The project has been stalled, first, by opposition from San Francisco Bay Area civic leaders and environmentalists, who fear the effects of wastewater-induced water pollution. They have prevented determination of the Delta outfall location. Second, the Bureau of Reclamation and the Westlands Water District, the San Luis Unit's largest water user, have failed to agree on terms for a long-term water delivery contract and the repayment of all federally constructed drainage facilities.

Delay in completing the Drain may result in major production losses for many Westlands farmers in the near future. The water table is within 10 feet or less from the surface under 151,000 acres in that district, and only 5,000 acres have thus far received access to the San Luis Drain. Agencies in the Valley estimate that in the entire west side, from the Tehachapi Mountains to the Delta, 462,000 acres will require drainage by 1995.

The most recent attempt at federal-state cooperation was the Interagency Drainage Program, involving the U.S. Bureau of Reclamation, California Department of Water Resources, and California Water Resources Control Board. Its 1979 report recommended a $1.3 billion plan, including a 290-mile Valley Drain that would discharge at Chipps Island in the Delta, and a series of marshes and holding ponds to regulate discharges during peak periods of drainage flow. Like its predecessors, this plan was condemned by Bay Area interests and rejected by state service area irrigators as too costly. Many potential Valley Drain users south of Kettleman City believed that they could solve their immediate drainage needs for the next 20 to 30 years with evaporation ponds and other local salt disposal methods already in use.

Efforts to overcome salinity and drainage problems in California have, in general, been highly successful. As these problems have advanced beyond the individual and local levels, however, and affected the interests of many divergent economic and political groups, finding adequate solutions has become increasingly complex and expensive. In the Imperial and San Joaquin valleys, a concerted effort will be needed to alleviate current salt problems and ensure the full productivity of irrigated lands.

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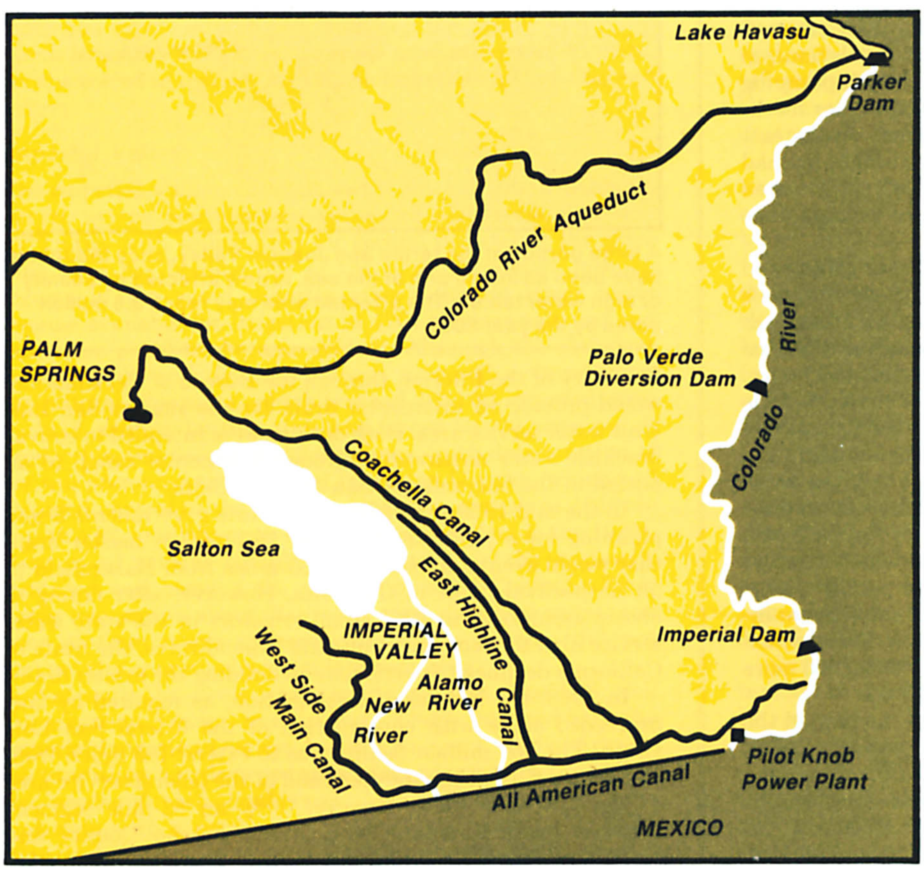
The lower Colorado — a salty river

Myron B. Holburt



The 1,400-mile-long Colorado River delivers 5 million acre-feet of water a year to irrigated farmland in California's Salton Basin and furnishes a full or supplemental supply of water to millions of people in southern California.

It has been said that the Colorado River is the most litigated, regulated, and argued-over major river in the world. The river provides irrigation water to 1.5 million acres within the seven states of Colorado, New Mexico, Utah, and Wyoming (Upper Basin) and Arizona, California, and Nevada (Lower Basin). More than half of this acreage is in California. The river also furnishes a full or supplemental supply of municipal and industrial water to 17 million people. The Republic of Mexico receives water from the river to irrigate 0.5 million acres of farmland and supply 0.5 million inhabitants.

A group of documents known collectively as the "Law of the River" essentially states the procedures for storing and delivering water to users in the seven states and Mexico. The U.S. Secretary of the Interior, in effect, is the river's water master.

Originating high in the Rocky Mountains of Colorado and Wyoming, the river flows southwesterly some 1,400 miles to the Gulf of California. The climate ranges from year-round snow fields in the high peaks of the Upper Basin to deserts with little precipitation in the Lower Basin.

The unregulated flow of the river varies widely during the year, from year to year, and from periods of mostly wet years to periods of mostly dry years.

Metropolitan Water District of Southern California

Salinity of the lower Colorado, shown here near Blythe, California, is a serious problem. The river carries 9 million tons of salt a year past Hoover Dam — about 47 percent of it originating from natural sources. The salt load lowers crop yields, alters crop patterns, and swells water management costs. Salinity damage amounted to $113 million in 1982.

The long-term average dependable flow is approximately 14 million acre-feet per year (maf/yr).

Colorado River deliveries to southern California, primarily for irrigated agriculture, range from 4.3 to 5.1 maf/yr. After deliveries to the Central Arizona Project begin, now scheduled for December 1985, California can depend on receiving only its basic apportionment of 4.4 maf/yr.

The other six Basin states use about 5.3 maf/yr, and Mexico is guaranteed by treaty the delivery of 1.5 maf/yr. The combined water use for all purposes, including reservoir evaporation and river losses, is about 12 maf/yr. The other six states are increasing their water use, and demand by the year 2000 is likely to equal the long-term dependable yield.

Salinity

Salinity of the lower river is a major problem. The Colorado River ranges in average salinity from less than 50 milligrams per liter (mg/L) in the headwaters to 825 mg/L at Imperial Dam (1982 figures), the last U.S. diversion point, and 950 mg/L in Mexico. The river carries a salt load of 9 million tons a year past Hoover Dam.

This salt comes from both natural sources and human activities through salt loading (adding salt from dissolution of soluble salts in the soil) and salt concentration (losing water volume through evapotranspiration). With the advent of irrigated agriculture in the basin in the early 1900s, salinity of the river began to increase through water consumption and the dissolution of salt in irrigated areas.

Natural sources contribute the most salt, accounting for about 47 percent of the total load, and irrigated agriculture is responsible for about 37 percent. Out-of-basin exports and reservoir evaporation contribute 15 percent, and municipal and industrial uses, about 1 percent.

The Colorado River Board of California estimates that, without control measures, future additional water use will increase salinity at Imperial Dam to over 1,100 mg/L by the turn of the century. To prevent this increase, nearly 2 million tons of salt per year must be kept from entering the river.

As of 1982, damage attributable to salinity amounted to $113 million annually, and by the year 2000, the damage will be over $250 million per year (1982 dollars), according to U.S. Bureau of Reclamation estimates. Most of this damage occurs in California.

For irrigators, higher salt concentrations decrease crop yields, alter crop patterns, increase leaching and drainage requirements, and increase water management costs.

Losses associated with municipal and industrial use result primarily from increased water treatment costs, accelerated pipe corrosion and appliance wear, increased soap and detergent needs, and decreased water palatability. High salinity also hampers reuse of the water.

Former President Echeverria of Mexico considered the Colorado River problem to be important enough to make it a major item in his joint presentation to Congress and meeting with former President Nixon in 1972.

Proposed solutions

The salinity problem has the potential to cause lengthy legal and political battles between the Upper and Lower Basin states. The Lower Basin wants to prevent salinity increases that would result from further upstream development; Upper Basin states are concerned that the salinity issue could prevent future increases in their water use.

The states began to work together and with the federal government in the late 1960s, and in the early 1970s several steps were taken to deal with the problems. In 1972, the U.S. Bureau of Reclamation identified 16 salinity control projects. These would be grouped into three categories: point source projects such as salt springs, diffuse sources that covered extensive areas, and agricultural projects that involved lining of canals and on-farm measures. That year, the seven Basin states adopted a policy to maintain salinity at or below 1972 levels in the lower Colorado River while the states continued to develop their apportioned waters. The federal Clean Water Act of 1972 required the establishment of salinity standards for the Colorado River. In 1973, the seven states formed the Colorado River Basin Salinity Control Forum to establish salinity standards and a Basinwide salinity control plan.

At the same time, negotiations were under way to solve the salinity problem with Mexico. In 1962, salty drainage water and reduced river flows had increased salinity of the water delivered to Mexico from 800 to 1,500 mg/L. After several temporary measures, an agreement was reached in 1972 providing that the average annual salinity of water delivered to Mexico at the northerly international boundary would not be more than 115 ppm (plus or minus 30 ppm) over the average salinity at Imperial Dam.

In 1974, Congress passed the Colorado River Basin Salinity Control Act, Public Law 93-320, to implement both the Mexican and domestic control proposals. The Act authorized a desalting plant at Yuma, Arizona, to reduce the salinity of the Wellton-Mohawk Valley drainage water and other facilities necessary to meet the obligations to Mexico. The domestic salinity problem was addressed by provisions for implementing the salinity policy adopted by the Basin states in 1972, planning studies on 12 salinity control units, and constructing and financing four units by the United States, with the Basin states repaying 25 percent of construction, operation, and maintenance costs.

In 1975, the Forum recommended water quality standards for salinity, including numeric criteria of 723 mg/L below Hoover Dam, 747 mg/L below Parker Dam, and 879 mg/L at Imperial Dam. Their proposal also called for prompt construction of the salinity control units authorized by P.L. 93-320, construction of additional units upon completion of planning reports, implementation of on-farm water management practices to control salinity, limitations on industrial and municipal discharges, use of saline water for industrial purposes, and the inclusion of the salinity components of water quality management plans developed by local governments. The salinity standards were adopted by each of the Basin states and approved by the U.S. Environmental Protection Agency.

Two of the four authorized salinity control units are under construction. The Paradox Valley Unit, a point salt source in Colorado, will be controlled by collection of highly saline brines and their disposal through deep well injection. The Grand Valley Unit, also in Colorado, will reduce salt contribution by reducing the amount of deep percolation of conveyance system seepage and irrigation water into the underlying saline soils. The U.S. Department of Agriculture has implemented a cost-share program of on-farm water management to reduce salinity in Grand Valley and in the Uinta Basin, Utah.

Although progress has been made, the Basin states see the need for expanded salinity control to maintain the numeric criteria. Bills now before Congress would authorize five additional salinity control units to be constructed by the Department of the Interior, give the U.S. Department of Agriculture specific authority for a program of on-farm Colorado River salinity control measures in cooperation with local landowners, and provide for 25 percent of the construction costs to be paid by the Basin states.

In other efforts to control the river's salinity, the Basin states have adopted a policy calling for a no-salt return from industrial discharges and limiting the incremental increase permitted from municipal discharges. The states have also called for the use of saline and/or brackish waters in lieu of high-quality water for industrial purposes.

Conclusion

These combined efforts of the seven Basin states and the federal government represent a significant step toward control of salinity in the Colorado River and reduction of the economic damage it causes. Through timely implementation of all phases of the Basinwide program, the salinity standards can be maintained in the lower river while the states continue to develop their apportioned waters.

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Status of soil salinity in California

Virgil L. Backlund **Ronald R. Hoppes**

Saline and sodic soils occur naturally in arid and semiarid regions, and as water development brings more land into irrigation, the salinity problem expands. The condition is aggravated by poor soil drainage, improper irrigation methods, poor water quality, insufficient water supply for adequate leaching, and insufficient disposal sites for water that leaches salts from the soil. Problems caused by soil salinity are compounded when a high water table impedes root development and concentrates salts in the already limited root zone.

Irrigation water applied to higher elevation agricultural lands drains into the problem areas, bringing salts and contributing to the high water table problem (see drawing). Difficulties increase when surface irrigation water is of poor quality, containing more than 300 to 800 mg/L in total dissolved salts. Groundwater supplies also are deteriorating in quality, because the groundwater overdraft occurring in these areas decreases the amount of water and therefore increases the salt concentration.

Recent surveys by the U.S. Department of Agriculture Soil Conservation Service indicate that salinity affects 4.18 million acres of the 55.6 million