

# I. History

*Salinity has been a problem in California since the advent of irrigation. Finding solutions for worsening conditions has become complex and expensive, involving divergent economic, environmental, and political groups.*

## Historical perspective on salinity and drainage problems in California

Robert L. Kelley      Ronald L. Nye

Salinity and drainage problems have plagued agriculture in California from the time irrigation was introduced in the second half of the nineteenth century. The emergence and spread of such problems, and the variety of ways in which irrigators and public agencies have responded to them, may be traced in the histories of the Imperial and San Joaquin valleys.

### Imperial Valley

The Imperial Valley, situated in the once desolate Colorado Desert in the southeastern corner of California, has had difficulties with salinization for several decades at the same time as it has become one of the most productive farming regions in the world. Shortly after Colorado River water became available for irrigation in 1901, serious salt and soil saturation problems became evident. Although the abundant water supply and dry hot climate nurtured a tremendous agricultural expansion, which reached 360,000 irrigated acres by 1918, salinity by that time had forced 50,000 acres out of production and damaged 125,000 acres. Such deterioration of the soil prompted the Imperial Irrigation District, which had assumed control of the Valley's irrigation system in 1916, to launch a \$2.5 million open-ditch drainage project in the 1920s. Because of several complicating factors — the unusually stratified and heavy soils, the use of salty Colorado River water (measuring about 700 mg/L total dissolved salts), and poor on-farm water management — the scheme did not prevent the continued accumulation of salts.

Not until the 1940s was a solution found. The U.S. Soil Conservation Service, in a program jointly financed with the Imperial Irrigation District, made a thorough study of drainage conditions and designed subsurface tile systems tailored to the needs of each landowner. About 100,000 acres were underlain with a network of concrete and clay tile lines by 1949, and for the first time since measurements were begun in

1943, more salt was removed from the Valley than was brought in. A favorable salt balance was made possible also by improved water management by farmers. They applied irrigation water more economically, adjusted canal grade and depth to reduce seepage, and leveled fields more thoroughly. Valley geography also played a role: the Salton Sea, created when the Colorado River inundated the Valley in the early 1900s, proved to be an ideal receptacle for the saline wastewater that was collected from tile lines in the fields and channeled by gravity to the low-lying lake.

The Valley's salt balance has been maintained continuously since 1949, and its large farms have flourished. Irrigators have paid a high price to control the salt menace, however, spending \$40.5 million on tile drains between 1929 and 1972, and over \$26.2 million on concrete lining for canals and laterals between 1954 and 1972. Other costs, made necessary by the rising salinity of the Colorado River, have included increasingly sophisticated irrigation and soil management techniques. Despite preventive measures authorized by the federal Colorado River Basin Salinity Control Act of 1974, aimed at reducing upstream return flows and improving upstream irrigation efficiency, salt concentrations averaged 810 mg/L at Imperial Dam in 1979 and are projected to climb higher with continued upstream development. If salinity levels in the river reach the 1,140 to 1,290 mg/L range, as projected by various public agencies for the year 2000, reduced yields and high operating costs could lead to significant economic losses for Imperial Valley farmers.

Another set of salt-related problems in the Imperial Valley that may worsen in the near future involves both the surface elevation and the saltiness of the Salton Sea. The Sea was as low as 241 feet below sea level in 1941, but increased runoff from expanded irrigation development and more efficient drainage systems caused it to rise to -227 feet by 1981. Millions of dollars in damage occurred to shoreline properties. Legal actions charging the Imperial Irrigation District with wasting water have prompted a major water conservation program. A high evaporation rate and an annual deposit in the Sea of 5 million tons of salt, meanwhile, has caused its salt concentration to rise steadily. It has hovered near the 40,000 ppm mark in recent years, threatening to kill the salt-water fish as well as the sport fishing industry successfully introduced in the 1950s.

Several state and federal agencies have studied the salt buildup in the Sea, yet no ameliorative action has been taken. For the time being, yearly fluctuations in elevation and salinity can be expected. Complex, contradictory factors are at work: Imperial Irrigation District conservation efforts tend to lower the Sea's elevation while increasing salinity, whereas periodic heavy runoff from storms decreases salinity while it raises the Sea's elevation.

## San Joaquin Valley

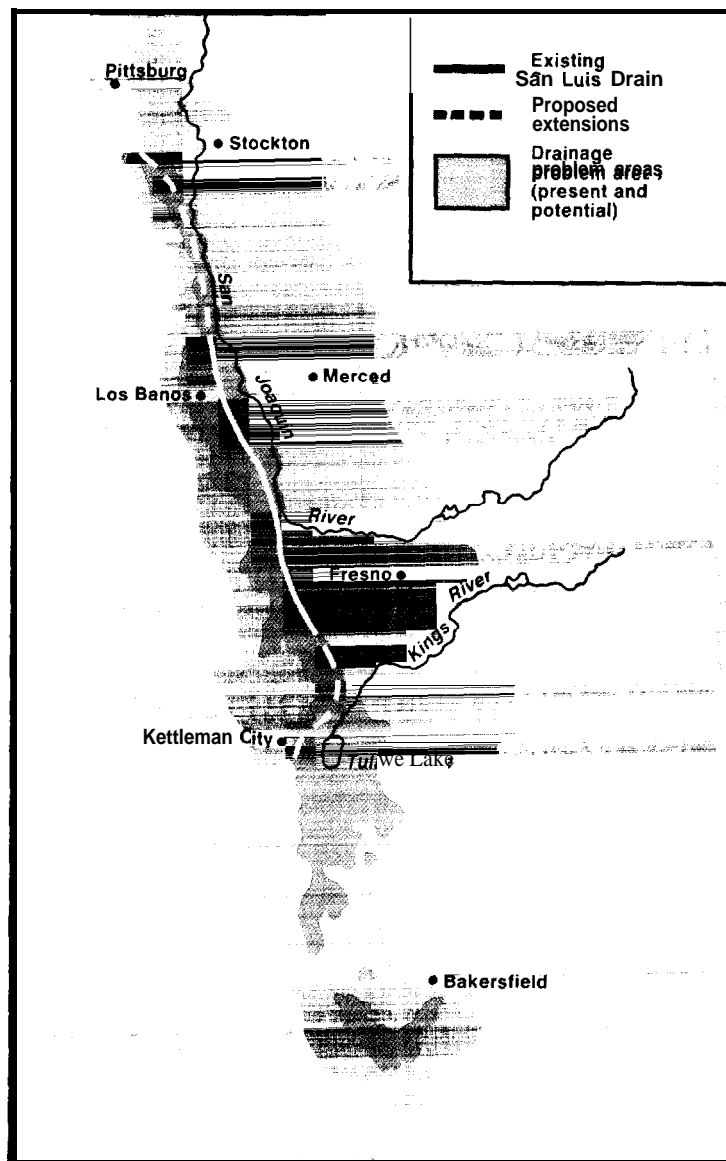
Situated in the southern two-thirds of California's great Central Valley, the San Joaquin Valley is another leading agricultural region with a long history of salinity problems. The advance of salinization and the various methods employed to control it may be divided into three periods.

The first, from the late 1870s to about 1915, was characterized by rapid growth in irrigated acreage, a parallel development of salinity and drainage problems, and generally futile attempts by individual irrigators to rehabilitate their soggy salt-encrusted fields. Experts from the University of California Agricultural Experiment Station and the federal Bureau of Soils established demonstration farms at Tulare and Fresno and urged farmers to cultivate more salt-tolerant crops, apply less water, and provide for adequate drainage. Such efforts, however, did not have a major effect on Valley salinity conditions. Many irrigators were reluctant to admit that they had a problem, squandered their money on untested remedies, or would not participate in large-scale cooperative drainage undertakings as recommended by government agents. The government's experts, for their part, had yet to demonstrate a complete understanding of the drainage of arid lands. By 1915, of the approximately 2 million acres of irrigated land in the Valley, 80,000 acres in Fresno County suffered from the influence of subsurface water lying 6 feet or less from the surface, and similar conditions existed in Stanislaus, Kings and Kern counties.

During the second period, from 1915 to the 1950s, an agricultural boom and proliferation of irrigation districts elevated drainage from an individual to a community undertaking. Just as the new agencies could raise the funds necessary to build massive irrigation works that were beyond the means of individual farmers, so could they provide drainage facilities for the district. Hundreds of miles of ditches and tile lines installed by districts lying east of the Valley trough, however, proved insufficient to lower the water tables enough to prevent salt accumulation. A solution that revolutionized drainage methods was the introduction of deep-well pumping in 1920. Less expensive and more efficient than older methods, the technique was enthusiastically embraced on the east side. Within a few years, drainage by deep-well pumping had lowered the water table under the most intensively irrigated sections of the Valley to safe levels, where it has since remained.

The third period, which began in the mid-1950s and continues to the present, has seen the emergence of serious drainage problems on the west side of the Valley trough, as well as broad support for a regional or valleywide salt disposal solution. Salinity problems on the west side assume two forms: high water tables under lands near the trough, caused for the most part by expansion, during the 1940s, of irrigation upslope from the trough and the Valley's natural drainage conduit, the San Joaquin River; and downstream degradation of the river. This degradation was caused in part by the substitution after 1951 of the saltier Central Valley Project water for fresh San Joaquin River water, which is diverted to east side irrigators upstream at Friant, in Fresno County, and in part by saline agricultural return flows. Threatening to make existing conditions worse was the planned federal San Luis Unit, which promised to provide impounded water to irrigate 500,000 more acres in western Fresno County by the late 1960s.

The imminent arrival of the San Luis Unit intensified the appeals for a comprehensive approach to salt management in the Valley. In response to west side lobbying, the federal San Luis Authorizing Act of 1960 required that drainage be provided in one of two ways: the State of California would build a master drain to serve the entire Valley; or the U.S.



**A large portion of the fertile San Joaquin Valley, once thought to have been an inland arm of the sea, is now affected by salinity or high water tables. The affected area may reach 3.6 million acres by the year 2000.**

Secretary of the Interior, through the Bureau of Reclamation, would provide an interceptor drain for the smaller San Luis Unit water service area. Both options were intended to convey brackish water northward, through a concrete canal, to an outfall in the Sacramento-San Joaquin Delta.

In the mid-1960s, the federal and state governments began planning for a jointly constructed \$86 million master drain that would eventually traverse 280 miles from Bakersfield to an unspecified point in the Delta. However, after failing to obtain assurances in 1967 from irrigators in the state water service area for repayment of state expenditures, the State of California declined to participate in building the master drain.

In 1968, the Bureau of Reclamation, as required by law, proceeded alone with construction of the federal San Luis Drain. The \$60 million facility was to extend 188 miles, from Kettleman City at the southern end of the federal service area to the Delta. To date, however, only an 82-mile segment between Laguna Avenue in southern Fresno County and Kesterson Reservoir in Merced County has been completed.

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 Chippis Island in the

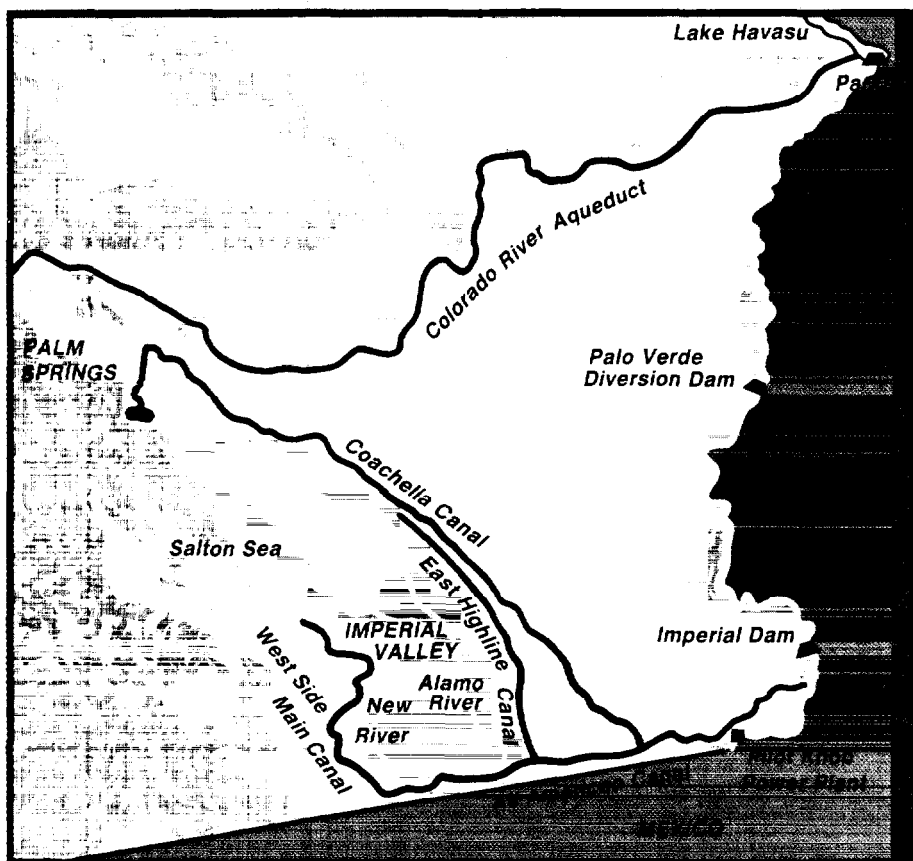
Delta, and a series of marshes and holding ponds to regulate discharges during peak periods of drainage flow. Like its predecessors, this plan was condemned by Bay Area interests and rejected by state service area irrigators as too costly. Many potential Valley Drain users south of Kettleman City believed 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



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.

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.