows cannot be prevented, controlled, or treated; and

--establishing special use charges for irrigation water provided from reclamation projects to cause more efficient usage and to encourage waste control measures.

According to the EPA report, some of the actions are either partially or fully underway in several States. The report stated that the actions appear technically, economically, and politically possible and appear to be somewhat effective for controlling certain causes of salinity. However, agricultural interests would be opposed to these actions because most would interfere with or add costs to their operations.

The effectiveness of all the above measures and their impact on reducing salinity in the basin has not been determined, nor has it been determined how they would fit into the overall salinity program.

State representatives said that the forum's salinity control plan is structured for continuation of planning, studies, and research into different ways of controlling salinity after 1990 or whenever the present program is no longer adequate for maintaining the salinity standards. However, Bureau officials advised us that they are not actively pursuing any salinity control measures other than those mentioned in the 1974 act plus one additional project.

Court suit pending

The water quality standards adopted by the seven basin States were designed to treat salinity as a basin-wide problem rather than as an individual State problem. As a result, salinity standards were not set at State line stations. According to EPA officials, the data necessary to develop sound numeric water quality standards was available only in the river's lower main stem.

The Environmental Defense Fund, a private environmental organization, believes that establishing salinity criteria for only three locations in the river is inappropriate.

In August 1977 it filed a civil suit to set aside EPA's approval of what it considers "illegal and unenforceable salinity standards" for implementing salinity control. The Environmental Defense Fund has proposed establishing salinity standards at five additional locations to ensure proper control, monitoring, and enforcement. The suit asks the court to require EPA to promulgate and implement effective water quality standards and an effective plan for controlling salinity in the basin. On March 30, 1979, the Environmental Defense Fund filed a motion for summary judgment, and a decision on the motion is expected in about 60 days.

EPA advised us that it will be monitoring salinity levels at 12 locations upstream from Hoover Dam. The need for additional control measures will be identified as salinity levels change. Its monitoring will not involve establishing salinity standards at the 12 locations.

DESALTING WATER FOR MEXICO--A COSTLY PROPOSITION

The water flowing into Mexico must meet "salinity standards" specified in an agreement between the United States and Mexico. Several measures were decided upon to control the salinity level of water going into Mexico. However, the costs of these measures have risen sharply, and delays in projects have been experienced. Some of the original alternatives should be reconsidered as they may be more economically feasible now than the authorized measures.

In 1961 the salinity of water delivered to Mexico rose from 800 mg/l to 1,500 mg/l due to the closure of Glen Canyon Dam, which reduced overdeliveries to Mexico, and the discharge of highly saline drainage water from the Wellton-Mohawk Irrigation and Drainage District, near Yuma, Arizona, into the Colorado River.

In 1972 President Nixon committed the United States to find a permanent, definitive, and just solution to the salinity problem. As a result, the two countries reached a negotiated agreement that was formalized in 1973 as minute 242 of the International Boundary and Water Commission. The key provision of the minute was a U.S. commitment to adopt measures to assure that the waters delivered to Mexico would have an average annual salinity of not more than 115 parts per million plus or minus 30 parts per million, over the annual average salinity at Imperial Dam.

Other features of the minute included extension of a drain to bypass Wellton-Mohawk drainage water from the

Colorado River to the Santa Clara Slough, which flows into the Gulf of California, at U.S. expense and limiting each country's pumpage of ground water to 160,000 acre-feet annually within 5 miles of the Arizona-Sonora international boundary.

Implementing the minute required legislation authorizing funds to construct the facilities necessary to achieve the agreed-upon salinity requirements. These facilities were not defined in the minute but were identified in title I of the Colorado River Basin Salinity Control Act.

Title I provided for:

--Measures necessary to control salinity of the river water delivered to Mexico at the Northerly International Boundary, including the construction, operation, and maintenance of a pretreatment and desalting plant on the Wellton-Mohawk drain; the construction of a 51-mile-long bypass drain; an irrigation efficiency program; and an acreage reduction program of 10,000 acres in the Wellton-Mohawk Irrigation and Drainage District to reduce the volume of irrigation return flows.

--Construction of a new concrete-lined, 49-mile section of the Coachella Canal to salvage water to replace the waters temporarily bypassed to the Gulf of California.

--Installation of protective ground water wells along the international border to control ground water pumping along the border by Mexico.

Significant cost growth and schedule delays for title I measures

Since passage of Public Law 93-320 in 1974, action to implement title I salinity control measures has been delayed and the costs have risen sharply. In addition, the Bureau told us that the daily capacity of the desalting plant has been reduced to the smallest size possible to meet the requirements of the act.

Estimated costs for the desalting complex and other title I measures have increased from $155.5 million to $333.7 million--an increase of $178.2 million, or 115 percent. On January 30, 1979, the Department of the Interior requested congressional authorization for the additional funds. The following table shows the cost increase by individual measure.

	1974 Authorized Costs	July 1977 estimate	Increase or decrease
	---------(000 omitted)---------		
Desalting plant and related features:			
Desalting plant facilities (note a)	$62,080	$178,400	$166,320
Bypass drain	15,370	23,600	8,230
Main outlet drain extension siphon	3,100	2,985	(115)
Irrigation efficiency improvement program	2,000	3,585	1,585
Acreage reduction and/or onfarm irrigation systems improvement	10,500	22,567	12,067
Gila River control measures below Painted Rock Dam	5,000	6,763	1,763
Total for desalting plant complex	$ 98,050	$237,900	$139,850
Other measures:			
Lining Coachella Canal	$ 20,400	$ 43,640	$ 23.240
Protective/regulatory pumps	17,600	26,165	8,565
Other	19,450	25,987	6,537
Total estimated costs	$155,500	$333,692	$178,192

a/Includes cost of testing and research and development at the Yuma Desalting Test Facility.

While inflation accounts for $64.3 million, or 36 percent, of the $178.2 million increase, Bureau officials believe that the remaining cost increases were due mainly to engineering and design changes, fish and wildlife mitigation costs, and the fact that cost estimates prepared for the legislation were not precise. The officials said the original cost estimates for title I were prepared hastily with little time given to investigation of cost and technical data, in an effort to give prompt effect to the 1973 agreement with Mexico.

In addition to significant cost increases, estimated completion dates have slipped from 11 to 48 months for various project components. Bureau officials said that schedule delays of title I features were caused by

--reassessment of preconstruction and construction requirements and

--delays in completion of ongoing studies necessary to develop project plans.

Alternatives to large desalting plant should be considered

The estimated cost of the desalting complex has escalated from $62 million to about $178 million, an increase of $116 million, or 187 percent. Annual operating costs for the complex are estimated to be $14 million. At the same time, the size of the plant has been revised downward from a capacity in excess of 100 to 96 million gallons a day.

The drainage return flow of the Wellton-Mohawk Irrigation and Drainage District has been approximately 200,000 acre-feet a year. The Bureau hopes to reduce significantly the return flow from the district by implementing an irrigation improvement program. Based on an operational study, of a 20-year period ending in 1996, the Bureau projected that over a 50-year period the return flow would average 155,000 acre-feet. This analysis showed that the desalting complex would salvage 88,000 of the 155,000 acre-feet with the remaining 67,000 acre-feet being diverted down the bypass drain to the Santa Clara Slough.

The 67,000 acre-feet consists of 35,000 acre-feet of brine and wastewater from the desalting plant and 32,000 acre-feet which will be bypassed when the plant is not required to operate because of surplus water in the river. Bureau officials point out, however, that if the water surplus does not occur as projected, then the plant would be required to desalt a portion or all of the 32,000 acre-feet. In other terms, the desalting plant is costing at least $178 million in construction costs plus $14 million in operation and maintenance costs to save 88,000 acre-feet each year. Based on the Bureau's July 1977 estimate of annual equivalent costs to operate the desalting plant, we estimate that it would cost $338 an acre-foot to deliver 88,000 acre-feet of water to Mexico. In contrast, the costs of augmenting streamflows have been estimated to be as low as $3 an acre-foot, although the process has not been fully proven. In any event, the costs to desalinate water have risen to the point where alternatives should be considered.

Prior to the approval of minute 242, a Presidential interagency task force, chaired by Ambassador Herbert Brownell, Jr., as Special Representative of President Richard M. Nixon, considered several alternative measures and different desalting projects before deciding on the authorized project. During these considerations, Ambassador Brownell made a commitment to the basin States to the effect that the solution of the salinity problems with Mexico should not reduce their water supply. Among the alternatives considered were nine different desalting plants, bypassing Wellton-Mohawk drainage water

and substituting it with water allocated to other States, and total or partial shutdown of the Wellton-Mohawk Irrigation and Drainage District. Ultimately, the alternative measures to the desalting plant were discarded as infeasible for economic and/or political reasons.

In commenting on our draft report, Bureau officials stated the Bureau was not requested or authorized to investigate the feasibility of the desalting complex. They said the Bureau had no plans to evaluate the economic feasibility of the desalting complex or any other alternative. However, Department of the Interior officials recently decided that alternatives to the desalting complex should be considered. During hearings on March 20, 1979, before the Subcommittee on Water and Power Resources, House Committee on Interior and Insular Affairs, Interior officials said two alternatives to the desalting complex have been proposed which could potentially reduce the size of the desalting plant.

--Expand the Wellton-Mohawk irrigation improvement program to reduce return flow to 80,000 acre-feet per year, which could potentially reduce the size of the desalting plant up to 40 percent.

--Reuse return flow water on existing Wellton-Mohawk irrigated lands by (1) designating a specific area for use of drainage water only and restricting the choice of crops, (2) returning drainage water to the Wellton Canal and mixing it with incoming Colorado River water, and (3) restricting diversions to Wellton-Mohawk with some form of compensation to the landowners.

Interior officials pointed out that these alternatives were proposed only recently and have not been studied fully to determine their potential. Furthermore, they pointed out that similar proposals were rejected by the Brownell task force.

Interior agreed to consider two additional alternatives suggested by the subcommittee.

--Buying out Wellton-Mohawk totally with the land leased back to the farmers (thereby decreasing water use by telling the farmers what crops they can grow).

--Buying the water development rights to Wellton-Mohawk and then telling the farmers how they can use the water.

Interior officials told us they plan to complete their evaluation of the four alternatives about mid-May 1979. They

plan to use data already available, as time does not permit them to perform additional field studies.

In addition, we believe there is another alternative worthy of consideration. In our draft report, we had suggested that funding for construction of the Yuma complex be deferred until the Bureau evaluated other less costly alternatives, such as bypassing Wellton-Mohawk return flows and substituting them with water from the basin States' allocations. This alternative appears to be feasible but probably would not be acceptable to the States. Even though Ambassador Brownell dismissed this alternative earlier because of the loss to U.S. users of the substituted water, estimated at that time to be 220,000 acre-feet, the Bureau is now using it as a temporary measure.

Ambassador Brownell's reasons for rejecting the bypass alternative need to be reconsidered because the Bureau estimates only 123,000 acre-feet rather than 220,000 acre-feet would have to be replaced annually by the Federal Government if the Yuma plant was not built. In any event, even if the plant is built, the Government will have to replace 35,000 acre-feet of water. Another reason for reconsidering this alternative is the significant cost increase of the Yuma complex.

In commenting on our draft report, Bureau and State officials objected to this suggested bypass alternative. They pointed out that the negative impact of the bypass alternative is the loss of water to the U.S. users--the States. They contend that because the Federal Government does not own or have rights to any water stored in the reservoirs and all the Colorado River water belongs to the States, any water loss would have to come from the States' allocations.

In addition, Bureau officials also said it should be kept in mind that water lost to the States while implementing any alternative must be replaced, as provided by the 1974 Salinity Control Act. During the recent hearings to increase the authorized cost ceiling for the Yuma complex, Interior cited this Federal obligation as one reason for acting quickly to approve the Yuma proposal. Interior officials reported the United States is already obligated to replace about 1 million acre-feet of drainage water which has been bypassed since passage of the 1974 act.

Except for decreed Indian and Federal reserved water rights, all the Colorado River water belongs to the States. Therefore, a question must be resolved: How will the Federal

Government meet its obligation to replace water lost as a result of bypassing water from the Wellton-Mohawk project to the Santa Clara Slough?

Another factor which needs to be considered in any evaluation of the bypass alternative is to what extent the Government has an obligation to replace bypassed water. We agree that an obligation does exist under the 1974 act, but the point in time when that obligation begins to accrue is subject to more than one interpretation.

The act states that except in times of surplus water in the Colorado River, replacement of the reject stream from the desalting plant and drainage water bypassed to the Santa Clara Slough is recognized as a national obligation, as provided for in section 202 of the 1968 Colorado Basin Project Storage Act (Public Law 90-537). Section 202 provides that satisfaction of the requirements of the Mexican Water Treaty from the Colorado River constitutes a national obligation and that this obligation will be met by augmenting the basin water supply. According to the 1968 act, the basin States are to provide water to meet the Mexican commitment until the Congress has authorized the water augmentation plan and it is in operation.

The Bureau believes that the Federal obligation to replace lost water began with enactment of the 1974 act and now totals about 1 million acre-feet. Although we agree that this may be a reasonalbe interpretation, we believe there are two other equally reasonable interpretations. These are that the national obligation did not begin to accrue until

--the extension of the bypass drain to the Santa Clara Slough was completed in 1977 and

--the augmentation plan for increasing water supply has been approved by the Congress and is in operation, as cited in section 202 of the 1968 act.

The Bureau has initiated studies of various methods of augmenting the river's water supply. Some of the methods examined appear promising, but so far none have been proven in one way or another The Bureau has been unable to quantify, with certainty, the amount of water resulting from this program.

CONCLUSIONS

Much uncertainty exists about the effectiveness and efficiency of the salinity control program for the basin and whether it can achieve the intended results. Also, assuming an annual virgin flow of less than 14 maf and using the Bureau's

assumptions of future rate of water resource development, the salinity control plan, even if implemented successfully, will not by itself achieve the water quality standards established for the basin. The effectiveness of the 1974 Salinity Control Act in controlling salinity in the basin, is questionable at best. The program got off to a bad start because the projects included in the act were based on hastily prepared, inadequate studies which resulted in numerous program changes and correspondingly significant cost increases.

It is doubtful now that the current salinity control program will reduce salt in the river as much as predicted because at least 6 of the 17 projects in the program may be in trouble. Construction has been deferred on two projects and preliminary studies on four other projects indicate they may be questionable. Interior, EPA, and State officials told us that additional measures are being studied to control salinity in the basin. However, a plan integrating these additional measures with the existing program has not been developed nor have their impacts been quantified. We believe that the uncertainties involved with all these factors point out the need for a new assessment of the overall salinity control problem as well as alternative solutions.

Under the normal water project approval process, the technical and economic feasibility of the salinity control projects would have been evaluated before authorization to insure a workable and cost-effective program. This was not done with the currently authorized projects. Such a study should have disclosed that the projects have high costs compared to benefits, and their effectiveness in reducing salinity is questionable. If the basin's salinity is to be controlled or reduced while the water resources are developed, the limited money available for salinity control must be applied to the most cost-effective projects. We believe, therefore, that the costs of salinity control projects should be compared to the benefits derived so that the most cost-effective projects are chosen.

Specifically, we believe that the Crystal Geyser and Las Vegas Wash projects, as presently formulated, will have minor impact in reducing the river's salinity and will cost more than benefits received.

The relationships and problems of water availability, development, and quality will have to be addressed as interrelated issues in order to achieve and maintain the water quality standards. The current project-by-project approach has led to water development that greatly increases salinity. Salinity control can best be accomplished through better basinwide management of total water resources which considers trade-offs between projects for water resource development and salinity control.

The significant cost growth and lengthy schedule delays for the desalting complex and other related projects authorized by title I of the 1974 act appear to have made other alternatives more attractive, although the problem of replacing the water lost or diverted or compensating the States for its loss will have to be resolved. We believe that less costly alternatives to satisfy our Mexican water commitment should be reconsidered.

We believe there are some serious questions that need to be resolved in considering the alternatives. Because of the widely varying impacts for the various alternatives, we believe it is vitally important for the Bureau to have a clear understanding of all the relevant information. Only then can the Bureau fully evaluate each alternative and determine the most cost-effective and beneficial solution. The U.S. obligation to replace the Wellton-Mohawk drainage water is one factor that needs clarification.

As part of considering the bypass alternative, we believe the Bureau should ask the Congress to clarify the intent of the 1974 Salinity Control Act concerning when the national obligation begins accruing for replacing the Wellton-Mohawk drainage water. The timing of when the U.S. obligation begins accruing can have an important impact on the bypass alternative consideration. For example, if the full provisions of section 202 of the 1968 Colorado River Storage Act apply, there would be no Federal obligation until the Congress approved the augmentation plan and it was in operation. If this interpretation is the one intended by the Congress, there would be no Federal obligation accruing now and there would be less urgency to construct the Yuma desalting complex. During the recent hearings, Interior officials cited the current Federal obligation as one of the primary reasons for prompt adoption of the administration's proposal to increase the authorized cost ceiling for the Yuma complex. The significant cost increase of the Yuma complex, and the fact that much less Wellton-Mohawk drainage water than initially estimated would be lost to U.S. users, are additional factors which indicate the bypass alternative should be reevaluated.

In any event, even if the Federal obligation is now accruing, it could be erased by 1985 if the basin reservoirs reach storage capacity and water releases are required. According to a Bureau official, this creates a surplus condition and any Federal debt accrued to that point would be wiped out. As mentioned on p. 12, the Bureau anticipates there will be a surplus condition prior to 1985 when initial water deliveries are scheduled to begin for the Central Arizona Project.

RECOMMENDATIONS

We recommend that the Congress temporarily defer Federal funding for construction of the

--upstream salinity control projects (title II of the 1974 act) until the Bureau develops an alternative plan, in cooperation with the basin States, which compares the costs and benefits of the many alternatives; addresses the salinity problems in a comprehensive manner; and results in an effective and efficient basinwide program and the

--Yuma Desalting Complex until the Bureau has reevaluated its feasibility and considered other viable and/or less costly alternatives.

Also, we recommend that the Secretary of the Interior ask the Congress to clarify the intent of the 1974 Salinity Control Act concerning when the national obligation for replacing the Wellton-Mohawk drainage water begins to accrue.

AGENCY COMMENTS AND OUR EVALUATION

Most of the State and Federal agencies commenting on our report were opposed to delaying funding for the basin salinity control projects. Rather, they believe funding should be expedited, primarily because of the potential loss of water to the basin and the need to meet a national obligation for improving the quality of water to Mexico. (See apps. IX through XV.)

However, we believe the overall interests of the basin can be best served by temporarily delaying construction funding until a more comprehensive salinity control program has been developed to identify the most efficient and cost-effective salinity control measures for the basin. The need to reduce basin salinity is obvious but the uncertainties discussed on pages 41 through 43 indicate the need for a new assessment of the overall program. Furthermore, in light of the cost growth for the Yuma Desalting Complex, we believe that other viable, less costly alternatives may exist and should be fully evaluated before proceeding with construction.

In summary, we believe it would not be wise for the Bureau to continue with construction of salinity control projects until sufficient detailed project studies have shown them to be technically feasible and cost-effective. The Bureau has pointed out that such studies were lacking at the inception of the program, which has resulted in many program changes. We believe these earlier pitfalls should not be

repeated. The best interests of the basin, region, and Nation will be served by deferring construction until the more detailed plans and studies have been completed.

CHAPTER 4

NEW METHODS OF MANAGING THE BASIN'S WATER RESOURCES ARE NEEDED

Traditional methods of managing the Colorado River Basin's water resources will not effectively or efficiently solve the basin's long-term water problems, as discussed in chapters 2 and 3. These problems, which affect the whole basin, have usually been addressed piecemeal, on a local or State basis.

There are many examples in the basin where Federal, State, and local governments worked together to provide solutions to local and some individual regional water problems. However, for the most part, the Colorado River Basin's planning and management has been and continues to be fragmented and crisis oriented mainly because of the States' reluctance to work together with the Federal Government in addressing the issues that concern the whole basin. For example, water planning and development have been oriented toward project construction rather than overall management of the basin's water resources. This construction provided water for irrigation, municipal and industrial purposes, etc., that stimulated economic development in the basin but caused river salinity to increase to unacceptable levels. However, salinity control projects were not proposed by the States until EPA's salinity standards threatened future water development projects.

In our opinion, the problems discussed here and in the previous chapters of this report either are not being resolved or proposed solutions are not the most timely, effective, or economical. This chapter discusses the overall management improvements needed for effective resolution of these and other problems.

LACK OF REGIONAL AUTHORITY IN THE BASIN HAS RESULTED IN INEFFECTIVE MANAGEMENT

One problem with existing management 1/ methods is the lack of a single authority to plan for water resources development and address problems on an interrelated, basinwide

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1/By management we mean planning and operating the basin's water resources, including addressing all basinwide water resource problems.

basis. Each of the seven basin States and the Federal agencies operate independently, attempting to achieve solutions that are best for them. Each has different management objectives and responsibilities concerning the basin. Currently, no central authority representing both State and Federal interests exists to formulate and carry out plans to meet the competing water needs of the States and the Federal Government.

State and Federal objectives often conflict

Water resource planning and development in the basin generally has been oriented to individual project construction rather than comprehensive management of the region's water resources. Nonstructural measures generally have not been considered, and water problems are being solved only when a crisis develops. This practice often results in solving one problem while creating another and is certainly not the most effective and economical way to plan programs and projects. For example, a program to develop water projects has greatly increased the salinity of downstream water, which in turn has led to the need for very expensive salinity control projects to meet national and international water quality requirements. The rush to solve the salinity problem appears to be resulting in projects which will have, at best, marginal impact on salinity control.

The Federal Government's role is divided among various agencies involved in planning, constructing, and operating water development, flood control, and desalination projects and in protecting Indian rights, water quality, and the natural environment. Federal objectives and responsibilities for water in the basin include the regional goals of developing and using water resources for economic profit; meeting national needs, such as energy production; and adhering to international commitments.

The Department of the Interior, primarily through the Bureau of Reclamation, has the largest Federal water planning and management responsibility. The Bureau has concentrated on planning, constructing, and operating individual water storage, flood control, and agricultural development projects. The Environmental Protection Agency has the primary responsibility for setting water quality standards.

Each State has its own water management system, with intrastate as well as basinwide problems. State water agencies have been responsible for administering water right and ground water laws, planning for development and distribution of water resources, meeting water needs

of local areas, and obtaining Federal participation in financing State water projects. The States are concerned with obtaining and putting their water entitlements to use, obtaining water of adequate quality and quantity to meet their needs, and providing water for future development in the State. State objectives, such as development, sometimes conflict with Federal objectives, such as fish and wildlife protection.

Although management responsibilities have been divided among the individual States and the Federal agencies, some basinwide organizations have been formed to consider specific issues. For example, one of the principal activities of the Upper Colorado River Commission is to assist in securing Federal appropriations for project studies and development. Also, the basin States established the Colorado River Basin Salinity Control Forum to formulate standards and an implementation program for controlling salinity in the river. However, neither of these organizations is responsible for addressing all water resources problems and issues in the basin nor has authority or resources to implement their plans.

Unresolved conflicts continue

Current management organizations in the basin do not provide an adequate mechanism for solving interstate disputes. The Upper and Lower Basin States have historically been in conflict over water allocations and development priorities. Development projects change the environment, and many environmentalists are opposed to any development--thus conflicts between environmentalists and project supporters arise. The 1922 Colorado River Compact, subsequent legislation, and court actions have not entirely resolved these conflicts, nor is there a concerted effort to resolve the conflicts now. For example, the two sub-basins disagree over how the major storage reservoirs should be operated and the amount of Upper Basin water storage considered sufficient to meet future releases to the Lower Basin while meeting Upper Basin needs. (See pp. 10 and 18.) Other critical but unresolved issues are:

--Which basin's water can be considered surplus and what is each basin's obligation in supplying water to Mexico?

--Should higher priority be given to water development or salinity control projects?

--How much water must be maintained for instream flow uses and where is it going to come from?

Studies cite unresolved problems

Studies by other groups have identified other areas which were not adequately addressed under existing management arrangements, including the following.

--Many Indian tribes in the basin have as yet unquantified rights to the water in the Colorado River, and their pursuit of water development could have important implications for both water development and water quality programs.

--There is a potential conflict over which State's apportionment of Colorado River water should be charged for the water consumed by federally constructed salinity control projects.

Timely resolution to water problems and conflicts needed

The basin States and the Bureau have traditionally waited until a water problem became a crisis or an interstate conflict was settled by the courts before taking actions to resolve the situation. This has resulted, in some cases, in costly and ineffective Federal programs, lengthy court proceedings, and increasing interrelated problems. For example, failure of the Lower Basin States to agree on how the water allocated to them by the 1922 compact would be shared resulted in a lengthy court battle which delayed water development for several years. Conflicts between the Lower Basin States led to a Supreme Court suit filed by Arizona in 1952. This suit was not settled until 1964 by the Arizona v. California decree.

In some cases water management groups are also delaying actions to resolve current problems and conflicts. These delays could lead to more costly and less effective programs. A further complication is that it takes 30 years and longer to plan and construct a water resource storage or distribution facility.

INTERIOR AND OTHERS HAVE RECOGNIZED THE NEED FOR CHANGES IN MANAGEMENT

The Department of the Interior recently stressed the need to reassess present management methods. The Assistant Secretary, Land and Water Resources, in an April 11, 1977, letter to the Commissioner of Reclamation said:

"Generally, greater emphasis, wherever practical should be placed on Bureau programs which stress total water management, the evaluation of diverse alternatives to major water storage and long distance water transfer projects, technical assistance to users to help them increase water use efficiency, and water conservation practices." (Underscoring added.)

"Total water management" is a term used to describe a system of managing water resources that integrates all aspects of water development, including water quality, quantity, and environmental concerns. The concept encourages all local, State, regional, and national entities involved in the basin's water management to work closely together. Under this concept water management plans would include, among other things,

--the ability of existing and planned projects to meet present and future needs;

--the basinwide impacts of water development projects on water quality, water availability, and the environment;

--conservation and more efficient water use;

--coordinated scheduling and operation of all river basin storage and control works;

--a full range of structural and nonstructural alternatives to accomplish objectives of the whole basin;

--use of surface and ground waters as an integrated supply; and

--salvage and reclamation of poor quality supplies, including desalination of brackish water.

Total water management study

In July 1977 the Bureau developed an outline for studying the concept of total water management in the basin. The study was to be a systematic evaluation of the existing and potential management system, covering a 30-month period, and was to be funded under the Colorado River Water Quality Improvement Program. The Bureau's study was intended to

--identify and analyze the changing needs of the river basin;

--examine the use of the basin's water resources to see if existing onfarm practices, reservoir operations, and structures could be modified to achieve better management; and

--explore alternative means of evaluating changing river conditions and water needs.

The study outline was reviewed by representatives from the seven basin States. They objected to the concept of total water management, the study's funding under the Colorado River Water Quality Improvement Program, and continuation of the study. In effect, they said that total water management involves less State control and that the river is not to be operated and managed for the benefit of the Nation or even the basin as a whole. Rather, they contended that the river should be managed by and for the seven States individually. To date, the study has not been funded.

State views on management methods

In regard to new water resources management methods, Senator Hart of Colorado stated the following in a conference at the University of Denver College of Law in 1976. 1/

> "Water resource management has shifted from the development of new supplies to this kind of prudent management of existing supplies and the allocation of these supplies among competing uses. Technological innovation must achieve the balance between the traditional demand that we are all familiar with and these new uses. The planning process that has served until recently will have to be overhauled; the planners and policy makers will have to reorder water priorities in their states and local regions to accommodate the new facts of resource life. As a part of this new focus, engineers and technicians must devise means to manage water resources more efficiently and effectively. They will be the ones who will present the alternatives to the politicians who have the ultimate responsibility to determine what needs must be met."

1/Hart, Gary,"Emerging Values in Water Resource Management," Denver Journal of International Law and Policy, Vol. 6, Special Issue 1976, pp. 357-361.

During the same conference, Governor Lamm of Colorado stated:

> "* * * it seems clear to me that we are in a transition period moving from the development and storage of water to a period which will be conflicts between the agricultural uses of water and municipal, industrial, recreational, and other environmental uses. We will not be as preoccupied with the development of new water supplies as we have been in the past." 1/

State officials we contacted objected to the concept of total system management largely because they fear that their interests, rights, and objectives will not be protected. State water officials have claimed that the river is a State matter and not to be operated for the benefit of the basin as a whole or the Nation. The basin States do not believe sufficient incentives are available to cause them to manage their water resources on a basinwide basis because they feel they may be required to give up their constitutional rights.

CONCLUSIONS

The basin's water managers are not emphasizing resolution of many of the conflicts and still address many problems after they become a crisis. The adverse impacts of not addressing these conflicts and other problems in a timely manner will be more severe, however because of the impending shortage. The full impact of crisis management has never been felt because a water shortage has not occurred. The 1976-77 drought was not a crisis because water releases were made from storage in the reservoirs. However, when the basin's resources are fully developed, such large supplies from reservoir storage may not be available. The long-term solutions that consider all alternatives will be impossible if the basin's water managers wait until a shortage occurs.

We believe that the traditional methods of managing the basin's water resources will no longer be effective or responsive to its needs. The basin States and Federal agencies need to be brought together under a partnership arrangement to solve the problems and conflicts discussed in this report to prepare for the projected shortage. There

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1/Lamm, Richard D., "Colorado, Water, and Planning for the Future," Denver Journal of International Law and Policy, Vol. 6, Special Issue 1976, pp. 441-447.

appears to be enough time to prepare effectively for a shortage if the States and Federal agencies resolve their differences and plan the resolution of all water-related problems soon.

If historical trends relating to the time it takes to achieve consensus, funding, and construction of resource projects are a fair indication of future leadtime requirements, long-term resolutions to the supply and salinity problems must be agreed on within the next 2 to 3 years. Long-term effective solutions may no longer be possible after a shortage occurs.

We believe that the unresolved problems and conflicts discussed in this report are basinwide in scope and indicate a need for some form of basinwide planning and management. A central planning authority, acceptable to the Federal Government and States, is needed to integrate State and Federal objectives for comprehensive management of the basin's water resources.

Several issues will have to be considered in setting up this organization, such as the States' interests and objectives, Federal policies and laws, the method of deciding on alternative approaches to solve problems, and the most efficient method for solving disputes. This organization would

--integrate and coordinate the various Federal, State, and local agencies involved in planning, developing, and operating basin water resources;

--evaluate the interrelationships, benefits, and costs of alternative solutions to water problems, considering such factors as water quality, water availability, conservation, and the environment; and

--consider all water resources in the basin as a total system.

RECOMMENDATIONS TO THE CONGRESS

Formulation and makeup of an organization of the type discussed above is an extremely sensitive issue, politically, legally, and economically. The organization must have enough authority to assure that the interests of all parties are equally protected without indiscriminately favoring the wishes of one over the others. Therefore, we recommend that the Congress establish a task force made up of the principal State and Federal executive agencies in the basin and water user representatives to study the problems and barriers

involved in forming such an organization and recommend the appropriate form of management and decisionmaking structure for the basin and the rules and regulations under which it will operate.

Among the options this task force might consider are an organization composed of

--only State representatives,

--representatives from each State and selected Federal agencies that are interested in the basin's water problems with a rotating or elected chairman,

--State and Federal representatives with a Federal chairman.

AGENCY COMMENTS AND OUR EVALUATION

In a January 8, 1979, letter (see app. VIII), Interior did not object to the recommendations but said that the concept of total water management in the river basin has been presented to the States before; it has always been rejected. Interior believes that there is a need to quantify the benefits to the States and Nation attributable to basinwide management, otherwise lack of cooperation from essential parties could thwart needed management efforts. Also, Interior believes that an atmosphere conducive to reaching basic agreements will exist for only a few more years and now is an ideal time to seek resolution of unsettled issues.

In a January 2, 1979, letter (see app. IX), EPA felt that strengthening, with possible redirection, of existing Colorado River Basin entities would have a greater payoff at this time than would creation of a new entity.

The basin States object to establishing a basinwide management organization. Their objections are based on a fear that the river will be operated in the national interests first and the States' interests second. The States fear that the compact will be upset, that historical water rights will be changed, and that States' authority will diminish. They insist that the compact cannot be altered and that the present methods of management are sufficient to deal with the river's problems. In summary, the States do not see a need for change. (See apps. XI through XV.)

Existing basinwide entities have tended to focus on individual issues, such as salinity, rather than on all the issues encompassing supply, quality, water rights, and so forth. Simply, strengthening and redirecting existing entities, without giving them additional authority and responsibility for performing comprehensive basinwide planning and management, is likely to provide only short-term benefits, at best.

There was one point of agreement among the States and Federal agencies that commented on our draft report. They all stated that a task force such as the one we recommend would be totally ineffective because it would be made up of the same people and organizations that have traditionally managed the basin's water. The feeling is that, because of their individual views, these parties would be unable to achieve any sort of meaningful consensus.

We agree that a distinct possibility exists that the task force may not be able to agree on a proposal. We believe, however, that such a possibility is less likely if the task force is established by the Congress. A strong congressional expression of preferring a management solution arrived at by the task force, as opposed to one imposed by congressional action, could provide sufficient incentive to achieve the necessary cooperation. We believe this possibility would be a strong motivation to task force participants to cooperate.

We continue to believe that a formal organization with authority to manage the river in the best interests of the States, the region, and the Nation is needed. Establishment of such an entity should lead to more effective solutions to existing water concerns and respond better to future problems. As indicated in our recommendations, we believe that the task force should specify the makeup and nature of the organization. However, this should be done after careful consideration of all the water resource problems and issues in the basin. This would include identifying benefits and disbenefits so that the most effective and acceptable organization could be chosen. Furthermore, we agree with Interior's statement that an atmosphere conducive to reaching basic agreements will only exist for a few more years and now is an ideal time to seek resolution of unsettled issues.

SELECTED LEGISLATION, COMPACTS, TREATIES, AGREEMENTS, AND COURT DECREES AFFECTING THE OPERATIONS OF THE COLORADO RIVER

There are many laws, compacts, treaties, agreements, and court decrees that impact on the management and use of water resources in the Colorado River Basin. We briefly summarized the significant points in some of these below.

COLORADO RIVER COMPACT, 1922

This compact was signed by the seven Colorado River Basin States November 24, 1922. The compact:

--Divided the Colorado River Basin into an Upper and Lower Basin. The dividing point is at Lee Ferry, approximately 30 river miles below the Utah-Arizona boundary line and 1 mile below the mouth of the Paria River. The Upper Basin States include Colorado, New Mexico, Utah, and Wyoming, while the Lower Basin States are Arizona, California, and Nevada.

--Apportioned from the Colorado River System, in perpetuity, 7.5 maf per year to each of the two sub-basins for beneficial consumptive use. In addition, the Lower Basin was given the right to increase its beneficial consumptive use by 1 maf per year.

--Provided for the possibility of a water treaty with Mexico. Delivery of water to Mexico would be supplied from surplus flows above the aggregate quantities specified above, and when there is insufficient surplus flows to meet the Mexican water obligation the deficiency would be borne equally by the Upper and Lower Basins.

--Provided that the Upper Basin shall not withhold water or cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75 maf in any 10-consecutive-year period and the Lower Basin shall not require delivery of water which cannot reasonably be applied to domestic and agricultural uses.

BOULDER CANYON PROJECT ACT, 1928 (43 U.S.C. 617)

This act authorized the construction of Hoover Dam and Powerplant, the all-American canal system serving the Imperial and Coachella Valleys in California, and approved

the Colorado River Compact. None of the provisions in this act were to take effect unless (1) the compact was ratified by at least six States including California and (2) California would limit its consumptive use of Colorado River water to 4.4 maf per year plus not more than one-half of any excess or surplus water. (These requirements were subsequently met.)

The act authorized the States of Arizona, California, and Nevada to enter into an agreement whereby the 7.5 maf of mainstream water would be apportioned for annual use by the Lower Basin as follows:

	(maf)
California	4.4
Arizona	2.8
Nevada	0.3

However, these States never entered into an agreement dividing the Lower Basin water.

The act also provided that the Lower Basin States will share surplus water and authorized the Secretary of the Interior to execute contracts with users for water made available by the Boulder Canyon Project, subject to the terms of the Colorado River Compact.

MEXICAN WATER TREATY, 1944

In 1941 the State Department undertook negotiations with Mexico for a treaty to encompass the Tijuana River, the Rio Grande River where a significant portion of the water originates in Mexico but is largely used in the United States, and the Colorado River where all the water originates in the United States but is used in both the United States and Mexico. The treaty divided the waters of the Colorado, Tijuana, and Rio Grande Rivers and was to be administered by the International Boundary and Water Commission, which consisted of a U.S. section and a Mexican section. No mention was made of the quality of water to be delivered.

Under the Mexican Water Treaty, the United States is obliged to deliver 1.5 maf to Mexico annually in the limitrophe section of the Colorado River (that stretch where the Colorado River is the boundary between the United States and Mexico) and some additional quantities if available. However, in cases of serious drought or a significant failure in the delivery system, Mexico could receive less than 1.5 maf.

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UPPER COLORADO RIVER BASIN COMPACT, 1948

This compact among the States of Arizona, Colorado, New Mexico, Utah, and Wyoming apportions the Upper Basin's share of the Colorado River on the basis of consumptive use.

The State of Arizona was apportioned 50,000 acre-feet of the Upper Basin's annual allocation and the other basin States were apportioned the following percentages of the remainder:

	(percent)
Colorado	51.75
New Mexico	11.25
Utah	23.00
Wyoming	14.00

COLORADO RIVER STORAGE PROJECT ACT, 1956

This act (43 U.S.C. 620) authorized the construction of major developments in the Upper Basin consisting initially of four major storage units and 11 participating water use projects. Operations of these projects will permit the Upper Basin to make required deliveries of water to the Lower Basin and to maximize the consumptive use of its water allocation. A number of other water use projects were authorized by subsequent legislation. These facilities are located throughout the Upper Basin.

DECREE OF THE SUPREME COURT IN ARIZONA v. CALIFORNIA, 376 U.S. 340 (1964)

Failure of the Lower Basin States to agree on the sharing of water allocated by the Colorado River Compact led to the Supreme Court suit filed by Arizona in 1952. The Court held that neither the Colorado River Compact, nor the law of prior appropriation, nor the doctrine of equitable apportionment controlled the division of Lower Basin water among the States, but that the Boulder Canyon Project Act authorized an apportionment of the Lower Colorado River and, hence, must be used as a guide.

The apportionment of Lower Basin water was restricted to the mainstream of the Colorado River downstream from Lee Ferry. The Court held that if 7.5 million acre-feet of mainstream water is available for annual consumptive use in the Lower Basin, it shall be apportioned as follows:

(maf)	
4.4	to California
2.8	to Arizona
0.3	to Nevada

The decree also included provisions for the apportionment of mainstream water to Lower Basin States in times when the amount of water available to the Lower Basin would be more or less than 7.5 maf. The five Indian reservations along the mainstream were given priority for water (about 1 maf), dating from the time the lands in question became part of the reservation. The decree also provided for delivery of water only to users who held valid contracts with the Secretary of the Interior.

COLORADO RIVER BASIN PROJECT ACT, 1968 p 8.

The act (43 U.S.C. 1501) authorized the construction of the Central Arizona Project and a number of water use projects in the Upper Basin. It directs the Secretary of the Interior to propose criteria for the coordinated long-range operation of the basin's reservoirs. It also provides that in the event there is insufficient water to release 7.5 maf to the Lower Basin, diversions to the Central Arizona Project shall be so limited as to, in effect, guarantee California the use of 4.4 maf annually.

An objective of the act is to provide a program for the comprehensive development of the water resources of the Colorado River Basin and additional water supplies for use in the Upper and Lower Basins. The act declares that the satisfaction of the Mexican Water Treaty constitutes a national obligation which shall be the first priority of any water augmentation project planned pursuant to the act. However, the basin States are not relieved of the obligation to provide water to Mexico until an augmentation plan is developed and in operation.

FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS of 1972 P.L. 92-500

The objective of this act (33 U.S.C. 1251) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. The act authorized the Environmental Protection Agency, after cooperation with other Federal agencies, State water pollution control agencies, and others involved to prepare or develop comprehensive programs for preventing, reducing or eliminating the pollution of the navigable waters and ground water and improving the sanitary conditions of surface and underground waters.

Some of the more important aspects of the act, briefly explained, include:

--Authorizing EPA to provide grants for research or demonstration projects and construction of treatment works to Federal agencies, States, or private organizations.

--Authorizing EPA to publish and revise from time to time water quality criteria and to revise standards to include intrastate as well as interstate streams.

--Providing for the best practical water pollution control technology to be applied by July 1, 1977, followed by the best available technology economically achievable by July 1, 1983. The deadlines for achieving treatment levels were extended in December 1977 with the passage of the Clean Water Act of 1977 (Public Law 95-217, 91 Stat 1582).

--Providing for the governmental regulation of pollutant discharges through a mandatory permit program, monitoring, inspection, and periodic reporting and requiring those dischargers of fill or dredge material into a navigable stream to obtain a permit from the Corps of Engineers.

--Requiring, as interpreted by EPA, that numerical standards for salinity be established for the Colorado River system.

PERMANENT AND DEFINITIVE SOLUTION TO THE INTERNATIONAL PROBLEM OF THE SALINITY OF THE COLORADO RIVER, MINUTE NO. 242, AUGUST 30, 1973, OF THE INTERNATIONAL BOUNDARY AND WATER COMMISSION

The agreement requires that the United States initiate several actions to assure that the waters delivered to Mexico upstream from Morelos Dam will have an average salinity of no more than 115 parts per million plus or minus 30 parts per million total dissolved solids greater than the average annual salinity of Colorado River waters arriving at Imperial Dam. The measures to be undertaken to meet this agreement were authorized by title I of the Colorado River Basin Salinity Control Act.

COLORADO RIVER BASIN SALINITY CONTROL ACT, 1974 (43 U.S.C. 1571) P.L. 93-320

Titles I and II of the act (43 U.S.C. 1571) require the Secretary of the Interior to implement several programs to improve the water quality of the Colorado River. Title I

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was authorized to improve the quality of water going to Mexico downstream from Imperial Dam. It included the construction of a desalting complex in the vicinity of Yuma, Arizona; reduction of irrigation return flows through acquisition of lands and implementation of irrigation efficiency improvement programs in the Wellton-Mohawk Irrigation and Drainage District; lining 49 miles of the Coachella Canal; and constructing a well field near the Mexican border capable of pumping approximately 160,000 acre-feet of water per year.

Title II authorizes measures to improve the quality of water upstream from Imperial Dam. It authorized the Secretary of the Interior to construct the Paradox Valley, Grand Valley, Crystal Geyser, and Las Vegas Wash salinity control projects and expedite completion of planning reports on 12 others. Title II also establishes the Colorado River Basin Salinity Control Advisory Council.

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APPENDIX II

LISTING OF PRINCIPAL REPORTS AND DOCUMENTS USED DURING REVIEW

Analysis of Managerial, Financial, and Regulatory Functions of Regional Water Resources Authorities and Other Institutional Arrangements, Booz, Allen and Hamilton, Inc., Springfield, Virginia, January 31, 1970.

Arizona State Water Plan: Inventory of Resource and Uses - Summary, Arizona Water Commission, July 1975. Also: Phase I, July 1975.

Arizona State Water Plan: Alternative Futures, Phase II, Arizona Water Commission, February 1977.

Colorado River International Salinity Control Project, Special Report, Bureau of Reclamation: Office of Saline Water, U.S. Department of the Interior, September 1973.

Colorado River Regional Assessment Study - Part One: Executive Summary, Basin Profile, and Report Digest, Utah Water Research Laboratory, Utah State University, Logan, Utah, October 1975. Also: Colorado River Regional Assessment Study - Parts 2 to 4, October 1975.

Colorado River Water Quality Improvement Program, Bureau of Reclamation, U.S. Department of the Interior, Washington, D.C., February 1972.

Economic Impacts of Changes in Salinity Levels of the Colorado River, Bureau of Reclamation, U.S. Department of the Interior, Denver, Colorado, February 1974.

Final Environmental Statement, Colorado River Basin Salinity Control Project - Title I, Bureau of Reclamation - Lower Colorado Region, U.S. Department of the Interior, June 18, 1975.

Final Environmental Statement, Colorado River Water Quality Improvement Program -- Volume I, II, Bureau of Reclamation - U.S. Department of the Interior and Soil Conservation Service - U.S. Department of Agriculture, Washington D.C., May 1977.

Federal Reserved Water Rights Task Group Report, Federal Reserved Water Rights Task Group, December 1977.

Geological Survey Professional Paper 813-C, "Summary of the Nation s Ground - Water Resources - Upper Colorado Region," Washington, D.C., 1974.

Lake Powell Research Bulletin, No. 14, "An Overview of the Effect of Lake Powell on Colorado River Basin Water Supply," November 1975.

Lake Powell Research Bulletin, No. 18, "Long-Term Surface - Water Supply and Streamflow Trends in the Upper Colorado River Basin Based on Tree-Ring Analysis," March 1976.

Lower Colorado Region, Specific Problem Analysis Summary Report: 1975 National Assessment of Water and Related Land Resources, Regional Sponsor - Bureau of Reclamation, U.S. Department of the Interior, December 1977. Also: Technical Memorandum No. 2, August 1976 and Technical Memorandum No. 3, April 1977.

Lower Colorado River Region: Comprehensive Framework Study-Main Report, Lower Colorado Region State - Federal Inter-agency Group Staff, June 1971.

Meeting of Federal and State Representatives for Review of Basic Data Pertinent to the Preparation of Operating Criteria for the Colorado River Pursuant to Section 602 of Public Law 90-537, Bureau of Reclamation, U.S. Department of the Interior, Washington, D.C., July 25, 1969.

Need for Controlling Salinity of the Colorado River, Colorado River Board of California, Los Angeles, California, August 1970.

One Third of the Nation's Land: Report to the President and to the Congress, Public Land Law Review Commission, Washington, D.C., June 1970.

Proceedings of National Conference: Irrigation Return Flow Quality Management, Colorado State University, Sponsored by: U.S. Environmental Protection Agency, May 1977.

Proposed Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control - Colorado River Systen, Colorado River Basin Salinity Control Forum, June 1975. Also: Supplement, August 26, 1975.

Report on Water for Energy in the Upper Colorado River Basin, U.S. Department of the Interior, Washington, D.C., July 1974.

Report to the Congress: Better Federal Coordination Needed to Promote More Efficient Farm Irrigation, Report No. RED-76-116, U.S. General Accounting Office, Washington, D.C., June 22, 1976.

Report to the Congress: More and Better Uses Could Be Made of Billions of Gallons of Water by Improving Irrigation Delivery Systems, Report No. CED-77-117, U.S. General Accounting Office, Washington, D.C., September 2, 1977.

Salinity Management Options for the Colorado River - Damage Estimates and Control Program Impacts, Utah Water Research Laboratory, Utah State University, Utah, October 1977.

State and Local Management Actions to Reduce Colorado River Salinity, Denver Research Institute, University of Denver, Denver, Colorado, September 1977.

The Colorado River, "A Natural Menace Becomes a National Resource," U.S. Department of the Interior, Washington, D.C., March 1976.

The Mineral Quality Problem in the Colorado River Basin - Summary Report, U.S. Environmental Protection Agency - Regions VIII, IX, 1971. Also: Appendices A, B, C, 1971.

Upper Colorado Region, Specific Problem Analysis Summary Report: 1975 National Assessment of Water and Related Land Resources, Upper Colorado River Commission and Bureau of Reclamation, U.S. Department of the Interior, April 1977. (Draft.) Also: Technical Memorandum No. 2, August 1976 and Technical Memorandum No. 3, March 1977.

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Water Policies for the Future, National Water Commission, Washington D.C., June 1973.

Westwide Study Report on Critical Water Problems Facing the Eleven Western States, U.S. Department of the Interior, Washington, D.C., April 1975.

AVAILABILITY AND USE OF GROUND WATER IN THE COLORADO RIVER BASIN

Subsurface water in completely saturated spaces between soil particles or rocks is considered ground water. Layers of soil or rocks bearing ground water (underground reservoirs) are called aquifers. Nationwide, aquifers have a storage capacity nearly 20 times the combined volume of the Nation's rivers, ponds, lakes, and all manmade water impoundments.

Ground water development in the Colorado River Basin has occurred mainly in the Lower Basin. Water resource development in the Upper Basin has been limited almost entirely to surface water.

LOWER BASIN

Although there is sufficient water in the Colorado River to meet present demands, there are areas in the Lower Basin not served by the Colorado River--mainly in Arizona--where significant water shortages are occurring. About 60 percent of Arizona's annual water withdrawal is pumped from underground water resources. In many areas of the State, ground water is the only supply. In areas with a surface water supply, ground water is often a supplement that assures a continual supply during low surface flows. Substantial amounts of ground water remain in storage in Arizona; however, the annual rate of recharge is very limited, and thus much of the ground water stored is available only for one-time use.

Based on limited testing, the U.S. Geological Survey estimates that the amount of ground water in Arizona is between 750 million and 1.25 billion acre-feet. According to an Arizona Water Commission report, approximately 94 percent of the State's water consumption occurs in 24 hydrologic basins for which ground water data is sufficient to permit reasonable estimates of current water conditions. In the 43 remaining basins, available ground water data is inadequate to make such estimates.

Alarming reductions in the amount of water stored in underground reservoirs are occurring as annual withdrawal exceeds recharge by about 2.2 maf. In the proposed service area of the Central Arizona Project, ground water resources are being overdrawn at the rate of 1.8 maf per year. This area includes Pima, Maricopa, and Pinal Counties and the metropolitan areas of Phoenix and Tucson.

In Pima County, which includes Tucson, the use of ground water is 3.7 times dependable supply. 1/ In Pinal (Phoenix) and Maricopa Counties the ratios of ground water usage to dependable supply are 2.4 and .9, respectively. In some small hydrologic basins, rates of depletion approach 100 times the magnitude of dependable supply.

Average declines in ground water tables in central Arizona range from 1.8 to 13.8 feet a year. As the ground water table drops, problems arise from increased pumping costs, deterioration in water quality, and land subsidence.

One of the Central Arizona Project's objectives is to reduce Arizona's dependence on ground water by diverting an average of approximately 1.2 maf annually of Colorado River water to central Arizona users. While it is intended that the ground water overdraft will also decrease by an average of 1.2 maf annually, the reduction will not always occur. For instance, the allocation of water to CAP has low priority and is subordinate to the water rights of other users in the Lower Basin; therefore, any reduction in releases to the Lower Basin in water-short years will result in less than an average of 1.2 maf being available for CAP and a corresponding increase in ground water depletions. In addition, the predicted shortage of surface water in the early 2000s can also result in increased use of ground water.

The realization that water in Arizona is gradually running out has led to increased competition and conflict among water users; i.e., urban and residential interests pitted against agriculture and Indians pitted against non-Indians. According to Arizona Water Commission studies, even with CAP operational and a median growth rate in nonagricultural activities, it is expected that agricultural acreage would have to be reduced if a balance between water supply and use is to be achieved by the year 2020.

Even though Arizona is experiencing significant depletions of ground water, it does not have a strong ground water law to control pumping and use of the water. Before 1977 Arizona's ground water law required a permit for the drilling of new irrigation wells in critical ground water areas, but did not place limits on the amount of water that could be pumped or used on the land; neither did it prohibit drilling domestic wells or the replacement of nonproductive

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1/Dependable water supply represents the amount of water that can be depleted annually over a long period of time without lowering the levels of ground water or surface water storage.

irrigation wells. The amount of ground water that can be extracted is limited only by the amount that can be put to "reasonable use." However, the term "reasonable use" has not been adequately defined.

In 1977 Arizona enacted a law that formed a Groundwater Management Study Commission. The commission is directed to review and evaluate ground water in Arizona and issue a final report by December 1979 for use in developing a ground water management code. The law provides that if the legislature fails to enact a ground water management code by September 1981, the code recommended by the commission shall become law.

UPPER BASIN

Ground water development in the Upper Basin has been done on a small scale even though the average annual replenishable ground water supply for the Upper Colorado River Basin is estimated by USGS to be about 4 maf. The total volume of recoverable ground water in storage in the upper 100 feet of the aquifer is estimated to be between 50 to 115 maf. The maximum figure is nearly four times the total active storage capacity of all surface water impoundments in the region.

Development of ground water resources for irrigation purposes has not been economically feasible in much of the Upper Basin because:

--About 85 percent of the estimated recoverable water in the upper 100 feet of storage occurs in rocks which have yielded water slowly.

--In much of the area away from the flood plains of the river and its tributary streams, the depth of ground water is generally from several hundred to more than 1,000 feet below the land surface and therefore is considered economically inaccessible.

--A large percentage of the ground water located away from the river flood plains is saline, and processing would be required for most uses.

The areas where ground water is more readily extracted are located in the flood plains of the river and its tributary streams. Pumping of this ground water decreases the surface flows and any use of ground water is considered part of the users' surface water allocations.

Although investigations have been limited, USGS indicated that the opportunity exists to use ground water more effectively in conjunction with surface water in many of these

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irrigated areas along the larger streams in the Upper Basin. In these areas ground water could be used to supplement surface water during periods of low flow, which commonly coincide with periods of peak seasonal demand.

If ground water withdrawal exceeds natural recharge during these low-flow periods, then the ground water could be recharged artificially during peak runoff periods. Such a coordinated system would provide a more uniform year-round water supply without surface reservoir construction. The developed ground water fields, regardless of their primary purpose, would also provide an emergency public water supply for towns located in these areas.

According to a USGS official, the agency's estimates of existing ground water supplies in the Upper Basin are only accurate within ± 50 percent. Existing wells along the river flood plain do not provide sufficient data to assess adequately the availability of ground water. Also, the lack of wells outside the flood plains requires ground water supplies to be estimated by analyzing soil samples and using data on similar aquifers in other basins.

APPENDIX IV

COLORADO RIVER BASIN DAMS AND RESERVOIRS

Dam	Reservoir	River	Storage capacity	Storage 9-30-78
			(thousand acre-feet)	
Upper Basin				
Fontenelle	Fontenelle	Green	344	322
Flaming Gorge	Flaming Gorge	Green	3,749	2,825
Blue Mesa	Blue Mesa	Gunnison	830	728
Morrow Point	Morrow Point	Gunnison	117	114
Navajo	Navajo	San Juan	1,696	1,238
Glen Canyon	Lake Powell	Colorado	25,000	16,563
			31,736	21,790
Lower Basin				
Hoover	Lake Mead	Colorado	26,159	20,867
Davis	Mohave	Colorado	1,810	1,484
Parker	Havasu	Colorado	619	567
			28,588	22,918
Total			60,324	44,708

EFFORTS TO SALVAGE, CONSERVE, AND AUGMENT THE WATER SUPPLY IN THE COLORADO RIVER

The following is a brief discussion of efforts to increase the usable water supply, or the utility of the water supply, in the Colorado River Basin through conservation, water salvage, and augmentation.

WATER SALVAGE

The 1968 Colorado River Basin Project Act (43 U.S.C. 1501) directed the Secretary of the Interior to undertake programs for water salvage and ground water recovery along and adjacent to the Colorado River. During congressional hearings on the act, the Bureau of Reclamation estimated that about 680,000 acre-feet of water could be salvaged annually through (1) operations of Senator Wash Dam to control releases to Mexico, (2) ground water recovery, (3) phreatophyte 1/ eradication (plant removal), and (4) channel stabilization in the lower reaches of the Colorado River. In addition, about 65,000 acre-feet of water had been salvaged annually as part of Colorado River Front Work and Levee System operations, which were established in 1927 and expanded in 1946. Water salvage was a byproduct of these operations which involved river dredging to stabilize the channel, clear sediment, and control bank erosion. As a result of the dredging, less water was lost to plant use and evaporation.

A 1968 comparison of the estimates of annual water salvage, including the remaining potential along the mainstream of the Colorado River, is presented in the next table.

1/A phreatophyte is a deep-rooted plant that obtains its water from the water table or the layer of soil just above it.

Program	Annual water salvage			
	1968 Estimate	Accom-plishments	Additional potential	Revised estimate
	(thousand acre-feet)			
Channel dredging	190.0	56.0	134.0	190.0
Phreatophyte eradication	100.0	160.0	57.0	217.0
Senator Wash Dam	170.0	207.5	0	207.5
Ground water recovery	220.0	80.0	125.0	205.0
Total	680.0	503.5	316.0	819.5
Previously accomplished	65.0	65.0	0	65.0
Total	745.0	568.5	316.0	884.5

We were informed that in 1970--after an annual 56,000 acre-feet of water was salvaged--the Colorado River dredging program was substantially curtailed in response to protests by local environmentalists and the Fish and Wildlife Service. However, some Indians and private landowners have ignored environmentalists' objections and have removed plants growing on their lands along the riverbanks. This has resulted in 160,000 acre-feet of additional water salvage annually.

Senator Wash Dam was designed to regulate deliveries to Mexico and reduce deliveries in excess of commitments. A Bureau official estimated that during the period 1967-76 about 207,000 acre-feet of water was salvaged annually as a result of operating the dam.

According to Bureau of Reclamation officials, 12 ground water recovery wells are pumping approximately 45,000 acre-feet of water annually in the Yuma-Mesa area of southwest Arizona so that ground water losses to Mexico can be reduced. The Bureau is recovering another 35,000 acre-feet from wells installed along the international border with Mexico. The Bureau plans to install additional wells along the international border and estimates that an additional 125,000 acre-feet of water will be salvaged annually when the wells are in operation. The border wells were authorized by the Colorado River Basin Salinity Control Act (43 U.S.C. 1573). A major portion of the water pumped from the United States wells will then be sent to Mexico via a surface stream in partial fulfillment of the Mexican treaty commitment to deliver 1.5 maf of water annually.

CONSERVATION

Efforts to conserve water in the basin have been primarily directed toward reducing losses from the irrigation process; that is, conveyance system losses, evaporation, and excessive water use in crop irrigation.

Water use is measured in amounts withdrawn or consumed. Water withdrawn is that which is diverted from its natural course for use and may be returned later for further use. Water consumed is water incorporated into a product or lost to the atmosphere and not available for reuse. Water consumed is the more important concern because it represents absolute reductions in water supply.

Agricultural irrigation uses the largest amount of water consumed in the Colorado River Basin--between 85 and 90 percent. Various Federal studies have highlighted the importance of seepage losses from agricultural water conveyance systems. The Department of Agriculture has estimated that 20 to 25 percent of the water diverted from streams or reservoirs for agriculture does not reach farms. Also, crop irrigation is a relatively inefficient water use, since under present practices less than half of the water delivered for irrigation is actually consumed by the crops.

Water lost through seepage or which is excess to crop needs may (1) be lost to nonrecoverable evaporation and deep percolation or consumed by wildlife habitat and nonagricultural vegetation, (2) oversaturate the lands, causing drainage problems, or (3) return to the supply system at downstream locations for further use but degraded in quality by minerals, fertilizers, sediment, and pesticides.

Bureau officials stated that information on nonrecoverable water losses and nonagricultural consumption for the Colorado River Basin is not readily available. However, according to an April 1975 Department of the Interior report, 1/ irrigation water budgets for 1970 for the 11 Western States show total water delivery losses of 32 maf and consumptive use of 69 maf. Of the latter, 75 percent, or 52 maf, was water consumed by growing crops and pasture. The remainder, 17 maf, was water consumed as a result of losses in the irrigation process. According to officials from the Bureau and the Soil Conservation Service, no studies or investigations have been conducted in the Colorado River Basin to determine how much water

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1/"Westwide Study Report on Critical Water Problems Facing the Eleven Western States," Apr. 1975.

presently lost through irrigation could be saved through conservation measures. State officials stated that some of these losses are returned to the surface streams from underground flows.

According to Bureau officials, the principal agricultural water conservation programs in the Colorado River Basin are the Irrigation Management Service (IMS) program 1/ and lining of agricultural water conveyance systems. IMS is a systematic determination of when to irrigate and how much water to apply. It has been implemented only to a limited degree in the basin. Although the program is rather inexpensive, the Bureau has achieved only limited success in getting farmers to use it. One reason for this is that the Bureau has been unable to develop statistically sound data to convince farmers of the economic benefits resulting from the program. Benefits include increased crop yields, lower operating costs, and use of less water. Some farmers feel that they would lose water rights if less water were used.

To reduce seepage losses, the Bureau is concrete lining the canals and laterals of all new water conveyance facilities being constructed in the basin. Also, as a part of the salinity control program, the Bureau established an improvement program that mainly involves lining of existing canals, ditches, and laterals. One major problem has emerged: the program may be in direct conflict with an Executive order prohibiting the drying up of existing wetlands so that the natural habitat of plants and wildlife may be preserved.

Mainly as a result of the Colorado River Basin Salinity Control Act, the Soil Conservation Service is involved to a limited degree in providing technical and cost-planning assistance to farmers as well as providing onfarm improvement--leveling land, lining ditches, installing automatic irrigation systems--in an attempt to improve onfarm irrigation efficiency. The onfarm improvements are to be paid for on a cost-sharing basis--75 percent by the Federal Government and 25 percent by the farmer.

The opportunities to conserve water in the irrigation process are pointed out in two GAO reports in 1976

1/The IMS program was instituted by the Bureau as a part of the Colorado River Salinity Control Act (Public Law 93-320, 88 Stat 266, June 24, 1974).

and 1977. 1/ The need for improving Federal involvement in promoting more efficient irrigation practices and for improving the efficiency of irrigation delivery systems in the Nation as well as the Colorado River Basin are also discussed in these reports. The Department of the Interior and the Bureau have taken lead roles in conducting the following two studies concerned with finding ways of improving water efficiency in irrigation. (Irrigation projects in the Colorado River Basin will be included in both of these studies.)

1. The Departments of Agriculture and the Interior and EPA have established an Interagency Task Force on Irrigation Efficiencies. This task force's mission is to examine problems of inefficient irrigation facilities and operations and develop recommendations regarding appropriate Federal objectives, policies, agency roles, and action programs. The task force is concerned with both Federal and non-Federal irrigation projects and is considering onfarm irrigation systems. The task force has established a technical work group, consisting of representatives from the participating Federal agencies and non-Federal groups to review and analyze data. It is planned that the task force's findings and recommendations will be presented in a report to the Secretaries of Agriculture and the Interior and the Administrator of EPA in May 1979.

2. The Bureaus of Reclamation and Indian Affairs are cooperating in a Water Conservation Opportunities Study. Its primary purpose is to inventory and rank Federal irrigation projects on the basis of opportunities to increase water use efficiency. Based on this inventory and ranking, high-priority projects will be selected for more detailed studies and subsequent implementation of improvements. A secondary objective is the development of basic data on causes and effects of low-irrigation efficiencies, factors which discourage desired improvements, programs needed to effect improvements, etc., for use by the Interagency Task Force on Irrigation Efficiencies. In this study, technical specialists are examining project and onfarm facilities, operations, and management of about 60 Bureau of Reclamation and Bureau of Indian Affairs

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1/"Better Federal Coordination Needed to Promote More Efficient Farm Irrigation," RED-76-116, June 22, 1976. "More and Better Uses Could Be Made of Billions of Gallons of Water by Improving Irrigation Delivery Systems," CED-77-177, Sept. 2, 1977.

irrigation projects to identify deficiencies in facilities and management which result in inefficient water use. The study will provide estimates of benefits and costs as well as the environmental and institutional constraints associated with upgrading existing facilities and management practices.

AUGMENTATION OF THE COLORADO RIVER

Past studies of the Colorado River Basin have concluded that water salvage and conservation programs can only delay, not prevent, water shortages from occurring in the basin; therefore, additional water is needed to meet future demands. The Congress, in passing the 1968 Colorado River Basin Project Act, recognized the need to augment the Colorado River by at least 2.5 maf in order to meet the commitment to Mexico and help meet the demand for additional water in the basin.

A 1968 House report on the Colorado River Basin indicated that water supply studies showed conclusively that a serious water deficiency already existed in the Lower Basin and that as this imbalance between requirements and supply continued to grow, the water situation throughout the entire basin would become more and more critical. The report stated:

> "There is no reasonable chance that the Colorado River will supply enough water to meet the demands of the area which relies upon it. The water supply situation, combined with the fact that there is insufficient water in the Colorado River to furnish the amounts specified in compacts, contracts, the Mexican Water Treaty, and the Supreme Court decree in Arizona vs. California, means continued controversy accompanied by economic stagnation unless there is augmentation of the water supplies available from the river. There can be no lasting solution to the water problems and disputes of the states of the Colorado River Basin without the addition of more water." 1/

The committee concluded that the most urgent and fundamental water resource issue before the Congress involved initiating plans and procedures to resolve the water supply deficiency of the entire basin.

1/Report No. 1312 on Bill HR 3000, House of Representatives 90th Cong., 2nd sess., prepared by the House Committee on Interior and Insular Affairs, 1968.

The House version of the Colorado River Basin Project bill differed from the Senate's in that it would have directed investigations of ways to augment the river. The Senate bill excluded any studies involving water importation into the basin as a result of pressure from the Pacific Northwest, which was not pleased with the idea of supplying its water to solve the Southwest's problems.

The House-Senate compromise bill that was signed into law in 1968 as the Colorado River Basin Project Act dealt with the need for augmentation studies by directing that a general study be made of Western water supply problems but prohibited for 10 years a study of water importation into the Colorado River Basin.

In April 1975 the Department of the Interior in its Westwide Study Report stated:

"While there is ample water supply in the Colorado River to meet current demands in the river, water shortages will develop in the not too distant future if the desires of the basin states for growth of water dependent developments are realized * * *. To assure the avoidance of serious water shortages in the Colorado River Basin, programs to augment river flows or to otherwise match water supply with water demand should be in operation by the 1995-2000 time frame * * *."

In the conference report 1/ on the 1968 act, it is stated that when the water supplies and requirements of the Western United States are determined, the Secretary of the Interior should then proceed with investigations to determine the most economical means of augmenting the water supply of the Colorado River. In the past, several individual studies by the Bureau and others have endeavored to evaluate various means by which the waters of the Colorado River could be supplemented, including weather modification, vegetation management, desalting of seawater and geothermal brines, and importation of water from other river basins.

Weather modification

Weather modification is one of the principal methods the Bureau is reviewing as a means of augmenting the Colorado River. Weather modification in the basin involves using cloud seeding to increase snowfall in a high mountain area, thereby enhancing spring and summer runoff into the

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1/H.R. Conf. Rept. No 1861 90th Cong. 2d sess. (1968).

Colorado River. As a result of the Colorado River Basin Project Act, the Bureau in 1968 established the Colorado River Basin Pilot Project. This was a $6.5 million, 5-year winter research program undertaken to help determine the feasibility of augmenting high mountain snowpack in the San Juan Mountains in southwestern Colorado by cloud seeding.

There have been conflicting views and considerable debate as to the results of the project, which was completed in April 1975, as to whether or not winter cloud seeding does increase the snowpack enough to increase stream flows significantly in the basin. The evidence is not overwhelming either way. A statistical analysis of the project performed by an independent consulting firm showed that the methods applied during the project failed to show any statistically significant increases in precipitation as a result of the cloud seeding. The analysis concluded that the lack of positive results was mainly a result of missed forecasts and in many cases seeding the wrong kinds of clouds. The firm concluded that a correctly designed and operated winter cloud seeding program has the potential of producing significant increases in precipitation and streamflow.

Although this research has shown cloud seeding to be more complex than was originally thought, the Bureau and the National Weather Modification Advisory Board believe that it is a viable means of augmenting Colorado River streamflow from both a technical and economic viewpoint. Bureau and Advisory Board officials believe that the results of the pilot project provide strong evidence that a 10- to 20-percent increase in seasonal snowfall can be achieved in the Colorado River Basin by selectively seeding the warmer winter storms.

In a June 1978 report, the Advisory Board stated that of all the U.S. cloud seeding objectives considered, that of increasing snowpack over the Western mountains of the United States rests on the firmest theoretical and experimental grounds. The annual potential of increasing streamflow in the basin is estimated at about 1.6 maf. Preliminary estimates of the cost of such water would be about $3 an acre-foot.

In addition to the technical questions of cloud seeding, there are many unanswered questions concerning the social, economic, legal, and environmental ramifications of using cloud seeding that need to be studied and resolved before this method could be considered a feasible alternative for augmenting the river. Much of the controversy of using cloud seeding centers around the following questions:

--What are the short-term and long-term environmental impacts?

--What are the far-reaching effects on regional development?

--Who owns the new water and who should pay for the operational costs? Who is responsible for possible liabilities?

--How can localized opposition to a generally acceptable and needed project be resolved?

--Who has the final decisionmaking authority--local groups, water and soil districts, State agencies, or the Federal Government?

To help resolve these questions and certain other technical and scientific uncertainties of cloud seeding, the Bureau is proposing a large-scale demonstration program for the Colorado River Basin. The principal thought behind the proposed demonstration program is that before the Bureau can ask for major decisions to be made on a continuing augmentation of the Colorado River by cloud seeding, the capability to produce sufficient quantities of new water should be thoroughly demonstrated.

The Colorado River Demonstration Program would involve full-scale cloud seeding in five of six major mountain areas in the basin for a 10-year period. The sixth mountain area would serve as a control for evaluation. The program, including planning, operation, and evaluation, would last 14 years and cost an estimated $36.6 million.

The Bureau has received support from the basin States for the program but is having problems in obtaining long-range budget approval because of certain legal implications. These involve determining who owns the new water produced and the possible impact the decision would have on the Federal Government being reimbursed for its investment or protected in its right to use the water to meet a Federal obligation, such as the Mexican Water Treaty.

Since the demonstration program was first proposed in 1975, the Bureau's planning has changed to include a small confirmatory experiment step prior to any large-scale demonstration test. The main objective of such an experiment would be to provide a verification of snow increases caused by seeding and resolution of the remaining technical questions.

Vegetation management

A July 1977 preliminary study by the U.S. Forest Service Extension at Arizona State University for the Pacific Southwest

Inter-Agency Committee indicates a possibility that the basin's water supply could be increased by about 1.5 maf per year through a process of regulating harvesting patterns in the commerical forests of watershed areas. The procedure would result in increased snowpacks, which in turn would increase runoffs and streamflows. Cost estimates for this additional water supply range from less than $2 per acre-foot to over $50 per acre-foot. One study based on mid-1960 prices showed that while some of the water costs are high, the average for 83 percent of the water yield was less than $9 per acre-foot.

The vegetation management procedure of harvesting in commercial forests has not been demonstrated on a large scale, and more research would be required to determine the effectiveness as well as the environmental ramifications of such a program. If proven, it would represent a long-term solution to the water shortage problem.

According to the Forest Service's study, forest harvesting management and weather modification are synergistic; any increase in precipitation brought about by weather modification, if complemented by forest harvesting management, would have greater effect than if the two programs were implemented independently. The greatest augmentation potential exists in the subalpine forests of the Upper Basin. One limitation of the program is that full implementation would take decades. Once fully implemented, the program could be maintained indefinitely to provide a permanent augmentation source.

Desalting geothermal water and seawater

Starting in 1968 the Bureau conducted a geothermal desalting program on the East Mesa in Imperial Valley, California. Five deep geothermal wells were drilled to depths of from 6,000 to 8,000 feet. The wells produced, at the ground surface, hot liquid and steam from 230 degrees to 340 degrees Fahrenheit.

Small quantities of freshwater were produced on a limited scale from two small test distillation desalting units. The Bureau also studied converting geothermal heat energy to electric energy and using this energy for desalting the geothermal fluids. The Bureau has installed a small high-temperature electrodialysis unit to test this process.

Bureau studies in the Imperial Valley showed that it is technologically but not economically feasible to produce freshwater from desalting geothermal water. For example, results indicate that geothermal desalting is technically feasible

and that about 75 percent of the water content of the geothermal energy is a heat source for a distillation plant. However, the report states that available data indicates that economic feasibility of developing the geothermal reservoir for desalting does not appear competitive when compared to present water costs. In order to prevent subsidence, the Bureau has studied injecting water back into the geothermal formation. The Bureau estimates that the cost for the geothermal desalting would range from $1,200 to $1,500 an acre-foot, depending on the source for reinjection water, for a desalting complex to produce 50,000 acre-feet of freshwater annually. Because of these high costs and low water yield, the Bureau has terminated its geothermal investigations in the Imperial Valley but is looking at other possible basin locations.

Desalting seawater appears to be too expensive to merit serious consideration as a source for large-scale augmentation in the Colorado River. For example, it was reported in the Westwide Study that a typical cost for a desalting plant with a 40-million-gallon-a-day capacity was $300 per acre-foot based on 1972-73 prices. The 1975 Westwide Study included the following statement:

> "Since 1952, Federal support for research and development of desalting technology has produced many advances in desalting processes such as distillation, reverse osmosis, electrodialysis, and freezing. Most of these processes are now considered commercially available for select applications. However, due to relatively high costs, lack of experience, and present availability of other water supply sources, United States desalting applications have been slow compared to current worldwide experience."

To reduce salinity in the Colorado River, the Bureau is planning construction of a 96-million-gallon-a-day desalting complex near Yuma, Arizona, to desalt irrigation return flow from the Wellton-Mohawk Irrigation and Drainage District in Arizona before returning the water to the river. It is estimated that the product water from this plant will cost around $338 per acre-foot based on July 1977 prices. The average salinity levels of the Wellton-Mohawk drainage water is about 3,200 parts per million as compared to 35,000 parts per million for seawater.

Importing water into the basin

The Bureau has not studied importation of surplus waters from areas outside the basin because of a 10-year moratorium

on such studies included in the 1968 Colorado River Basin Project Act. This moratorium was recently extended another 10 years in the Bureau of Reclamation Safety of Dams Act. In 1973 the National Water Commission said that the feasibility of interbasin transfers increases as (1) economic demand for water increases, (2) available water supplies in areas of shortage shrink, (3) technological capability improves, and (4) national income grows. The Commission recommended that interbasin transfers should not be undertaken unless the net economic gain for the area receiving the water would more than offset the economic loss to the area losing it.

Certain State and Federal officials believe that while it may be technologically feasible, it might not be economically, politically, or socially possible to import water to the Colorado River Basin from outside the basin. One Bureau official stated that water importation might be economically feasible if enough high-quality water could be imported to mix with the water in the Lower Basin to improve its quality significantly and thus eliminate the need of spending millions of dollars for salinity control projects.

APPENDIX VI

SALINITY CONTROL ACT PROJECTS

(ACTIVE) AUTHORIZED FOR CONSTRUCTION

PARADOX VALLEY

Paradox Valley, located in southwestern Colorado, has been identified by the Bureau of Reclamation as a significant natural contributor to salinity in the Colorado River Basin. Ground water comes in contact with the top of a salt formation in the valley and surfaces as salt brine in the channel of the Dolores River. The Bureau estimates that the Dolores River picks up about 200,000 to 250,000 tons of salt annually in Paradox Valley and deposits it into the Colorado River. The Paradox Valley project is estimated to reduce the annual salt inflow to the Colorado River by 180,000 tons.

The Bureau has been conducting tests to prepare design and construction data for the Paradox Valley unit. It has been having problems in finding proper locations for the brine wells that will enable it to pump out sufficient quantities of brine water to eliminate the natural brine inflow into the rivers. A December 1976 status report stated that the results of pumping tests performed on 3 of the 18 wells authorized for construction showed no conclusive evidence of any change in the salinity content of the Dolores River.

Preliminary testing has been completed, and Bureau officials believe that the wells are now properly positioned and that testing of all the wells as a unit will prove the project to be effective in reducing salinity in the Dolores River by the amount estimated. Testing began in October 1978 and is planned to continue for approximately 2 years.

LAS VEGAS WASH

The Las Vegas Wash is a natural channel which drains the entire Las Vegas Valley watershed area of 2,200 square miles and discharges into Lake Mead. The Bureau estimates that the Las Vegas Wash contributes about 200,000 tons of salt a year to the Colorado River system.

The Las Vegas Wash unit was initially expected to reduce the annual salt load to the river by about 131,000 tons and bring a 13 mg/l salinity reduction at Imperial Dam. However, later studies show that the unit will reduce the salt load to the river only by about 83,000 tons annually for a salinity reduction at Imperial Dam of 9 mg/l. Construction costs for the project at the same time have escalated from $49.6

million to $56.5 million. These costs do not include preauthorization investigation costs and interest during construction.

Bureau representatives explained that one main reason for the lower than expected salt load reduction was an error in estimating the rate which a highly saline ground water mound under evaporation ponds would dissipate due to lining the ponds. The ponds are used to evaporate water effluents from an industrial plant. The ground water mound that developed under these ponds significantly contributed to the salt inflow to the wash.

The ground water was initially estimated to take 30-40 years to dissipate. However, after further study, the Bureau now estimates that the dissipation will take only 3 years and will be completed before the Las Vegas Wash project is operational. The Bureau is delaying construction to study the project further.

GRAND VALLEY

The Grand Valley, located in west-central Colorado, was carved in a high salt-bearing marine shale (Mancos shale) formation. Four irrigation entities in the valley divert water from the Colorado River to irrigate about 71,500 acres, including approximately 38,000 acres under Federal projects. All sources of return flow in the Grand Valley are estimated to contribute an average of about 700,000 tons of salt annually to the Colorado River system. Most of these salts are thought to be leached from the soil and underlying Mancos shale and washed into the river by deep percolation and water delivery system seepage losses.

The Bureau initially estimated that the project would reduce salt loading in the river by about 200,000 to 280,000 tons per year, but it has revised this estimate upward to about 410,000 tons. However, the reliability of these estimates has not been firmly established. Certain Bureau officials question the effectiveness of the salinity control measures for the proposed Grand Valley project because there are no real assurances the methods used will reduce the salt load by the amounts estimated. They stated that the theory behind these methods has proven mathematically successful but that the Bureau has little or no hard test data from the Grand Valley to support the salt reduction estimates.

Segments or groups of the Bureau, Agricultural Research Service, Soil Conservation Service, Colorado Water Conservation Board, and Colorado State University (CSU) have

been involved in studying salinity control in the Grand Valley. In the early 1970s these groups formed the Grand Valley Salinity Coordinating Committee to coordinate their activities.

These groups essentially agree that about 700,000 tons of salt are contributed annually by the valley. However, CSU estimates that the amount of salt from canal seepage is about 90,000 tons less and from onfarm percolation is about 70,000 tons more than the committee's estimate. CSU differs with the committee about the amount of salt contributed due to seepage from the Grand Valley canal system and contends that most of the salt being picked up in these areas is from high ground water tables rather than from canal seepage.

Economic feasibility of the individual salinity control measures proposed for the valley varies considerably. Comparing each measure's cost-effectiveness with benefits to be derived by downstream users raises questions about the cost-effectiveness and how much should be invested in each of the proposed measures. The following schedule shows the control measures in the Bureau's plans for Grand Valley. As shown, lining of laterals 1/ Irrigation Management Services, 2/ and onfarm improvements appear to be more effective--in terms of cost and tons of salt removed--than lining of canals.

Control measure	Estimated tons of salt reduced	Estimated cost
	------(000 omitted)------	
Canal lining	110	$73,000
Lateral lining	170	65,000
IMS & onfarm improvements	130	24,000

A May 1977 publication sponsored by EPA recorded the results of a CSU preliminary analysis of the best management practices for salinity control in Grand Valley. The

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1/Laterals are the part of agricultural water conveyance systems that cut across farming plots.

2/IMS is a systematic determination of when and how much to irrigate.

researchers concluded that from an economic standpoint canal lining would be only marginally feasible and would depend on the costs assigned to downstream damages from salinity.

Another uncertainty facing the project is the IMS program; the Bureau may have trouble getting farmers to use this system. One Grand Valley district notified the Bureau that it has no desire to participate in the IMS program. Also, IMS would be limited in controlling salinity in Grand Valley under existing onfarm conditions. Furthermore, the Soil Conservation Service has been unsuccessful in securing $23.6 million in funding necessary to carry out an onfarm improvement program.

Largely because of these problems, the Bureau is behind schedule in constructing the project, despite being under considerable pressure from the States. In an attempt to start construction and demonstrate to local residents the type of coordinated improvements contemplated, the Bureau plans to select a small area of about 7,000 acres, instead of the whole project, to implement the program.

Depending on the results of this pilot, the Bureau will decide whether to go ahead with the rest of the project. Certain officials from the basin States and the Bureau believe that the whole project should be completed regardless of the results of the pilot project and the economic feasibility of the various measures.

INDIAN WATER RIGHT CLAIMS

There are Indian water right claims in the basin that have not been settled. We have briefly summarized a few of these below.

FIVE COLORADO RIVER INDIAN RESERVATIONS ARE UNHAPPY WITH CURRENT ALLOCATIONS

In the Supreme Court decree of 1964 (Arizona v. California, 376 U.S. 340, 343-345), besides upholding allocations of waters to the sub-basins and States, the Court allocated water to five reservations that border the the Colorado River in the Lower Basin. Indian water rights were measured in terms of the "practicably irrigable acreage" on the reservations involved. The annual allocations were as follows.

Reservation	Irrigable acres	Acre-feet of water
Chemehuevi	1,900	11,340
Cocopah	431	2,744
Yuma	7,743	51,616
Colorado River	107,588	717,148
Fort Mohave	18,974	122,648
Total		905,496

We were informed that the Indians on these reservations are dissatisfied with the Supreme Court allocation and are considering future actions to obtain greater water allocations. The Indians believe that the acreage assessment used to quantify their water rights did not consider all of the irrigable acreage on the reservations. The Indians are also unhappy that certain reservation lands and certain lands involved in reservation boundary disputes were not included.

The controversy over classification of Indian lands as irrigable centers around the economic feasibility of irrigating such lands. The land survey used by the Court considered economic feasibility. The Bureau of Indian Affairs (BIA) and the Indian tribes believe that such economic considerations should not be a constraint in classifying Indian land as irrigable.

We were informed that a BIA-sponsored soil survey of these Indian lands conducted in 1975 by private consultants increased the total irrigable acreage for the five

reservations by 50,000 acres. This survey did not consider economic feasibility in determining the irrigable acreage figure. According to a BIA official, the Indians rejected the survey's results and identified additional land parcels that they want included in any determination of irrigable acres.

NAVAJO TRIBES ARE CLAIMING 5 MAF

The Navajo Reservation encompasses 25,000 square miles and is located in parts of Arizona, New Mexico, and Utah. The entire reservation lies within the Colorado River Basin, with portions of the Colorado and San Juan Rivers forming the northern boundary. The Little Colorado River flows into the Colorado from the southwestern part of the reservation.

Under the Winters doctrine, the Navajo Indians now claim all the water reasonably necessary to irrigate all practicably irrigable acreage on the reservation. The Navajos believe that they have an entitlement from the Upper and Lower Colorado River Basins of at least 5 million acre-feet of water. According to BIA officials, the tribe has tried to obtain a small part of the 5 maf by filing suit in New Mexico State Court to acquire their entitlement to San Juan River water. They stated that the Navajos are contemplating other suits pending the outcome of the San Juan case.

Arizona State officials argue that to establish the Indian entitlement as the Supreme Court intended, the practicably irrigable acreage must be determined at the time the reservation was established. On this basis, they find it difficult to believe that the Navajo Indians or U.S. Government contemplated irrigating the high plateau areas of the reservation when it was established in 1868.

CENTRAL ARIZONA RESERVATIONS

Indians located on five reservations in central Arizona have asserted claims to greater quantities than they presently receive of ground water and surface water from central Arizona rivers, such as the Verde, Salt, and Gila. These waters are being used by or have been allocated, generally, to non-Indian water users. The Indians contend that the Government failed to protect their water rights and have asserted compensation claims for water from the Colorado River to be delivered by the Central Arizona Project to make up for their original water rights.

As a result, in October 1976 the Secretary of the Interior ruled that the central Arizona Indian reservations were entitled to receive a firm supply of 257,000 acre-feet

per year of CAP water, as shown in the following table, for the first 20 years or until 2005, whichever occurs first.

Reservation	Acre-feet
Ak Chin	58,300
Fort McDowell	4,300
Gila River	173,100
Papago	8,000
Salt River	13,300
Total	257,000

After 2005, the Indians will receive either 20 percent of the agricultural water or 10 percent of total project water, whichever is to their advantage.

The tribes are protesting the decision and are claiming substantially increased amounts of CAP water. In 1976 and 1977, two Indian reservations, the Gila River and the Salt River reservations, filed lawsuits over the matter, claiming significant increases in the acres of reservation land that could be irrigated. It is estimated that the two suits, if successful, would increase the water claimed by the two reservations by about 1.3 maf.

Legislation was introduced in 1976 and 1977 that proposed to settle the water rights claims of the central Arizona Indians through acquisition and transfer of existing water rights to the Indians. The Secretary of the Interior would be authorized to acquire, either by purchase or condemnation at fair market value, 170,000 acres of non-Indian land with surface water rights, involving about 1 maf of water. The water rights would be transferred to the Indians in settlement of their claims. One area to be considered for purchase or condemnation was approximately 65,000 acres of the Wellton-Mohawk Irrigation and Drainage District of the Gila Project near Yuma, Arizona.

The people owning, living on, and/or farming the lands of the Wellton-Mohawk District object to the arrangement for social and economic reasons. Various officials from the State of Arizona objected to the proposal to transfer over 90 percent of the dependable supply of Central Arizona to the reservations, pointing out that such a quantity could never have been developed by the Indians from streams flowing through or bordering the reservation, a condition of the Winters doctrine. However these officials do agree that the claims of the central Arizona tribes should be quantified

for all time and believe that the legislative approach offers a better opportunity for an equitable and timely solution to the problems than does the judicial procedure.

After hearings on the proposed legislation, Interior has been negotiating with Indian and non-Indian representatives to resolve their differences. Some progress has been made, such as on the Ak-Chin Indian Community Claims discussed below. In addition, as of September 12, 1978, negotiations are continuing with the other Indian communities to reach agreements which will most likely result in legislative proposals.

Papago Tribe's claim to ground water

The United States, on behalf of the Papago Tribe, whose reservation is located in south-central Arizona near Tucson, filed suit in 1975 against the City of Tucson and certain private companies to enjoin them from excessive pumping of ground water, which the suit claims is infringing on the tribe's surface and ground water supply. The suit also seeks damages from the defendant's use of surface and ground water in derogation of the Papago's claimed rights and declaration of the tribe's water rights in the Upper Santa Cruz River Basin.

Department of the Interior attorneys plan to amend this lawsuit to include allegations that the tribe's ground water supplies have been infringed upon in violation of the Winters doctrine. This is based on an Interior interpretation of a 1976 Supreme Court ruling in the case of Cappaert v. United States, 426 U.S. 128,138 (1976) that the doctrine of Federal reserve water rights applied to ground water. It is the position of several Western States that this decision applied only to surface water, not to ground water.

Ak-Chin Indian Community's claims

On July 28, 1978, Public Law 95-328 was passed to settle water right claims of the Ak-chin Indian Community against the United States. The legislation provides for the annual transfer of 85,000 acre-feet of ground water from nearby Federal lands until a permanent supply of water is provided.

APPENDIX VIII

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

JAN 9 1979

Mr. Henry Eschwege
Director, Community and
Economic Development Division
General Accounting Office
Washington, DC 20548

Dear Mr. Eschwege:

This is in response to your October 23, 1978, letter to the Secretary requesting our comments on the GAO Draft Report, "Colorado River Basin Water Problems: Proposals to Reduce Their Impact."

Although the report contains a number of misconceptions which need to be corrected, it generally presents a thorough and objective analysis of the water supply problems in the Colorado River Basin. The report, however, does fail to recognize the complex nature of the Colorado River Basin water supply problems, especially with regard to the Basin States' water related interests and water rights. The concepts of total water management studies and a river basin commission have been presented to the Basin States before, and have always been rejected. For example, a Cooperative Federal-State Study Group has been working since June 1978 to prepare studies to define the urgency of developing a hydrologic basis and procedures for determining section 602(a) storage requirements of Public Law 90-537, Colorado River Basin Project Act, September 30, 1968, but initial responses indicate that the States do not believe development of such procedures is urgent at this time.

Although the Bureau of Reclamation has planned, financed, and constructed many major water development projects in the basin, all the water controlled by those projects is still subject to State water right laws, compacts, or decrees. Therefore, Reclamation must always work in cooperation with the States in attempting to solve water related problems.

We refer you to the statement on page 68 of the draft report, "State water officials have claimed that the river is a State matter and not to be operated for the benefit of the basin as a whole or the Nation. The basin States do not believe sufficient incentives are available to cause them to manage their water resources on a basinwide basis" (emphasis added). That statement aptly describes the problem that has faced the Department of the Interior over the past decade in seeking to study basinwide management of the Colorado River. The studies to

APPENDIX VIII

quantify the incentives have never been made because the States do not believe that sufficient incentives are available. The potential for improved management cited in the draft report is largely of a qualitative nature, and the actual benefits to the State and to the Nation have not been quantified. We believe that quantification of those benefits is in the best interests of the States and the Nation. Accordingly, GAO may wish to consider the viability of the draft recommendation to the Congress that a basinwide State-Federal management entity be established. Without prior quantification of the benefits, lack of cooperation from essential parties could thwart needed management efforts. After water from the Colorado River starts being used in 1985 for the Central Arizona Project, basin interests will see that a water shortage will eventually come. At that time they will be less able to negotiate from a viewpoint of equity, and instead will probably take a litigative attitude of protecting their own interests. Thus, an atmosphere conducive to reaching basic agreements will only exist for a few more years, and we support GAO's conclusion that now is an ideal time to seek resolution of unsettled controversies.

Representatives of Reclamation's regional offices and E&R Center have informally provided comments on the report to GAO representatives at previous meetings, and while their general comments have been incorporated in this letter, most of the specific comments provided at those meetings are not included. At a November 27, 1978, meeting in our office, GAO representatives indicated they would consider those specific comments in preparing the final report. The following comments were discussed at the November 27, 1978, meeting:

Page iv, par. 1--Indian water rights development is possible, but many questions exist. Most projects would take 20-30 years to be developed, and many of those projects may not be economically feasible under present criteria for justifying investments in water resources developments. For the potential "1/3 of all the water in the basin" referenced by GAO as being claimed by Indian interests to be developed, a significant shift in national priorities would be required to subsidize classically infeasible developments. The President's water policy has stressed a negotiated solution in which quantification is accompanied by development, and this may alter the situation favorably.

Page iv, par. 2--It is true that there are no specific plans for controlling salinity after 1990, but that does not mean the salinity control program will end at that time. The Colorado River Water Quality Improvement Program is an ongoing program to identify needed salinity control activities. Also, 208 studies under Public Law 92-500 are identifying additional salinity and quality control activities.

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Page v, par. 1 and Page 51, par. 2--The smaller size of the desalting plant is the result of irrigation efficiency improvement and acreage reductions which have decreased the volume of drainage. The size was reduced intentionally to reduce costs of the plant.

Pages 3 through 6--The scope of the Supreme Court Decision, Arizona v. California, was limited to an interpretation of water rights under the Boulder Canyon Project Act, and only adjudicated main stem waters. Tributary flows are not included. There are existing mechanisms for apportioning water during periods of shortages in the Arizona v. California Decree, in the Colorado River Basin Project Act (Public Law 90-537), and in the 1944 Mexico Water Treaty.

Pages 11 and 12--Terms such as "virgin flow," "average annual virgin flow," "future virgin flow," "dependable yield," and "actual records," are used interchangeably but all have different meanings. We suggest that GAO clarify or standardize this terminology.

Reclamation's estimates for annual Lee Ferry flow are: 14.8 million acre-feet (maf) long-term average virgin flow, and 14.05 maf dependable yield. Tree ring hydrology is not yet considered a reliable and proven procedure for estimating historical flows.

Page 14, par. 2--The upper basin development level of 5.8 maf does not go with "the downstream and power storage commitments," but is derived from the flow that would be available for upper basin use with an annual 8.25 maf Lee Ferry delivery.

Page 15--Reclamation's dependable yield projection which is derived from a critical period analysis of streamflow is very conservative. Representatives of some basin States feel it is too conservative for use in establishing storage requirements for protecting future uses.

Page 29--The costs of implementing water conservation measures often exceed the benefits and the overall potential appears to be small. Therefore, GAO may wish to consider those aspects before indicating that such measures "could lessen the impact of future shortages."

Page 32, par. 2--Reclamation is not using an "overly optimistic estimate" of water supply, but has actually used the worst historical experience, combined with the storage capability of the basin's reservoirs, to determine the dependable yield.

Page 39 and others--All benefit values cited are based on the old value of $230,000 per milligram per liter which was developed in 1974 and should significantly increase when a new value is available.

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Page 42, par. 2--The salinity detriment in dollars per milligram per liter of salinity at Imperial Dam is one measure of the benefits of salinity control. While it is true that we do not use those values in a benefit-cost type of analysis, they are used as a measure of the effectiveness of the project.

Page 43, par. 2--Crystal Geyser was deferred primarily because of high costs, not because of its minor impact.

Page 44, par. 1 and Page 53, par. 1--Late appropriations have not been a factor in schedule delays on either the Title I or the Title II program as indicated.

Page 44, par. 2--The salinity control program has been treated more like pollution control programs, where the most cost-effective procedures are implemented rather than applying "feasibility" or "benefit-cost" standards. It was not anticipated by the Congress that the salinity control program would meet feasibility criteria.

Page 45, par. 3--Reclamation is proceeding with plans for units which may require desalting. The studies will evaluate alternatives and the most cost-effective alternative selected. Therefore, those units mentioned are still being considered.

Page 50, par. 1--We suggest changing the phrase ". . . closure of Glen Canyon Dam . . ." to ". . . elimination of consistent over deliveries to Mexico . . ." to make the statement more accurate.

Page 52, par. 2--Fish and wildlife mitigation costs of nearly $10 million are not mentioned as a significant part of the cost increase in the Salinity Control Program.

Page 54, par. 1--A specific study authorized by Public Law 93-320 is underway to find a means of replacing the brine stream water. It is not a part of a basin augmentation plan.

Pages 55 and 59--This discussion ignores the water that would be bypassed prior to the implementation of an augmentation program and the U.S. obligation to replace that water. It also ignores the legal and institutional questions associated with water derived through weather modification. We suggest adding some discussion of those problems.

Page 55, par. 3--The changes in salinity reduction of the program as now envisioned are not major. In addition, we are adding new projects (such as Meeker Dome) as we find reasonable ones which should maintain or increase the salinity reduction capability of the program.

APPENDIX VIII

Page 57, par. 1--When discussing alternatives to the Yuma desalting plant, it should be kept in mind that: (1) the water lost while implementing any alternative must be replaced, and (2) the Brownell task force concluded that the agreement with Mexico is a national obligation and thus should be met by using dollars rather than water (which costs only the Basin States).

Appendix IV, page 111, par. 2, and Page 56, par. 2--Reclamation is delaying construction of the Las Vegas Wash Unit to further study the project in the light of recent developments.

Sincerely,

Daniel Beard

Acting Assistant SECRETARY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

JAN [illegible] 1979

REF: 8W-WP

Mr. Henry Eschwege, Director
Community & Economic Development Division
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Eschwege:

Attached are the Environmental Protection Agency's comments on the Draft GAO Report, Colorado River Basin Water Problems: Proposals to Reduce Their Impact. A draft of these comments was previously submitted to Mr. Carl Bannerman of your staff. These comments reflect the position of EPA Headquarters and the EPA Regions involved with the Colorado River Basin.

EPA's principal concerns are the analyses and recommendations regarding the institutional aspects of water planning and management and salinity issue. EPA believes that a strengthening, with possible redirection, of existing Colorado River Basin entities would have a greater pay off, at this time, than would the creation of a new entity. With regard to the salinity problem, EPA believes it is essential that all parties involved with Colorado River salinity acknowledge their responsibilities for achieving appropriate, cost-effective solutions to the salinity problem.

We hope the attached comments will assist preparing the final report on these very complex and controversial issues.

Sincerely yours,

Alan Merson
Regional Administrator

Attachment

cc: Thomas C. Jorling, Hdqts.
Adlene Harrison, Regional Administrator, Reg. VI
Paul DeFalco, Jr., Regional Administrator, Reg. IX

status of water development efforts relative to the status of the salinity control program at the time the standards were adopted. However, as an overall salinity control policy, EPA has previously indicated that a salinity mitigation policy should be maintained to assure that numerical criteria for salinity in the lower main stem will not be exceeded. This policy would require that any development project which increased salinity must be accompanied by a decrease in salinity in some other part of the Basin, which, at a minimum, would equal the expected increase.

This policy is based on the conclusions and recommendations of the reconvened 7th Session of the Conference in the Matter of Pollution of the Interstate Waters of the Colorado River and its Tributaries adopted by the seven Basin States and the Federal Government on April 27, 1972, and the salinity control policy, procedures, and requirements for establishing water quality standards for salinity in the Colorado River promulgated in the Federal Register on December 18, 1974 (39 FR 43721). Maintaining this policy would provide an equitable solution for salinity control. Although current efforts in salinity control are not proceeding as expeditiously as initially envisioned, the requirement for offsetting measures would prevent salinity aggravating activities from proceeding faster than controls. Furthermore, this policy would ensure continuing salinity control beyond 1990.

(2) The GAO report states that studies conducted by the Bureau of Reclamation indicate that salinity levels are expected to range from 970 mg/l to 1000 mg/l at Imperial Dam during the period 1990 to 2000. However, this concentration range is dependent on certain supply/depletion assumptions. In any event, the GAO report indicates that there are no plans for salinity control beyond 1990. This position of planned degradation is incompatible with the conclusions and recommendations of the Conference mentioned in Comment No. (1), the Federal Register salinity standards promulgation, and the salinity standards developed by the Forum, adopted by the States and approved by EPA.

(3) The GAO report does not acknowledge current salinity control efforts which are being developed as a result of nonpoint source control through implementation of Best Management Practices as part of the Section 208 (Clean Water Act) water quality management planning program, and point source control through the NPDES permit program.

EPA has identified salinity as a high priority for 208 Water Quality Management Planning in the Colorado River Basin. For example, the Clark County 208 Areawide Water Quality Management Plan indicates that salt contributions from irrigated agriculture in the Lower Virgin River Valley and Moapa Valley in northeastern Clark County, Nevada may be significantly reduced at a considerably greater cost effective-

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ness than the proposed Bureau of Reclamation Lower Virgin River Unit of the Colorado River Water Quality Improvement Program.

Irrigated agriculture is the major man-induced contributor to Colorado River Salinity. EPA sponsored research has demonstrated the existence of cost-effective solutions to salinity caused by irrigated agriculture. (A list of recent Irrigated Agriculture - Water Quality Control Publications is attached.) EPA believes that implementation of these measures should proceed rapidly.

The GAO Report should acknowledge the NPDES/Salinity policy. Under this existing policy, NPDES permits issued to industrial discharges require no salt return wherever practicable. Municipal permits, similarly, require salinity reductions from major municipalities.

(4) According to the GAO report, EDF has proposed establishing state-line salinity standards at locations upstream from Hoover Dam. GAO should note that efforts are currently underway to establish baseline salinity values at twelve monitoring stations upstream from Hoover Dam and are expected to be essentially complete in early 1979. Baseline values will represent 1972 salinity levels at the monitoring points. Any shift in baseline values at any monitoring station would be evidence of upstream changes that could lead to lower main stem standards violations, and therefore identify the need for control measures to assure compliance with the lower main stem standards. It must be emphasized, however, that these baseline values will not be water quality standards, but an effective method of indicating the possibility of downstream violations and allowing for sufficient opportunity to correct potential downstream problems before they occur.

(5) Preliminary studies, completed for the Bureau of Reclamation, of the Colorado River Indian Reservation and the Palo Verde Irrigation District indicated that irrigation distribution system improvements (canal and lateral lining) would have little impact on salt contributions to the Colorado River. However, the Bureau of Reclamation approach is not being relied on as the only salinity control program in the area. SCS studies are expected to show on-farm improvements to be cost effective and show a positive impact on salinity reduction in the Colorado River.

(6) The most counterproductive report recommendation is on page 57. Rather than delay salinity control efforts authorized by Congress to be implemented by the Bureau of Reclamation and others, there should be accelerated evaluation, planning and construction of cost effective salinity control projects. Those projects found during evaluation and planning to be ineffective in salinity control and/or not cost effective should be replaced at an early date with projects that satisfy these requirements. Federal responsibility, as acknowledged in the Colorado River Basin Salinity Control Act (P.L. 93-320), must not be abdicated.

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EPA COMMENTS ON DRAFT GAO REPORT, COLORADO RIVER BASIN WATER PROBLEMS: PROPOSALS TO REDUCE THEIR IMPACT

Following are EPA's comments on the Draft GAO Report, Colorado River Basin Water Problems: Proposals to Reduce Their Impact. These comments are in addition to the items discussed during the brief meeting between representatives of our staff and GAO in Denver on November 17, 1978.

While the GAO study touches upon numerous critical water resources issues in the Colorado River Basin, EPA feels that there are two principal policy issues which are particularly critical as well as sensitive. First are the institutional aspects of water planning and decision making in the basin. And second is the salinity problem and alternative solution to the problem. These particular concerns must be approached in a thoughtful and comprehensive manner if progress is to be made in dealing with these issues. EPA also has some comments on other issues addressed in the Draft Report.

Institutional Aspects of Water Planning and Decision Making

The GAO report recommends establishing a Federal-State task force to develop solutions to Colorado River Basin problems. Several groups already exist that could satisfy this description, e.g. the Colorado River Basin Salinity Control Forum, with Federal participation in an advisory capacity, the Upper Colorado River Commission with additional participation by the Lower Basin States and the Federal Government, and, especially, the Colorado River Interagency Salinity Control Committee.

It would seem that redirecting the efforts of these entities toward solution of the basin problems would be more effective than establishing another group. EPA sees potential merit in having a Congressional mandate directed to the existing entities to examine the following:

- strengthening existing interagency efforts,
- the balance of local, state, and national interests,
- nonstructural alternatives to water problems,
- water conservation opportunities,
- environmental concerns (water quality, fish and wildlife, National Parks and Monuments, etc.) and water decisions.

In summary, EPA believes that, at this time, more progress can be made through a strengthening of existing State/Federal/Interagency efforts than could be achieved by a new decision making body.

The Colorado River Salinity Problem

EPA has some major concerns with the GAO treatment of the salinity problem in the Colorado River.

(1) The salinity standards permit temporary increases in salinity in recognition of the hydrologic variability in the basin and the

Additional Comments

(1) We agree with the GAO finding that water plans in the Colorado River Basin should be based on realistic water supply/ demand projections. The projections must be sensitive to and reflect valid social, economic, political, and environmental concerns. Priority should also be assigned to specifying criteria for the declaration of water shortages, and reservoir storage and operation during low flow periods.

(2) The GAO report asserts that augmentation is the only viable long term solution to future water shortages in the Basin. Importing water from other hydrologic regions, however, is probably the least desirable solution from social, economic, political, and environmental standpoints. Salinity control is much more effective since the water quality problem is essentially reduced to a financial/economic question.

Importing water would probably result in localizing the benefits of these schemes within parts of the Colorado River Basin, aggravating the current Colorado River Basin problems in the remainder of the Basin, and exporting a portion of the current Basin problems to areas located outside the Basin. In light of the fact that several Basin States intend to or are already exporting portions of their allocated waters to other river basin systems, it is counterproductive for GAO to recommend import of water from other basin systems to augment Colorado River Basin resources.

(3) The report could be strengthened if GAO were to present a table, early in the report, of anticipated or predicted water use needs by the year 2000. (Quoting "most" authorities as agreeing that there will be a shortage is not sufficient.

The water use entitlements to states under various decrees are discussed in depth, but it does not appear, especially early in the report, that current water uses or allocated reserves are listed by each state. Such tables would place the problems in better prespective.

(4) On pages 65-70, total water management as conceived by the Bureau of Reclamation has been recommended as a panacea for Colorado River Basin salinity control problems. Although water management studies should be a part of the solution and several studies have been completed for the Basin by various Federal agencies during previous years, a "total water management study" probably won't resolve the basic issues any better than the previous studies but merely justify delaying implementation of identified cost-effective salinity control actions.

Attachment

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RECENT IRRIGATED AGRICULTURE WATER QUALITY CONTROL PUBLICATIONS

Integrating Desalination and Agricultural Salinity Control Alternatives; EPA-600/2-78-074, April 1978

Identification and Initial Evaluation of Irrigation Return Flow Models; EPA-600/2-78-144, July 1978

Implementation of Agricultural Salinity Control Technology in Grand Valley; EPA-600/2-78-160, July 1978

Evaluation of Irrigation Methods for Salinity Control in Grand Valley; EPA-600/2-78-161, July 1978

"Best Management Practices" for Salinity Control in Grand Valley; EPA-600/2-78-162, July 1978

Socio-Economic and Institutional Factors in Irrigation Return Flow Quality Control: Volume I-Methodology; EPA-600/2-78-174a, August 1978

Socio-Economic Institutional Factors in Irrigation Return Flow Quality Control: Volume II-Yakima Valley Case Study; EPA-600/2-78-174b, August 1978

Socio-Economic and Institutional Factors in Irrigation Return Flow Quality Control: Volume III-Middle Rio Grande Valley Case Study; EPA-600/2-78-174c, August 1978

Socio-Economic and Institutional Factors in Irrigation Return Flow Quality Control: Volume IV-Grand Valley Case Study; EPA-600/2-78-174d, August 1978

Western Water Laws and Irrigation Return Flow; EPA-600/2-78-180, August 1978

APPENDIX X

OFFICE OF THE COMMISSIONER
UNITED STATES SECTION

INTERNATIONAL BOUNDARY AND WATER COMMISSION
UNITED STATES AND MEXICO
IBWC BUILDING
4110 RIO BRAVO
EL PASO, TEXAS 79902

NOV 28 1978

Mr. Richard J. Gannon
Supervisory Audit Manager
U.S. Government Accounting Office
Suite 1010, World Trade Center
Los Angeles, California 90071

Dear Mr. Gannon:

I refer to your call on November 20 asking this Section for comments on the GAO Draft Report (Restricted to Official Use), on the "Colorado River Basin Water Problems: Proposals and Their Impact". A copy of the report was furnished to me by the Regional Director, Bureau of Reclamation, Boulder City, Nevada.

Since the jurisdiction of this Commission with respect to the Colorado River is limited to the boundary reach of the River and more specifically to the provisions of the 1944 Treaty relating to the deliveries of Colorado River waters to Mexico and agreements reached thereunder, the comments of this Section are limited to the related parts of the Draft Report, and particularly to the statements relating to the United States commitment to Mexico in the Agreement reached August 30, 1973, for a "Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River", Minute No. 242 of this Commission, which agreement was approved by the Presidents of the two Governments.

This Section must oppose the recommendation on page 57 that the Congress delay Federal funding for the Yuma Desalting Complex to re-evaluate its feasibility and to consider other "less costly alternatives" to fulfill the United States commitment to Mexico relating to the salinity of the waters of the Colorado River delivered to Mexico, for the following reasons:

1) Each of the alternatives referred to in the Draft Report was considered by the Interagency Task Force chaired by Ambassador Herbert Brownell as Special Representative of the President, and was ruled out as not being feasible for economic or political reasons or both. To be sure, inflation has increased the cost of the desalting plant, but so also inflation has increased the

cost of the alternatives. There are also other increases in costs for the desalting plant but even so, this Section understands from Bureau of Reclamation studies that the desalting option is the most viable today as it did in 1973.

2) This Section cannot agree with the statement in the Draft Report that the option of bypassing Wellton-Mohawk drain waters and substituting for them other Colorado River water "now appears to be feasible." Replacement of the Wellton-Mohawk drain returns whether about 200,000 acre-feet per year as currently, or 167,000 acre-feet per year as is proposed, would effect a significant reduction in the already short supply of Colorado River waters. The point emphasized most in the Draft Report is the short supply and the bypass option would make it worse. It was in recognition of this fact that Ambassador Brownell made the commitment to the Basin States that solution of the salinity problem with Mexico should not cause a reduction in their water supply. His recommendation to the Congress was made on this basis, and the Congress, after careful consideration of the basis for the recommendation, approved it as the means of implementing the agreement with Mexico in Public Law 93-320.

3) With the desalting plant, the Bureau reports an unavoidable bypassing of 42,000 acre-feet of the brine waters (not 67,000 acre-feet) to the Gulf of California, but by the terms of Public Law 93-320, the Congress required that replacement of all such waters be recognized as a national obligation, reflecting its concurrence in Ambassador Brownell's basis for his recommendation as well as its own concern that there be no permanent loss of waters to the Basin States because of the settlement with Mexico.

4) The Draft Report mentions estimated costs of augmenting stream flows as low as $3 an acre-foot but this Section is not aware of any technically proven and valid means of augmentation at any such cost. The only realistically available means known to this Section to augment stream flows would be importation of water to the basin, and the costs would approach or exceed the desalting costs. Moreover, importation is now and for years to come, politically infeasible.

5) Care should be used in referring to the total estimated costs of the desalting plant and related features as amounting to $334 million, because most of the related features, which make up 47 percent of the total, would be needed without the desalting plant itself, which is estimated to cost $178 million. Several of the other facilities, some already built, will serve a useful purpose in conserving United States waters of the Colorado River.

6) Each year's delay in construction and operation of the desalting plant imposes the serious risk of annual losses of water to the Basin States ranging from some 200,000 acre-feet as currently to about 167,000 acre-feet in the future. With a desalting plant, there would be only a temporary loss of the 42,000 acre-feet per year, resulting in immediate savings of 158,000 to 125,000 acre-feet. To not effect such savings at the earliest practical date would be contrary to the commitment made to the Basin States by Ambassador Brownell and to the will of the Congress for implementation of the salinity agreement with Mexico.

Therefore, this Section must oppose any delay in Federal funding for the Yuma Desalting Complex. Rather, the Section must urge earliest possible funding of the authorized works in keeping with the Executive and Congressional commitment to the Basin States that implementation of the salinity agreement not cause them to lose waters.

While this Section is directly concerned with the parts of the Draft Report relating to fulfillment of the salinity agreement with Mexico, it is also concerned with the parts of the Draft Report relating to the control of salinity of the waters of the Colorado River upstream from Imperial Dam. This concern is founded on the view that should the salinity of the upstream waters not be controlled as contemplated under Title II of Public Law 93-320, we would have to anticipate, in time, another serious salinity problem with Mexico. Therefore, like Ambassador Borwnell and the Department of State at the hearings before the Congress, this Section continues to support a program for control of salinity of the Colorado River upstream from Imperial Dam.

This Section also wishes to comment on the statement in the Draft Report on page 5 line 4: The 1944 Treaty was not amended--to provide for water of a specific salinity content. Rather, in 1973, an agreement was reached under an interpretation of the Treaty, to require the United States to deliver water to Mexico having a salinity only somewhat higher than the salinity of Colorado River waters reaching Imperial Dam.

We note several technical statements in the Draft Report which appear questionable but believe the Bureau of Reclamation is more qualified to comment on those statements.

We appreciate the opportunity to review the Draft Report and would be glad to meet with you if you desire to clarify this Section's position.

Sincerely,

FOR THE COMMISSIONER:

Bob Ibarra
Secretary

APPENDIX XI

MIKE O'CALLAGHAN
GOVERNOR

STATE OF NEVADA
DIVISION OF
COLORADO RIVER RESOURCES
P.O. Box 19090
LAS VEGAS, NEVADA 89119
TELEPHONE (702) 733-7785

December 8, 1978

Mr. Henry Eschwege, Director
Community and Economic Development Division
United States General Accounting Office
Washington, DC 20548

Subject: Proposed Draft - "Colorado River Basin Water Problems: Proposals to Reduce Their Impact"

Dear Mr. Eschwege:

We appreciated receiving a copy of your proposed draft report entitled "Colorado River Basin Water Problems: Proposals to Reduce Their Impact" on November 13, 1978. We wish to thank you for the opportunity of commenting on this report prior to it being finalized. Additionally, we appreciated our meeting with Messrs. Carl Bannerman, Larry Harrell, Richard Gannon and Noel Lance at which time we had the opportunity of expressing our opinion concerning this draft report.

Inasmuch as our agency does not have the necessary manpower to provide a detailed page-by-page and line-by-line review of your report, it is our intention to direct our comments to the conclusions outlined in the report. However, we did note several glaring errors in the text. We trust that appropriate corrections will be made during your review process.

A review of this report indicates that considerable effort was directed at documenting present and future Colorado River water supply and salinity problems. However, in doing so we feel that the report completely misrepresents the complexity of the issues associated with these problems. This oversimplification has led the authors to conclusions that fail to recognize the long-range implications upon the Colorado River Basin states.

There apparently is a lack of understanding relative to the water rights and salinity issues associated with the Colorado River Basin by the authors. The report indicates that the Federal Government has planned, financed, and constructed all of the major storage dams, power plants and related canal systems in the Basin. However, the report fails to recognize that the Federal Government does not own or control any water that is not subject to state water laws, compacts or decrees. Therefore, we must conclude that states' rights, as well as other legal and environmental restraints have not been appropriately considered in this report.

A DIVISION OF THE DEPARTMENT OF ENERGY

APPENDIX XI

The report implies that due to lack of cooperation between the states and the state and federal agencies, planning efforts have been fragmented and crisis oriented. This has resulted in rising salinity levels, solutions that are not economic, conflicts between federal and state objectives, and ineffective management of the Basin.

The report then concludes that Basin states and federal agencies must be brought together under a management agency that could exercise the necessary authority in order to solve all of the Basin problems and conflicts. It is our firm belief that this conclusion will not serve to resolve the aforementioned problems. In order to substantiate our position, we respectfully point out the following facts:

1. The talent, expertise, and capabilities of the people in the seven states and the Federal Government who are already involved with the water planning and salinity issues is unquestioned. These individuals have been working to resolve these problems under a cooperative working atmosphere for many years. The proposed task force or decision and planning organizations would more than likely be composed of the same individuals who have represented the Federal Government and states in the past.

2. When there is a need for cooperation between the states and the Federal Government, such cooperation has in the past always been obtained. There has been full cooperation and joint action to resolve such problems as salinity control, negotiations for agreement as to present perfected rights, river management operation, flood control regulations, standards for water quality, the resolution of problems concerning the delivery of water to Mexico, etc.

3. When it comes to the problems facing each independent state, that state, through its compentent representatives, will take every measure necessary in order to protect the interests of its citizens. A planning and decision making organization will not impose its will upon a state when such directive would be contrary to the best interests of the people of such a state. Such a directive would lead to misunderstanding, disagreement, and ultimately litigation for the state adversely affected by any such decision making body. Such an approach is unrealistic and unworkable.

The report then focuses on the salinity control aspects of the Colorado River as an example of the ineffectiveness of the present management system. The report implies that on-going salinity control projects should be delayed and the whole program re-evaluated. This proposed course of action would further increase the salinity problems of the River System. While the report suggests a delayed course of action, we feel it is deficient inasmuch as it does not recommend any alternatives to the on-going salinity control program if such are available.

APPENDIX XI

Mr. Henry Eschwege, Director
Community and Economic Development Division
United States General Accounting Office

December 8, 1978
Page 3

The report properly concludes that the Colorado River Basin is facing probable water deficiences sometime soon after the turn of the century. There is no question that all seven Basin states agree with this evaluation. However, the report is deficient insofar as it fails to provide any recommendations realtive to solving these anticipated water shortage problems.

The report implies that there is no mechanism set up to deal with the water shortages that will likely occur on the River in the future. The report fails to recognize that the Department of the Interior has already been given the responsibility of finding additional water supplies for augmentation of the River System. Thus, we have supported the Federal Government in its efforts to obtain additional water supplies for the Basin.

We appreciate the opportunity to comment on this proposed draft report. We trust our comments will be utilized in order to provide a comprehensive report that will meet the needs of the citizens within the Colorado River Basin.

Sincerely,

Duane R. Sudweeks
Administrator

cc: Noel J. Lance, General Accounting Office, Los Angeles, CA

APPENDIX XII

STATE OF NEW MEXICO
STATE ENGINEER OFFICE
SANTA FE

S. E. REYNOLDS
STATE ENGINEER

BATAAN MEMORIAL BUILDING
STATE CAPITOL
SANTA FE, NEW MEXICO 87503

December 1, 1978

Mr. Carl Bannerman
United States General Accounting Office
Community and Economic Development Div.
Washington, D. C. 20548

Dear Mr. Bannerman:

Mr. Eschwege's October 23 letter to Governor Apodaca requests comments on the U. S. General Accounting Office draft report, "Colorado River Basin Water Problems: Proposals to Reduce Their Impact" by November 23. As you are aware, David Hale and I met with Larry Harrell and Dick Gannon of your office on November 15, and discussed the report in detail. We gave Larry and Dick our general reactions and some editorial suggestions. At the close of that meeting it was agreed that I would furnish you our summary comments by December 15.

The report is well-written in that it is literate and easy to read but it is subject to substantive criticism on several points.

Several passages of the report reflect a grave misunderstanding of the Colorado River Compact of 1922. This misunderstanding is most clearly reflected in the following quotation from page 13:

> As discussed in chapter 1, the Upper and Lower Basins were allocated 7.5 maf (million acre-feet) each by the 1922 Compact and Mexico was allocated 1.5 maf by the 1944 Mexican Treaty, for a total allocation of 16.5 maf.

In fact, Articles III(a) and III(b) of the compact apportioned a total of 16 million acre-feet of consumptive use to the Upper Basin and to the Lower Basin from the Colorado River System. It is very important to the substance of the report to note that Article II(a) defines "Colorado River System" as "that portion of the Colorado River and its tributaries within the United States of America." (emphasis added). That is, consumptive use from the tributaries and the main stem in both basins is accountable against the apportionments of III(a) and III(b). Article III(c) of the compact anticipates a treaty with Mexico and specifies how the treaty obligation, whatever it might be, will be met. As the report notes, the 1944 Treaty set the United States' obligation to deliver 1.5 maf annually to Mexico. Thus, the total allocation from the Colorado River System is 17.5 maf of consumptive use annually -- not 16.5

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maf as the report states.

The first complete sentence at page 15 of the report states:

> The flows from these streams (Colorado River tributaries) are mainly in Arizona and were not included in the Colorado River water allocated to the Lower Basin states by the 1922 compact.

The definition of Article II(a) quoted above makes it abundantly clear that this statement is incorrect. From the correction of this statement there will flow a number of other corrections in the report which I will not detail here.

At page 14 the report states:

> Although the Upper Basin states were apportioned 7.5 maf a year, the Bureau estimates that these states will only be able to consumptively use a maximum of 5.8 maf annually sometime after 2030 because this is the estimated amount remaining when the downstream and power storage commitments are made.

First I would point out that Articles III(e) and IV(b) of the Compact make it abundantly clear that the storage and release of water for electric power generation are subservient to the use and consumption of water for agriculture and domestic purposes, whether or not such use is within the apportionment to the Upper and Lower Basins. Secondly, I would point out that the rationale attributed to the Bureau estimates is incorrect. By way of documentation there are attached copies of Ival Goslin's July 19, 1978 letter to Secretary Andrus, Deputy Assistant Secretary Dan Beard's reply and Ival Goslin's November 6, 1978 letter to Assistant Secretary Beard.

The last complete sentence at page 14 of the report states:

> The principal difference between the estimate of the Upper Basin States of 6.3 and the 5.8 maf estimated by Bureau is the 0.75 maf that the Upper Basin <u>is supplying</u> to meet one-half of the Mexican water commitment. (emphasis added).

Under the current "Coordinated Long-Range Operating Criteria for Colorado River Reservoirs (pursuant to Public Law 90-537)" <u>the objective</u> is a minimum annual <u>delivery</u> at Lee Ferry of 8.25 <u>maf</u>. <u>However</u>, this minimum is not set by the Mexican Treaty or the Secretary's interpretation of that treaty, but rather is based on projected short-term water requirements in the Upper Basin

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and the need for power revenues for the development of Upper Basin resources. By way of documentation, there is attached a copy of Secretary Hickel's December 16, 1969 letter to Governor Cargo. (see page 3, particularly).

Further, in connection with the estimate of 5.8 million acre-feet of consumptive use in the Upper Basin attributed to the Bureau, attention is invited to the inconsistency of the factors listed on page 14 as being considered by the Bureau. It is obvious that if an average annual virgin flow of 15 million acre-feet at Lee Ferry and an annual release of 8.25 maf were assumed, the balance left for consumptive use in the Upper Basin would be 6.75 maf, not 5.8 maf.

At the bottom of page 3 the report states, "The Lower Basin has never exercised its right to increase the 7.5 maf allotment by 1 maf." I am not aware of any basis for this statement. The Department of the Interior's report, "Colorado River System, Consumptive Uses and Losses Report -- 1971-75" reflects annual Lower Basin consumptive uses of 6.4 maf from the main stream and 4.2 maf from the tributaries including groundwater overdrafts. According to Table LC-1 main stream reservoir evaporation in the Lower Basin is estimated at 1.1 maf annually; thus, the report shows a total of 11.7 maf consumptive use annually from the Colorado River System in the Lower Basin.

I believe it is fair to imply, as the report does at page 25 and at several other points, that there is not agreement between the Upper Basin and the Lower Basin on how much water, in addition to 75 maf in each period of 10 consecutive years, the Upper Basin may have to deliver at Lee Ferry to meet its obligation under Article III(c). As I indicated in the meeting on November 15, I believe the compact and hydrologic data resolve any question on this point, but I admit that I have talked to some who do not agree with my view. This question is treated in some detail, with documentation, beginning at page 6 of my June 12, 1975 statement to the Energy Research and Water Resources Subcommittee of the Senate Interior and Insular Affairs, copy of which I furnished Larry Harrell at the November 15 meeting. I invite careful reading of that discussion of the question. I am not aware of any similar comprehensive statement and documentation of the Lower Basin position.

At page 5 the report states, "In 1973 the treaty was amended to require the United States to deliver water of a specific salinity content." This statement is incorrect on two points. The treaty was not amended in 1973; Minute No. 242 was adopted under the treaty as a permanent and definitive solution to the international salinity problem. The Minute does not provide for a specific salinity content in the water delivered to Mexico, but rather sets a differential between the salinity of the water of the Colorado River at Imperial and the salinity of the waters delivered to Mexico. This point is

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discussed correctly at page 50 of the report.

I believe the report is gratuitously negative about what has been accomplished in planning and carrying out the development and management of the Colorado River and its tributaries through the cooperation of the state and federal governments and through cooperation among the states themselves. Not the least of these accomplishments are the Colorado River Compact of 1922, the Upper Colorado River Basin Compact of 1948, and the Mexican Treaty of 1944. These compacts provided an essential foundation for the Boulder Canyon Project, the Colorado River Storage Project and the Colorado River Basin Project. It is not unreasonable to suggest that the outcome of World War II might have been different without the energy and water supply made available by the Boulder Canyon Project. The other projects have already made, or will make, tremendous contributions to the economy and welfare of the Colorado River Basin and the rest of the nation.

There is other evidence of the ability of the Colorado River Basin states to cooperate effectively that has a bearing on the need for a "river basin authority" such as recommended by the report. The Committee of Fourteen is a creature of the Basin states; each state has two representatives appointed by its Governor. While the Committee has no statutory authority, it played an important role in the consummation of the Mexican Treaty of 1944, in the negotiation of Minute 242 which resolved the international salinity problem that arose in 1961, and in the formulation and enactment of Public Law 93-320 which implemented the solution agreed upon by the Minute. Further evidence of the willingness and ability of the basin states to cooperate effectively is given by the states' creation, at the suggestion of the Environmental Protection Administration, of the Colorado River Basin Salinity Control Forum (Forum) in November of 1973. The Forum was able to formulate, and have adopted by each of the Basin states pursuant to Public Law 92-500, "Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System." Considering the potentially conflicting interests of the Upper Basin and the Lower Basin and the states within those basins, the accomplishments of the Forum to date are notable.

At page iv, the report states that the Bureau of Reclamation has pointed out that recent studies indicate some of the salinity control projects authorized for construction or investigation by Public Law 93-320 will not reduce the salinity level as much as initially hoped and that there are no plans for control of salinity after 1990. The statement that the goals of the current salinity control efforts do not extend beyond 1990 is reiterated throughout the report; attention is invited particularly to passages at pages 36, 39, 47, and 55. I suggest that there is no basis for this statement. By enacting Title II of Public Law 93-320 (see

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particularly the document cited in Sec. 201(a)), the Congress has committed the Secretary of the Interior, the Administrator of the Environmental Protection Agency and the Secretary of Agriculture to a salinity control program in cooperation with the states extending far beyond 1990.

Even though it may be that projects and measures presently identifiable as feasible cannot be expected to maintain the current salinity standards under water-use development projected past 1990, it does not follow that the states and federal agencies are not seeking to develop projects and measures that can be expected to do that. The need for additional projects and measures is clearly recognized in Chapter VII of the Forum's "Proposed 1978 Revision: Water Quality Standards for Salinity Including Numeric Criteria and Plan of Implementation for Salinity Control." (copy of which I have furnished Larry Harrell). While the Colorado River Water Quality Improvement Program is a 10-year study program undertaken by the Bureau in 1972, there can be little question that the intent is to implement the program developed over whatever period is necessary to maintain the salinity standards.

In this connection, attention is invited to page I-3 of the Bureau's report, "Colorado River Water Quality Improvement Program" which states:

> The Colorado River Water Quality Program is a 10-year investigational program of the Bureau of Reclamation aimed at evaluating the means by which the salinity control goals can be most efficiently attained from the standpoint of cost effectiveness and time. (emphasis added).

The first sentence of the paragraph beginning at the bottom of page 54 states, "The option of bypassing Wellton-Mohawk flows and substituting them with other Colorado River water now appears to be feasible." As the rest of the discussion of the paragraph seems to acknowledge, the Congress has recognized that there are no other waters of the Colorado River available for delivery to Mexico. The Wellton-Mohawk return flows could be bypassed only if the Colorado River System could be augmented in a like amount with waters from outside that system.

The discussion at page 56 takes the view that the program authorized by Title II of Public Law 93-320 is proceeding without adequate consideration of cost-effectiveness. There is little basis for this view. Construction of the authorized Crystal Geyser salinity control unit has been deferred indefinitely because of its poor cost effectiveness and small impact; and the Bureau of Reclamation, with the support of the Colorado River Salinity Forum, has concluded

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that the authorized Las Vegas Wash unit should be reanalyzed and reformulated before its construction is undertaken.

The second sentence of the paragraph beginning at the bottom of page 56 states, "The current project by project basis has led to water development that greatly increases salinity." It seems not appropriate to consider programs such as those authorized by the Boulder Canyon Project Act, the Colorado River Storage Project Act, and the Colorado River Basin Project Act as a "project-by-project basis." In any event, the Congress has recognized that any beneficial consumptive use of the waters of the Colorado River System will result in an increase in salinity downstream and for this reason directed the Secretary of the Interior (Section 201(a) of Public Law 93-320) to implement a salinity control policy that treats salinity as a basin-wide problem that needs to be solved to maintain Lower Basin water salinity at or below present levels while the Upper Basin continues to develop its compact apportioned waters.

Much of the discussion of the report, particularly that at pages 26 and 63, neglects the extent to which issues over the operation of reservoirs on the Colorado River system have been resolved. These issues, including questions of operations during times of shortage, have been resolved by the compacts and by Sections 301, 304, 501(c) and 602 of Public Law 90-537. The "relevant factors" to be considered by the Secretary pursuant to Section 602(a) remain the subject of some difference of opinion between representatives of the Upper Basin and the Lower Basin, but one can reasonably be optimistic about the timely resolution of these differences. As the report indicates, there remains a difference between those representatives with respect to the amount of water that the Upper Basin ultimately may have to deliver for the Mexican Treaty pursuant to Article III(c) of the 1922 Compact. These differences might be resolved by augmentation pursuant to the Congressional policy adopted by enactment of Title II of Public Law 90-537. On the other hand, negotiation or litigation may yet be necessary to resolve this issue; but the record going back to the negotiations for the 1922 Compact, supports the view that even this issue will be timely resolved.

Some comment on the list of "unresolved issues" at page 63 may be helpful.

> --How the term "surplus water" in the 1922 Compact is defined.

The term "surplus water" is not used in the 1922 Compact. The Compact does provide (Article III(c)) that water to satisfy any right that Mexico may have "... shall be supplied first from the waters which are surplus over and above the aggregate of the

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quantities specified in paragraphs (a) and (b)." This provision seems clear enough.

> --Should higher priority to water be given to water development or salinity control projects?

The Congress resolved this issue by enacting Section 201(a) of Public Law 93-320, directing the implementation of the salinity control policy alluded to in that section; i.e., the maintenance of salinity concentrations at the 1972 levels while the states develop and use their compact apportionments.

> --How much water must be maintained for instream flow uses?

This issue is in large measure resolved by the delivery obligations of the compacts and the treaty, existing laws of the states, and in some cases, individual project authorizations. In some situations, geography itself and public land ownership patterns control the question.

The report recommends a "central authority," or "river basin authority," to resolve the problems and issues of the Colorado River Basin. The report is not specific about the jurisdiction to be given such an entity, but recognizes the need for authority to achieve the intended goal by the following sentence at page 70:

> The organization must have enough authority to assure that the interests of all parties are equally protected without favoring the wishes of one over the others.

The benign authority to protect the interests of all parties necessarily implies the authority to adversely affect the interests of some to enhance the interests of the region or the nation as the authority may determine. The creation of such an authority obviously poses very difficult political problems. Given the issues that the authors apparently feel that the "authority" should resolve, it appears that amendment or repeal of the compacts would be necessary. Such amendment or repeal would require the unanimous action of the seven states and the consent of the Congress, or some assertion of federal supremacy that would almost certainly raise serious constitutional questions. It is my view that the creation and contemplated role of the recommended authority are politically and functionally impractical. The mechanism of Article VI of the Colorado River Compact of 1922 is available, and I believe more nearly viable, than a Colorado River Basin Authority. The thrust of the draft report is misdirected; I recommend that it not be submitted for publication.

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Mr. Carl Bannerman
December 1, 1978
Page Eight

The opportunity to comment on your draft report is greatly appreciated.

Sincerely,

S. E. Reynolds
State Engineer

SER:pt

Eclosures

APPENDIX XIII

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

State Engineer's Office

BARRETT BUILDING CHEYENNE, WYOMING 82002

November 30, 1978

Noel J. Lance
Advisory Auditor
United States General Accounting Office
Suite 1010, World Trade Center
850 South Figueroa Street
Los Angeles, California 90071

Dear Mr. Lance:

As a result of our meeting with you and Mr. Carl Bannerman on November 15, 1978, concerning the draft of the proposed report, "COLORADO RIVER BASIN WATER PROBLEMS: Proposals to Reduce Their Impact", we offer the following comments concerning this report.

First, here are the comments concerning the report from Al Minier of the Governor's State Planning Coordinator's Office:

I find the following specific problems with the GAO report we discussed Wednesday.

1. Reserved Rights: The report authors reflect no knowledge of a recent U.S. Supreme Court decision, United States v. New Mexico (July 3, 1978), which directly bears on many of their assertions and intimations. Quoting from page six of the slip opinion: "Where water is necessary to fulfill the very purposes for which a federal reservation was created, it is reasonable to conclude even in the face of Congress' express deference to state water law in other areas, that the United States intended to reserve the necessary water. Where water is only valuable for a secondary use of the reservation, however, there arises a contrary inference that Congress intended, consistent with its other views, that the United States would acquire water in the same manner as any public or private appropriator."

This directly conflicts with assertions about the potential federal uses for energy development (page 24), intimations about the significance of the virgin western waters (page 24), and concerns for Indian reserved rights (page 19 and following).

Further, the GAO report does not seem to appreciate the present deference of federal law to state water law, evidenced not only in United States v. New Mexico, but in a companion case, California v. United States, as well as the general corpus of western water law. While

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it is not accurate to say that the law of the river is strictly a state affair, it is clear that the national interest has been defined in terms of a composite of state interests, rather than as an exclusive and independent assertion of national authority (see page 68).

2. Recommendations: I believe that the recommendation of yet another federal/state task force is bound to be fruitless, unless further direction is given.

First, the thrust of the organization is implicitly to address questions of authority to make management decisions in the Basin (see page 70). This is bound to lead to a dead end, since the essence of the Basin difficulty is conflicting authorities and responsibilities. The attitudes of the states in this regard are not whimsical; the Wyoming Constitution, as approved by the United States upon admission to the Union, provides for the allocation of all the state's waters. Contrary assertion of authority can only stimulate disagreement.

We would prefer to focus on questions regarding physical management problems, as oppossed to the authority to manage. Recent Wyoming experience with the conflict between the Grayrocks Dam and Reservoir project and endangered whooping cranes in the Platte River indicate the specific problems may be resolved without raising the issue of soverign control. The solution in that case turns on specific water use commitments by private parties involved, with the blessings of the states of Wyoming and Nebraska.

Second, the proposed organization is likely to be composed of the same officials who are presently responsible for water policy in the Basin. In this event, the proposed task force will result in little more than a plebiscite on the wisdom of the proposals made thus far; and, given the information available when those decisions were made, it is difficult to say that the decisions were unwise. But if new directions are desired, such a charge must be explicit in the recommendations to the Congress.

Third, it seems to me that there may be a wide variety of sources for fresh insight into the Basin's problems, particularly if the focus of renewed interest is site-specific problems rather than the macrocosmic over-view of existing institutions. One alternative is to provide support for new or outside technical assistance to catalog specific management problems, perhaps through the Water Resources Council. Another is to investigate state-specific experiences in managing the complex institutional framework surrounding water development; one example is the twelve-agency Governor's Interdepartmental Water Conference of Wyoming. We believe that the sources of fresh, practical insight are potentially boundless, but the alternatives for new, centralized management authority in the Basin can only lead to a dead end.

3. Shortcomings of the Traditional System: The overall thrust of the report is that the present institutions that have authority to manage

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the Basin do not have the answers to chronic shortages that will begin to appear at the turn of the century. I believe that this is incorrect. Western water law has always been designed to manage water scarcity. The answer to shortages will turn on existing agreements under the law of the river regarding who bears the burden of such shortages. We do not see how the implied alternative of the GAO report, a more centralized allocation of these shortages, will improve upon the existing arrangements.

In short, the implied next step of a centralized authority has clearly not been adequately justified by the report. I believe that there are also political and legal constraints upon such a course of action, and that these constraints should be explicitly surfaced in the report. As I have said above, the price of pursuing this line of thought, i.e., the central authority, will be more wasted time and frustration. One way in which we do agree with GAO is that we cannot afford that delay.

We wish to offer the following general comments:

Generally, the report provides a broad overview of the circumstances and conditions surrounding utilization of the water in the Colorado River as development of the region has evolved over the years. There are many activities continually addressing the problems and operation of the river with the objective of improving the coordination of all related functions to provide the most benefit for the national interest.

Basically, it is our position that with the enactment of the Colorado River Compact in 1922, and the Upper Colorado River Basin Compact in 1948, the framework for each of the basins states rights was defined and it is the responsibility of each state to operate within the limits thus established. From this concept, emanates much debate over the primacy of Federal or State law. We believe that the general tenor of this report favors the Federal status, however, recent litigation tends toward the deference of Federal law to State law. While it is not accurate to say that the law of the river is strictly a State affair, it is clear that the national interest has been defined in terms of a composite of State interests, rather than as an exclusive and independent assertion of national authority. Considering the state of development in the basin and the methods employed to reach that state, it must be admitted that creditable results have been and will continue to be achieved.

We also wish to offer the following specific comments concerning the report:

Page i. - During recent years, the salinity concentration trend has been decreasing and from current projections, it does not appear that salinity will be much different around the Year 2000 than it is now, provided proposed salinity control projects are implemented. It is true that each entity has its own interests, however, there is not a strictly parochial attitude as there has been and continue to be a number of basin cooperative studies in long range planning efforts.

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Noel J. Lance
Page 4
November 30, 1978

Page ii - *Salinity has been acknowledged as a problem in the Colorado River for many years. Negotiations with Mexico and resulting national committments to Mexico have had a major impact on promoting salinity control projects. Due to these actions, it was necessary for the States to support the projects in order that water development could continue on an orderly basis. Current data indicate a decreasing trend in salinity concentration, probably due to the dampening effect of storage and also periods of favorable runoff.*

Page iv - *Due to national responsibilities resulting from international negotiations with Mexico and also since in excess of 50% of the salinity sources are from natural causes, the application of cost-benefit criteria is not considered pertinent. Although not specifically identified, many interests in the basin are giving consideration to programs for controlling salinity after 1990.*

Page 1 - *To the first sentence could be added ... producing much wealth for the nation". Power generation and flood control were among the purposes for constructing the original facilities.*

Page 6, Line 12 - *Add the word "projected" after the word "Recently."*

Page 8 Line 2 - *Delete the word "shortages" after the word "shortage".*

Second Paragraph Line 9 - *The issues listed have been or are currently being addressed. By compact, the Upper Basin is obligated to deliver an average of 7.5 million acre-feet of water yearly to the Lower Basin and it is assumed this will continue to be done even during periods of low flow as long as there is sufficient water in storage. There is question of who will bear the burden of providing water to resolve institutional conflicts.*

Page 9 - *The Bureau's projections have been generally developed in cooperation with the States and are probably as sound as those of any other entity, as the Bureau's activity has been management and compilation of data relative to operation of the river.*

Page 12 - *The Bureau uses a range of alternative flow estimates in its studies including some of less than 15 maf.*

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Page 13 - *Schedule for the Central Arizona Project (CAP) to begin operations is 1985 instead of 1989.*

Page 16 - *Initiation of the CAP after 1985 should not, at least in the early years, basically affect the ability of the River to yield sufficient water to meet demands. Withdrawals by Arizona are intended to be offset by decreases in diversions to California.*

Page 18 - *Last sentence - We do not believe that the question of whether or not Indian and Federal reserved rights are dependent on actual diversion and use has been yet thoroughly settled.*

Page 19 thru Page 24 - *Resolution of Indian and Federal reserved water rights claims needs to be accomplished but it may not be realistic to anticipate that these claims will be settled in the near future.*

Page 25 - *All Basin States have established procedures for administration of water during sub-normal or periods of water shortage. Operation procedures are continually under evaluation and are believed to be functional to provide flexibility during periods of drouth stresses.*

Page 32 - *The USBR has consistently conducted studies on the basis of conservative estimates of water supply with the deficiency being charged to the Upper Basin States entitlement. On this basis, agreement has not been reached.*

Page 34 and 35 - *Studies of the nature recommended are continually underway. Development of a master plan on which agreement could be reached by all entities concerned would be a cumbersome task which may prove to be unachievable.*

Page 37 - *The defined requirement is to limit the salinity of waters going to Mexico to 1972 levels with accepted variations and is not to decrease salinity of waters reaching Mexico.*

Page 38 Line 15 - *After the phrase, "salt is added", add the words "or concentrated", then in Line 16, delete the word "to" and insert the word "in". Last paragraph - Considering the present and projected state of use and past rate of increase in salinity concentration in relation to the*

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20 years to the turn of the century, it does not appear realistic that salinity would increase to "about 1214 mg/l" by the turn of the century.

Page 40 and 41 - *Inasmuch as the States were granted entitlement to use of water of the Colorado River by compact, they should be allowed to develop for such use and not be restricted by non-implementation of salinity projects which are considered a benefit to the national interest and hence, a national responsibility.*

Page 47 - *What studies have been made by (EDF)?*

Page 48 - *There are other measures such as the Section 208 plans which are in the process of development which no doubt will extend beyond 1990.*

Page 55 - *The Forum's salinity control plan is structured for continuation of planning and studies after 1990 as an on-going program.*

Page 57 - *Further dealy in implementing the salinity control projects can only result in further escalation of costs. The present program does constitute the most effective and economical projects. Other less costly alternatives have not been revealed from many evaluations that have been made.*

Page 59 - *Water planning and development are a composite part of overall management of the basins water resources. As with many western streams, without storage, there would be nothing to manage as flows rapidly diminish after spring and early summer runoff. Basically, water use must evolve around irrigation, municipal and industrial uses as the functions producing the necessities for existence in the basins economy.*

Page 59 Last line *Delete the word "Agricultural" and insert the word "water".*

Page 60 - *Relations and cooperation among the various entities are generally favorable and constitute a good demonstration of the democratic process. It is doubted if a central authority could function effectively.*

Page 62 - *It is suggested that the words "or vice versa" be added to the last sentence, 1st full paragraph. Also, in the last paragraph, 4th line, the word "principal" should be deleted since we do not feel the securing of*

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Federal appropriations for project studies and development is the "principal" activity of the Upper Colorado River Commission.

Page 63 - *Last line - We suggest you add after the word "uses", the phrase "and where is it going to come from?"*

Page 66 - and 67 *The Total Water Management Study was opposed as being not legally authorized or funded. Also, it was considered that the scope of the study was not adequately defined.*

The states do not contend that the river shouldn't be operated and managed for the benefit of the Nation or even the basin as a whole. We feel that this entire section on "The Total Water Management Study" should be rewritten to be less derogatory to the states position.

Page 68 - *The states have responsibilities to their residents which can best be fulfilled through local management and are of the belief that rights granted through past negotiation should be upheld. We believe this page should be rewritten to reflect this and the other concerns we voiced to you.*

Page 70 - *A central authority acceptable to the Federal Government and States for the purpose of providing comprehensive management of the basin's resources, does not appear feasible, due to the large number of interests involved in resolution of any issue. As stated, such an organization would be an extremely sensitive issue, both politically and economically and a task force to define its structure would have a very difficult assignment to resolve.*

The report does serve to point up the many problems associated with the river and that it is unique in its own right. In the final analysis, considering the extent of quality development and the great amount of wealth produced for the national benefit, its utilization has made possible, it may well prove that the management methods and procedures which have been acceptably employed in the past could continue to serve the purpose best.

Sincerely,

George L. Christopulos

GEORGE L. CHRISTOPULOS
State Engineer

GLC/llw
cc: Governor Herschler
Al Minier
Henry Eschwage

APPENDIX XIV

BRUCE E. BABBITT, GOVERNOR
Arizona Water Commission
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Phoenix, Arizona 85004
TELEPHONE (602) 258-7561

December 11, 1978

Mr. Henry Eschwege
Director
Community and Economic
Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Eschwege:

Governor Babbitt has asked that I respond to your letter of October 23 transmitting a copy of the proposed draft report to the Congress entitled, "Colorado River Basin Water Problems: Proposals to Reduce Their Impact." The opportunity to review the draft and to discuss it on November 29 with Messrs. Richard Gannon and Noel Lance of your Los Angeles staff is greatly appreciated.

The report attempts to analyze and offer recommendations on a number of problems involving the Colorado River. Unfortunately, it is founded on inaccurate facts, misunderstandings and misinterpretations of law, lacks objectivity and overstates and over-dramatizes the problems and reaches conclusions that are naive and without merit.

Having had an opportunity to discuss the report in detail with representatives of your staff, I will confine my written remarks to major areas of concern.

The report cites, beginning on page 60, "the lack of a single authority to plan for water resource development and address problems on an interrelated, basinwide basis" and proposes the establishment of a task force by the Congress to formulate the makeup of such an authority. The report on page 63 contends that "current management organizations in the basin do not provide an adequate mechanism for solving interstate disputes," and on page 64 that existing management groups are "delaying actions to resolve the current problems and conflicts."

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The report fails to recognize the tremendous progress that has been made during the past 10 years in developing and maintaining cooperation among the seven states and between the states and the affected federal agencies. Included among our successes are: (1) negotiation and authorization of the Colorado River Basin Project Act in 1968; (2) resolution of the Mexican salinity problem; (3) authorization of a program to control salt input throughout the basin; (4) the development and adoption of common salinity standards for the Colorado River; (5) coordination of river management operations in the Lower Basin; (6) establishment of a measuring system to evaluate unmeasured return flows to the Lower Colorado River; (7) negotiation of a stipulated agreement covering present perfected rights along the Lower River; and (8) the development of procedures for dealing with illegal diverters from the Lower Colorado River and (9) for obtaining a water supply for recreational and urban lands that do not have perfected rights or a contract with the Secretary.

The organizational mechanisms necessary to reach compromise where compromise can be achieved do in fact exist and their efforts in most instances have been successful. In advocating the establishment of a basinwide management authority the report fails to recognize the constraints of current compacts and court decrees. Water supplies of the Colorado River have been allocated amongst the states and cannot be reallocated by a new basin authority without the unlikely approval of all seven states. The most important function of an authority, the allocation and utilization of the water resource, has been preempted by compact and decree. For example, neither the Secretary, as proposed on page 35, nor a basin authority can establish the respective shares of the Mexican treaty burden to be borne by the two basins. To believe otherwise, to propose otherwise, is the height of naivete.

While I feel that the states and the federal agencies acting through the organizational mechanisms that they have jointly established have dealt effectively with the problems that needed attention during the past 10 years (i.e., the Committee of Fourteen, the Colorado River Basin Salinity Control Forum, the Lower Colorado River Management Coordinating Committee, and several ad hoc groups formed to consider such problems as operating criteria, etc.), these organizations could be expanded to form an umbrella group that deals with the total spectrum of problems affecting all seven states. The benefits of such an expansion would appear primarily cosmetic, in that the same individuals would be involved as currently represent the states. While the benefits may be marginal, the disadvantages of forming such an umbrella organization would also appear minimal.

The report is unfairly negative in its treatment of the salinity control program. It fails to point out that the treatment of salt control projects is the same as Congress established for other elements of water quality in the

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Federal Water Pollution Control Act Amendments of 1972. Benefits do not have to exceed costs. Project priority is established on the basis of cost effectiveness and the federal share of the costs of construction, operation, maintenance and replacement is similarly set at 75 percent.

The report recommends (page 57) that "Congress delay federal funding of salinity control projects and require the Bureau to develop an alternative plan in cooperation with the basin states which would address the salinity problems in a comprehensive manner and result in an effective and efficient basinwide program." No factual support for the recommendation is offered or alternatives suggested. The recommendation is ill-founded, dangerous, and harmful and should be modified to call upon the Congress and the Administration to expedite rather than delay funding for the salinity control projects.

The report concludes that "the option of bypassing Wellton-Mohawk return flows and substituting them with other Colorado River water now appears to be feasible." That is not the case. The United States agreed to protect the seven Colorado River basin states against all costs of the settlement with Mexico, including any loss of water, in exchange for their support of the agreement. The states cannot tolerate the bypassing of any quantity of water to the Gulf without concomitant credit against the Mexican treaty burden or replacement by the United States from sources of supply not otherwise available to the states. The quantity of water in question is at least 155,000 acre-feet, not the 88,000 cited in the report. The cost comparison drawn in the report is a most improbable one. Bureau of Reclamation studies of alternative sources of supply to replace the brine loss from the desalter, a maximum of 42,000 acre-feet per year, indicate costs consistently in excess of $300 per acre-foot. The availability of $3.00 an acre-foot replacement water in Yuma County is a pipe dream.

The report is overly pessimistic concerning the future water supply of the Colorado River and potential water shortages. It grossly over estimates the rate at which the Upper Basin will increase its use of Colorado River water. Actual depletions in the Upper Basin have consistently lagged federal and state projections and are currently approximately 700,000 acre-feet per year lower than the Bureau of Reclamation in 1968 projected would occur by this point in time. The report should be revised to recognize this fact.

The report concludes, on page 33, that specific operating criteria should be developed immediately and, on page 35, that the Secretary should amend the operating criteria in several specifics. There has been no need to date for more definitive criteria then were promulgated in 1970 by the Secretary pursuant to the requirements of the Colorado River Basin Project Act and it does not appear that there will be a need for them in the foreseeable future. More rigid operating rules should not be established until they are

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essential so as to retain maximum flexibility and to permit the latest possible judgements on the relative importance of all factors affecting operating decisions including water needs and values, power needs and values, water quality, etc.

It is my belief that the report should be withdrawn or significantly modified. I appreciate the opportunity to review the draft and would be pleased to discuss the matter further with you should you desire.

Sincerely,

Wesley E. Steiner
Executive Director

cc: Governor Babbitt
Richard J. Gannon

APPENDIX XV

STATE OF CALIFORNIA—THE RESOURCES AGENCY

EDMUND G. BROWN JR., Governor

COLORADO RIVER BOARD OF CALIFORNIA
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December 4, 1978

Mr. Henry Eschwege, Director
Community and Economic Development Division
United States General Accounting Office
Washington, D. C. 20548

Dear Mr. Eschwege:

Thank you for the copy of your proposed draft report to Congress entitled "Colorado River Basin Water Problems: Proposals to Reduce Their Impact," which was transmitted to Governor Brown by your October 23, 1978, letter. The report has been referred to me for reply. I also met with and discussed the draft report with Messrs. Richard Gannon and Noel Lance from the GAO Los Angeles Office on November 20.

Your investigators were able to determine and analyze several of the major current and future Colorado River problems and issues. Unfortunately, the draft report reveals a lack of understanding of some of these problems. To a large degree, it is a superficial analysis of complex issues which has led to erroneous conclusions and simplistic and poorly conceived recommendations. If the report is released essentially as drafted, it would either have a harmful impact on resolving Colorado River problems or at best would tend to be ignored by people having responsibility to seek solutions to Colorado River water problems.

My major concerns with the conclusions and recommendations in the draft report are briefly summarized as follows and are covered in more detail in the attachment to this letter.

1. The issue of future water shortages in the basin is much more complex than is presented, and the report's overly pessimistic view indicating impending water shortages is not substantiated by a careful analysis of all relevant factors.

2. The report recommends that the undefined areas in the current operating criteria for Colorado River reservoirs be defined numerically at this time. This would not be a desirable action for two basic reasons: (a) there is no pending water shortages now or for many years in the future that would require additional numerical values and (b) the flexibility in the current criteria and the listing of factors to be considered will allow future decisions to be reached at a later date that will better reflect the conditions existing at the time decisions need to be made.

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3. Notwithstanding the report's conclusions, the United States Bureau of Reclamation's (USBR) current salinity control projects, while making a major contribution thereto, are not the only means for meeting salinity standards. They are a part of a combined program with other measures now developed and which will continue to be developed by federal agencies and the basin states. Studies now underway by the USBR, Department of Agriculture, University researchers, the Bureau of Land Management, and others have identified several prospects for reducing salt loads not now in the control program, and also show the need for adjustments in the basic salt-flow relationships in the basin. The states' and the Environmental Protection Agency's program for reviewing salinity standards and control measures every three years will continue to provide sufficient lead time for the evaluation of trends in salinity and the implementation of additional control measures as needed in a cost-effective manner.

4. The report's recommendation to delay the funding of the USBR's salinity control projects would be a major mistake, especially since the USBR is finally beginning to show some progress on these projects. Any delays would only result in increases in costs of the projects and increases in the river's salinity.

5. The conclusions that salinity control can best be accomplished through better basinwide water management is not substantiated. The report contains no alternatives for the current salinity control program.

6. The proposal for an overall management agency for the basin is based on erroneous statements, such as that there is a lack of cooperation among the states and that there is a fragmented approach to the basin's problems and issues. For many years, the basin states and concerned federal agencies have been working cooperatively and in a coordinated manner on the many issues now before the basin. The imposition of a new agency and bureaucracy would be harmful rather than helpful in solving the basin's problems. Further, this agency would not have the authority to resolve the issues listed in the report on which differing positions are held by the basin states and federal agencies. Any attempt to do so would lead to major litigation.

I recommend that the detailed comments attached hereto, together with comments from other basin states and federal agencies, serve as guidelines for a revamping of the draft report to the end that it can serve as a useful document to Congress, the Administration, and the basin states.

Sincerely yours,

M. B. Holburt

Myron B. Holburt
Chief Engineer

Attachment
cc: Richard J. Gannon

APPENDIX XV

DETAILED COMMENTS ON GAO DRAFT REPORT "COLORADO RIVER BASIN WATER PROBLEMS: PROPOSALS TO REDUCE THEIR IMPACT"

In the following detailed comments, I have not attempted to correct many of the errors in the report, but have essentially limited the comments to some of the major conclusions and recommendations and have referred to other items in the report when necessary to relate them to these conclusions and recommendations. No comments are given on the digest, Chapter I (Introduction), and the Appendix to the report. The comments are listed by subject areas within each chapter and are prefaced by a quotation or paraphrase of the pertinent GAO conclusion or recommendation followed by my comments on that item.

CHAPTER 2

Water Shortages in Colorado River Basin

GAO conclusion (pg 32): The United States Bureau of Reclamation (USBR) is using "an overly optimistic estimate of the basin's water supply" which could result in inadequate preparation for future water shortages.

In developing a concept that the Colorado River Basin faces a crisis in the near future, the report uses USBR studies to identify the possibilities of future water shortages. It then makes several references to others who believe that the shortages will occur sooner and be more severe than have been projected by the USBR (pgs 8, 13, 15, and 16) and ends up by presenting an overly pessimistic view of potential water shortages within the Colorado River Basin.

Future water shortages will depend on many factors, the major ones being water supply, water use and the amount and utilization of water in the major reservoirs. With respect to the major items, the situation is essentially as follows:

The basin is currently in a water surplus situation which should last until at least the late 1980's when the Central Arizona Project is expected to commence full deliveries. This gives a high probability that usable water in storage in the major reservoirs will be approximately 55 million acre-feet (maf) at that time. Increase in Upper Basin water use has been much slower than predicted by the USBR and others in recent years. Based on a recent analysis of prospective Upper Basin projects, we estimate that the 1990 Upper Basin use will be approximately 4.1 maf rather than the 5.3 maf shown on page 15 of the report. Using a lower average water supply (14 maf/yr) at Lee Ferry rather than the 15 maf/yr attributed to the USBR (pg 12), the reservoirs can be gradually drawn down for many years after the year 2000 without shortages.

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The conclusions and statements in the report that indicate early water shortages is not justified by the available information. The report should be rewritten to consider all of the factors that bear on water shortages and present a more balanced view on potential water shortages.

Reservoir Operations

GAO conclusion (pg 33): "Complete operating criteria are needed so the basin's water officials can plan their operations during a shortage" and that the time available to set these criteria may be shorter than expected by the Bureau.

In 1970, after consultation with representatives of the seven basin states, the Secretary of Interior promulgated the Criteria for Coordinated Long Range Operation of Colorado River Reservoirs pursuant to P. L. 90-537. Since January 1972, the Secretary has issued an annual report describing the actual operation under the adopted criteria for the preceding year and projected operations for the current year.

The GAO draft concluded that more specific rules are needed. As the earlier discussion indicated, the probability is high that the Colorado River Basin states will not face a shortage condition for many years to come. Thus, there is no immediate need for more specific reservoir operating criteria. Further, it should be noted that the reasons why the adopted criteria did not contain more specific operating rules are due to factors in addition to disagreements as to specifics of operating rules.

Since the time when shortages will occur are many years in the future, it is unwise to establish rigid operating rules at this time since the current flexible approach is the best way that changing conditions can be given proper weighting at that time when specific rules are required. It should be recognized that the current operating criteria do contain a description of all of the factors that the Secretary of the Interior is to consider in arriving at his decisions. Since the factors will change in their significance over time, it would be a mistake to prematurely set specific operating rules. Under the current operating criteria, the necessary decisions on specific operating criteria during shortage conditions can be made closer to the time when the decisions are necessary, and can then more correctly reflect the relative weighting and importance of the factors identified in the current criteria.

GAO recommendation (pg 35): The Secretary should "amend reservoir operating criteria by stating (1) the conditions under which he will declare a water supply shortage, (2) the amounts to be released during a shortage, (3) the reservoir storage levels to be maintained in low-flow years, and (4) the amount of water each sub-basin must provide for the Mexican Water Treaty commitment."

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This recommendation should be deleted for the reasons given in the above discussion. If this recommendation were to be given and subsequently followed, it would lead to unnecessary disputes among the basin states and between the states and federal government. It would also lead to attempts for additional legislation and protracted litigation.

CHAPTER 3

Domestic Colorado River Basin Salinity Control Program

Salt Removal by Salinity Control Program

GAO conclusion (p. 55): "It is doubtful that the current salinity control program will reduce the salt in the river as much as predicted."

Estimates of salt removal by the salinity control program change as the investigations continue and more becomes known about each of the projects in the program. Some of the projects are now estimated to remove less salt than originally while others are estimated to remove more. The original estimates of salt removal by the USBR salinity control projects which were shown in the 1975 report by the seven-state Colorado River Basin Salinity Control Forum was 1,644,000 tons per year. The amount shown in the 1978 Forum Report, after removal of the Crystal Geyser, Colorado River Indian Reservation and Palo Verde Irrigation District projects, and after substantial reduction for the Las Vegas Wash Project and addition of the Meeker Dome Project was 1,901,000 tons per year. Overall, the salinity control program is now estimated to remove more than originally estimated.

Thus, the statements and conclusions in the report (pgs. 39 and 55) that the program will not remove as much salt as originally predicted are not supportable.

Relationship of Salinity Control Program to Salinity Standards

GAO conclusion (p. 55): ". . . the salinity control plan, even if implemented successfully, will not by itself achieve the water quality standards established for the basin."

Although the USBR salinity control program authorized by P.L. 93-320 is expected to play a major role in meeting salinity standards in the future, it is not the only element being relied upon. There are other potential salinity control projects and still others could develop in time. For example, the USBR is currently studying the Meeker Dome Project, and BLM is studying the possibility of development of diffuse source salinity control projects on areas under BLM jurisdiction that produce high rates of salt loading to the Colorado River system. Both of these possibilities were not in the list of original project possibilities. Further, if shifts occur in future uses of water within the Upper Colorado River Basin from irrigated agriculture to industrial use, there would be a decrease in the amount of salt pickup that would occur within the Basin. In addition, a significant contribution to salinity control is expected from non-federal actions.

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The whole matter of meeting salinity standards is complex and dynamic. It depends upon salt inflow, water supply, reservoir operations, rate of increase of water use in the Upper Basin, location and type of use, progress of salinity control and other factors. In recognition of these factors and the need for periodic review, and to comply with Section 303 of P.L. 95-217, the seven-state Colorado River Basin Salinity Control Forum has a three-year review schedule for the standards and plan of implementation. The 1978 draft was recently completed and public hearings were held. A recent example of a changing situation concerns the all important matter of salt inflow. The 1978 draft Forum report revealed that salt inflow in the basin is 500,000 tons per year to 1,000,000 tons per year less than used in the current model. This matter will be extensively studied.

There were several comments in the report relative to the 1990 date used for planning. The Forum limited its projections to 1990 since it was considered that any projections beyond that date would be too speculative. This date will be extended into the future as new reviews will be made.

The discussions on planning in the report should be modified to accurately explain the dynamics of the USBR salinity control program, other salinity control activities, and the relationship of all these factors to the standards.

Project Feasibility

GAO conclusion (p. 56): ". . . evaluation of the technical and economic feasibility of salinity control projects prior to authorization will better insure a workable and cost effective program."

Reference is made in the report to the authorization for construction of the four salinity control projects by the 1974 Salinity Control Act without feasibility level reports. Based upon this information and the problems that have developed with these projects, the report concludes that feasibility should be determined prior to authorization. The 1974 authorization based on reconnaissance level reports was a unique situation and is unlikely to be repeated. The states and the USBR do not question that authorization should be based upon feasibility reports and current efforts by the USBR are geared to that end. This is an unnecessary conclusion that should be deleted.

Cost Effectiveness of Projects

GAO conclusion (p. 56): ". . . the costs and benefits of salinity control projects should be considered so that the most cost effective projects are chosen."

The report concludes that "costs and benefits of salinity control projects should be considered so that the most cost effective salinity control projects are chosen". The conclusion also contains some negative comments about the Crystal Geyser and Las Vegas Wash salinity control projects. Again, these conclusions are unnecessary since the

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states and the USBR have already taken actions with respect to these items. The problems with these projects have been recognized and states have recommended and the USBR has concurred that the Crystal Geyser Project be deferred and that the Las Vegas Wash Project be deferred until a revised salinity control unit is formulated. The cost-benefit information in the report commencing on page 39 is misleading in that: (a) In comparing benefits and costs, it lumps all four authorized salinity projects rather than considering only the current active Grand Valley and Paradox Valley Projects, and (b) It uses the most up-to-date project cost figures but uses the old USBR benefit figure of $230,000 per mg/l, rather than the up-to-date USBR benefit figure of $343,000 per mg/l.

Also, it should be realized that approval for construction of salinity control projects involves consideration of more factors than a simple comparison of benefits and costs. Congress recognized this by stating in P.L. 93-320 that "In recognition of Federal responsibility for the Colorado River as an interstate stream and for international comity with Mexico, Federal ownership of the lands of the Colorado River Basin from which most of the dissolved salts originate, and the policy embodied in the Federal Water Pollution Control Act Amendments of 1972 (86 Stat. 816), 75 per centum of the total costs of construction, operation, maintenance, and replacement of each unit or separable feature thereof shall be nonreimbursable."

Basinwide Water Management and the Salinity Control Program

GAO conclusion (pgs. 56 and 57): "Salinity control can best be accomplished through better basinwide management of the total water resources which consider tradeoffs between projects for water resource development and salinity control."

The report does not indicate what is meant by better basinwide management or how it would reduce salinity. The only reference in the report regarding water resource management is the discussion on page 48 concerning the September 1977 EPA-contracted study. That study was performed by the Denver Research Institute with the objective of identifying actions that could be taken by the Basin states to significantly control salinity. The report did not find very much in the way of reduction of salinity that could be obtained through better water management. Many of the actions identified in the report that are feasible are already being undertaken and the states have indicated a willingness to follow through on others that appear to be feasible.

Delay in Funding for Salinity Control Projects

GAO recommendation (p. 57): ". . . Congress delay federal funding of salinity control projects and require the Bureau to develop an alternative plan in cooperation with the basin states which would address the salinity problems in a comprehensive manner and result in an effective and efficient basinwide program."

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This recommendation is not substantiated by the information stated in the report. The report does not indicate any alternatives to controlling salinity. It does not recognize that the Bureau and the states have worked cooperatively for many years to develop salinity control plans and intend to continue to do so.

The Salinity Control Forum in its adopted plan of salinity standards and plan of implementation does consider all known methods of controlling the river's salinity, both through non-federal activities as well as the federal USBR salinity control projects. The Forum did develop a comprehensive basin-wide program. Procedures have been established to incorporate other salinity control measures as they become known. Any delay in funding salinity control projects would result in increases in the river's salinity which the report states (p. 36) "is increasing at significant rates".

One of the problems with the salinity control program is that the USBR has given it a relatively low priority and this, combined with other factors, has resulted in slow construction progress on the Paradox Valley and Grand Valley Salinity Control Projects and delays in completion of the feasibility reports. Recently, the Bureau assigned a higher priority to the program and made other changes which should result in better progress.

In order to achieve the objectives stated in the draft report, the recommendation should be that Congress expedite rather than delay funding for the USBR salinity control projects.

Mexican Salinity Problem

GAO recommendation (p. 57): The Bureau should reevaluate "the feasibility of the Yuma Desalting Complex considering other less costly alternatives to improve the quality of water delivered to Mexico".

The only less costly alternative identified in the report is on page 55 where it states that "In contrast, the costs of augmenting stream flows have been estimated as low as $3 an acre-foot". This is a very misleading statement since $3 an acre-foot water is not available anywhere in the Colorado River Basin. This figure was presumably obtained from a rough estimate of the cost of water to be obtained from weather modification. Since a demonstration project on weather modification in the Colorado River Basin, being developed by the USBR, has yet to commence, this should not be listed as an alternative. If the GAO has any alternatives, they should list them.

The 88,000 af/yr salvage listed on pages 53 and 55 understates the production of the desalting plant. It is my understanding that the plant is to salvage 119,000 af/yr, not 88,000 af/yr.

CHAPTER 4

Management Agency for the Colorado River Basin

GAO conclusion (p. 69): "The basin states and federal agencies need to be brought together under a partnership arrangement to solve the problems and conflicts discussed in this and previous chapters and to prepare for the projected shortage."

GAO recommendation (pgs. 70 and 71): ". . . we recommend that the Congress establish a State-Federal task force made up of the principal executive agencies in the basin to recommend the appropriate form of management and decision making structure for the basin."

The report uses the terms fragmented, crisis oriented, lack of cooperation between the states and the states and federal agencies, reluctance to work together, no adequate mechanism for interstate disputes, and other similar language to describe water resources planning and management in the basin (pgs. 59, 60 and pg ii of Digest). Based on the above judgment, the report reaches the above conclusion and recommendation.

The basic judgments are essentially wrong, which leads to an erroneous conclusion and improper recommendation.

For more than a decade, the state agencies concerned with Colorado River matters have worked together on a cooperative basis on complex Colorado River issues with a success that other investigators have considered to be seldom equalled in other parts of the nation. The states have also worked closely with the appropriate federal agencies. A partial listing of problems that have been and are currently being worked upon by cooperation among the Basin states and federal agencies follows. It should be noted that since some of these problems are of concern to only some of the basin states and some of the Federal agencies, only the agencies that are directly concerned are involved in the activities leading to resolution of the particular problems. Also, many of these actions commenced years in advance of time when a solution was needed and could not possibly be described as "crisis oriented".

1. A Task Force with representation from California, Arizona, Department of Interior, USBR, and Bureau of Land Management analyzed the problems and developed a solution for obtaining a water supply for lands along the Colorado River that do not have water rights. The same Task Force developed procedures for handling of illegal diverters from the Lower Colorado River.

2. The States of Arizona, California and Nevada, and the U.S. Departments of Interior and Justice negotiated a supplemental decree on the issue of Colorado River presented perfected rights (pre-1929 water rights) and recently presented it to the United States Supreme Court as part of the Arizona v. California litigation.

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3. California, Arizona, and Nevada water resource and fish and wildlife agencies, and USBR, Bureau of Indian Affairs (BIA), Bureau of Sport Fisheries and Wildlife, formed the Lower Colorado River Management Coordinating Committee to coordinate River management operations along the Lower Colorado River.

4. A Task Force involving California, Arizona, Nevada, USBR, BIA, and U.S. Geological Survey have been attempting to quantify underground return flows to the Colorado River so that proper credit will be given to the States for these flows in accordance with the decree in Arizona v. California.

5. A Task Force from California, Arizona, and Nevada, USBR and U.S. Army Corps of Engineers have been reviewing possible changes in flood control regulations for the Colorado River Reservoirs.

6. The seven basin states and USBR have worked jointly in analyzing the adequacy of the operating criteria and considering proposed changes.

7. The seven basin states jointly sponsored basin-wide legislation in 1968 (Public Law 90-537) and 1974 (Public Law 93-320) that developed basin-wide programs in the area of water development and salinity control.

8. The seven basin states jointly formed the Colorado River Basin Salinity Control Forum and have worked with the Environmental Protection Agency (EPA) and USBR to develop basin-wide salinity standards including a plan for implementation that each state may separately adopt for the purpose of controlling the salinity of the Colorado River.

9. The seven basin states are working with the Department of Interior, EPA, and Department of Justice to defend the adopted standards in a lawsuit brought by the Environmental Defense Fund to set aside these standards.

10. The seven state Committee of Fourteen has worked with the International Boundary and Water Commission, USBR and other federal agencies on solutions to Colorado River problems with Mexico.

This partial listing indicates the high level of cooperation and coordination now existing on an efficient basis, between the states and with concerned federal agencies. There also are many informal meetings between concerned state agencies among themselves and their federal counterparts that are not listed. This level of cooperation and coordination would not be enhanced if a basin-wide management agency were to be established for the Colorado River Basin. Each of the existing federal and state agencies concerned with Colorado River matters would still have their respective responsibilities and point of view. Such an agency would:

1. Add personnel and costs through creation of a new bureaucracy

2. create a new bureaucracy that would have to be involved in Colorado River matters,

3. have an extremely difficult time in obtaining people with expertise in Colorado River matters,

4. increase the work load of existing agencies in order to monitor, analyze and comment on the proposals of the new agency,

5. involve all State and Federal agencies in the problems that directly concern only several of the states and federal agencies,

6. generally tend to increase the difficulty in obtaining a solution to complex Colorado River problems,

7. not have the authority to do and take the actions listed in the report. If it attempted to do so, it would be sued by some injured party.

The concept of a basin-wide agency has been considered and rejected in the past and there is nothing in the draft GAO report that justifies creation of such an agency in the future. It is recommended that the report be revised to include examples of cooperation as listed herein, and discuss the significance of such cooperation in negating the need for another agency. The concerned states and federal agencies should be urged to continue and expand cooperative activities that result in a saving to taxpayers and avoid the needless expenses that would be associated with the development of a new management agency.

Total Water Management

GAO recommendation (p. 35): ". . . the Secretary of Interior direct the Bureau to develop a comprehensive plan specifying the conservation, water salvage, and augmentation techniques that will be used to prevent or minimize the adverse effects of shortages."

The Total Water Management (TWM) concept is also discussed in other places in the report, (pgs. 56, and 65 to 68). On page 65, it is defined as follows: ". . . a system of managing water resources that integrates all aspects of water development including water quality, quantity and environmental concerns."

Although the TWM name is new, similar concepts have been applied in the Westwide report, National Assessment report, and other Colorado River studies without any particularly fruitful results. "Conservation" has been mentioned as part of the TWM concept. It should be recognized that water users of the lower Colorado River are among the most efficient in the United States and will become even more efficient as the period of surplus Colorado River water ends in the next decade.

"Alternatives" is another frequently used word. There is very little opportunity for alternatives in the Lower Colorado River Basin. California expects to reduce its Colorado River use once the Central

Arizona Project commences major deliveries. Arizona has committed all of its available supply to this project and Nevada has committed all of its available supply to the Southern Nevada Project. The Upper Basin is in a dynamic situation, with the exact mix of future uses of Basin water resources still unresolved. All aspects of the impact of water resource development will be analyzed and considered when different proposals are made for developing any of the water resources within the Upper Basin.

The statements on pages 66 and 67 do not correctly present the basin states concern with this program. The states considered that the program was unnecessary since similar generalized reports have been prepared in the past for the Colorado River Basin and the more specific items were already included in studies of individual projects. These studies include the preparation of both feasibility reports and environmental impact statements which require study of all possible alternatives, including non-structural measures, and identify and assess the impact of alternatives on the environment as well as on project beneficiaries. Since the proposed program's objectives were already covered in the on-going studies, the proposed program would have been duplicative, wasting time, personnel, and money, with no discernible advantage to be obtained.

While opposing the proposal for TWM, the basin states are acutely aware of the need for good management of the Colorado River's water resources. The Colorado River Basin and service area includes a huge area covering portions of seven states and Mexico. There are numerous conflicting demands on this river that result in many complex problems, which will require careful management for resolution. Some of these problems have been resolved over time, others have been partially resolved, others are unresolved and new problems arise from time to time. The basin states and concerned federal agencies appreciate the attention given to some of these problems by the GAO and would welcome any help that could be received from recommendations sent to Congress by the GAO.

In considering aspects of the overall management of the basin, the report should also discuss the benefits that the Basin states and the nation as a whole have derived from the development of the Basin's water resources to date. This would assist in the development of a better perspective on the Colorado River, its problems and potential solutions.

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