

Colorado River Association

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March, 1968

MEMO RE COLORADO RIVER WATER DEVELOPMENTS

Growing needs for water in all seven States of the Colorado River Basin soon will exceed water supply.

What this means to just one Southwestern State is subject of the attachment, "California's Stake in the Colorado River."

Some 10,000,000 residents of Southern California now rely upon the Colorado River to meet 80% of their present water requirements. To satisfy those needs, Californians withdrew from the river last year some 5,000,000 acre-feet.

Pending before Congress now is legislation to authorize the building of new works in Arizona and in the Upper Basin which will cause California to reduce its draw upon waters of the stream to 4.4 million acre-feet annually. This reduction will be accepted without objection from the united, bi-partisan group of 35 California Congressmen provided assurances are in the proposed bill that the cut will go no deeper. In Cong. Wayne Aspinall's bill, HR 3300, such assurances were incorporated March 1. California supports that bill.

Just as essential as authorization of new water projects to serve growing needs throughout the basin is the necessity for augmenting the supply of water in the Colorado River. A study of all alternative ways to add more water is called for by the bill. Protection for States having surplus water is given them. Also, a fund to help pay for works to implement the best augmentation method, whatever that proves to be, is provided.

The House Interior Committee starts its discussion of Cong. Aspinall's bill on March 20, following favorable action by the House Irrigation and Reclamation Subcommittee March 1.

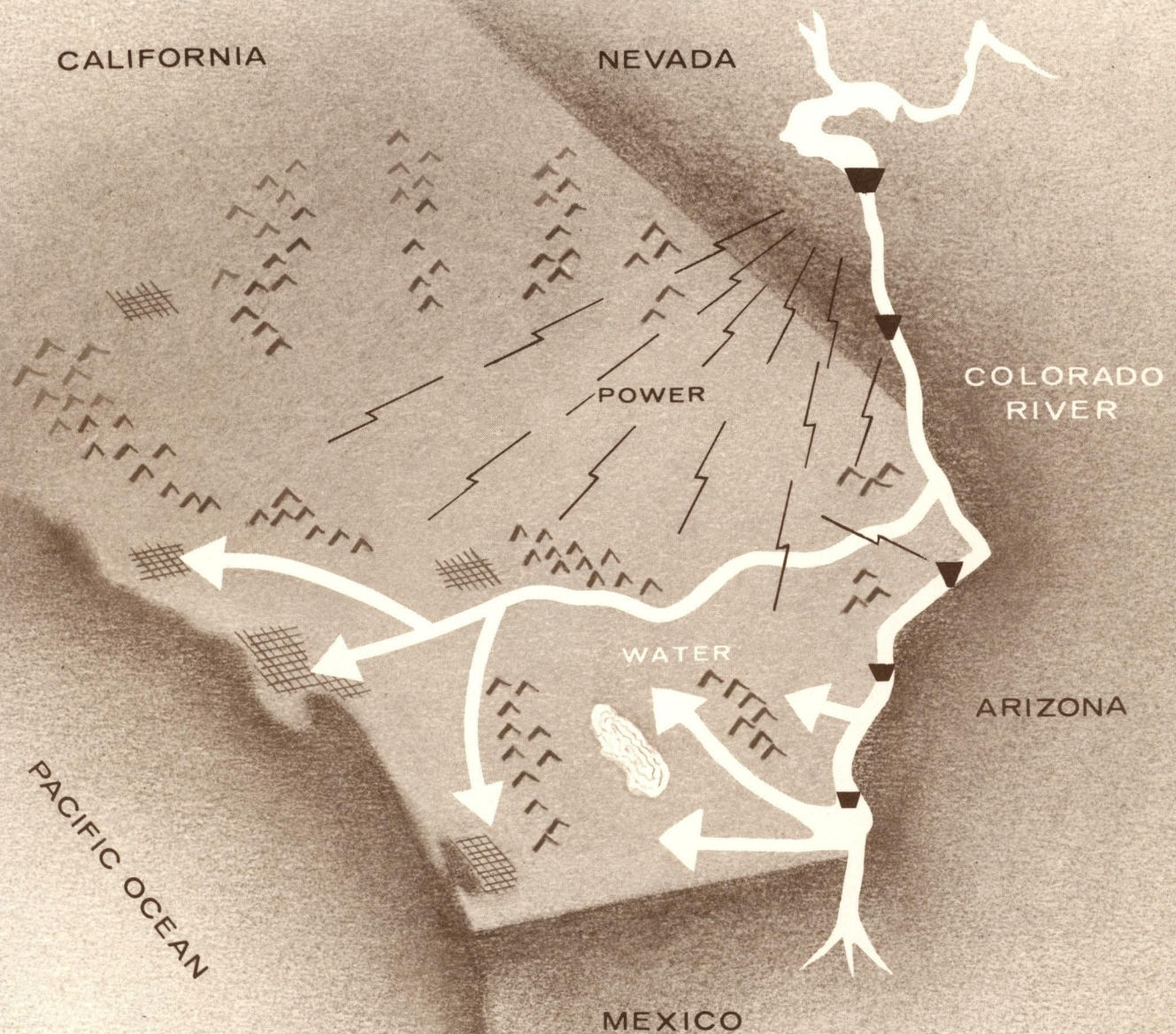
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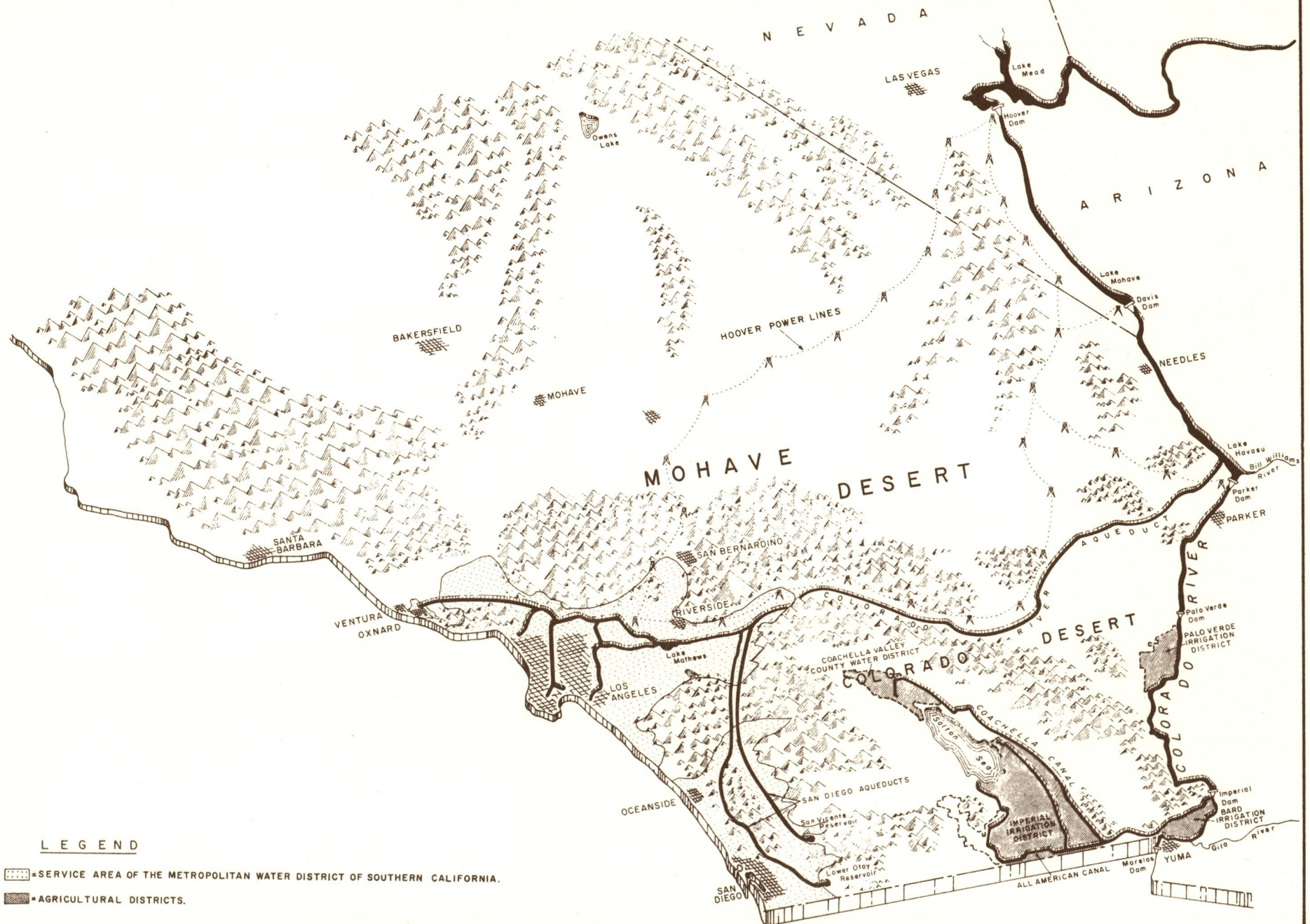
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CALIFORNIA'S STAKE IN THE COLORADO RIVER



CALIFORNIA DEVELOPMENTS USING COLORADO RIVER WATER



LEGEND

- SERVICE AREA OF THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA.
- AGRICULTURAL DISTRICTS.

STATE OF CALIFORNIA

RONALD REAGAN, *Governor*

CALIFORNIA'S STAKE IN THE COLORADO RIVER

COLORADO RIVER BOARD OF CALIFORNIA



Dallas E. Cole, *Chief Engineer*

Harold F. Pellegrin, *Executive Secretary*

Los Angeles, California

COLORADO RIVER BOARD OF CALIFORNIA

The Colorado River Board of California was created as a State agency by the Legislature under Chapter 838, Statutes of 1937 (Sections 12500 to 12533, State Water Code). It has the statutory responsibility of protecting the interests of California, its agencies and citizens in the waters of the Colorado River system. The Board is composed of six members appointed by the Governor, each representing one of the public agencies of California having established rights to the use of water or power from the Colorado River. These agencies are: Palo Verde Irrigation District, Imperial Irrigation District, Coachella Valley County Water District, The Metropolitan Water District of Southern California, San Diego County Water Authority and City of Los Angeles Department of Water and Power. The Board selects from its members a chairman who serves as Ex Officio Colorado River Commissioner of California. The Commissioner, by statute, is the official representative of California in all communications or negotiations with other states and with the Federal Government in connection with Colorado River problems.

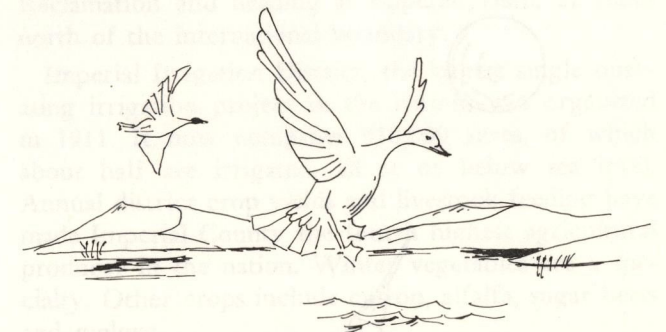
CALIFORNIA'S STAKE IN THE COLORADO RIVER

Suppose the present Colorado River water supply of Southern California were taken away entirely. What would happen? Among other things, economic depression; recession and stagnation of industry and trade; forced evacuation of millions of people; and reversion to desert of thousands of square miles of presently watered farms, golf courses and parks. For the Colorado now furnishes four-fifths of the water that makes Southern California green and habitable, prosperous and dynamic. This vast region of some 32,000 square miles, from Ventura to San Diego and from the ocean to the eastern state line, is by nature semi-arid to arid. Much of it inward from the coastal mountains is a natural desert as barren and stark as will be found anywhere on this globe. Yet in at least one respect Southern California is like no other place on earth. The economy that thrives here is surpassed in few other areas and is unequalled in any other area of like aridity.

That this is so is a tribute to the imagination, daring and industry of man, and is owed in large measure to the existence of the Colorado River along the eastern bounds of the state, between California and Arizona. Water from the Colorado supports hundreds of thousands of acres of magnificent year-round agricul-

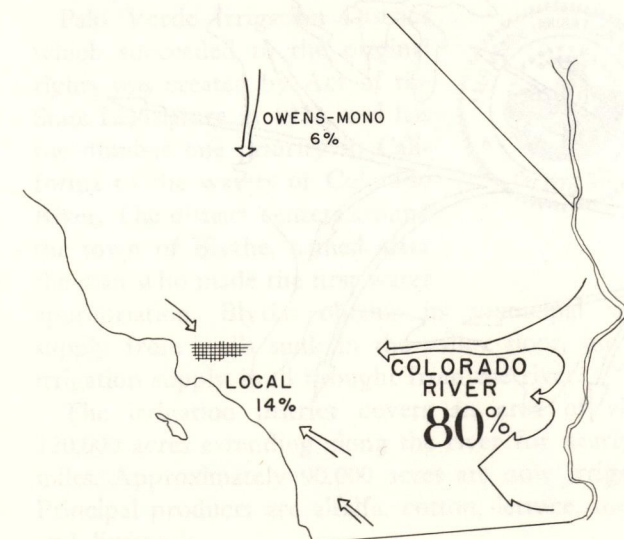
ture in the deserts of Southern California and provides municipal, domestic and industrial water for many millions of people on the coastal plain, three hundred miles from the river. About eighty percent of the water now used in the South Coastal plain and the Colorado Desert area of the state comes from the Colorado.

Besides that, millions of people from the cities flock to the Colorado each year for outdoor recreation—fishing and hunting, boating, water skiing, sightseeing and camping.



Whirring turbogenerators on the river send an endless flow of electric energy to Southern California to help keep factory and farm machines humming and homes, schools and stores lighted.

For years to come, the Colorado River will continue to be the largest single source of water supply for Southern California as a whole, even after completion of the State Water Project now under construction to bring Sierra Nevada water 444 miles through the San Joaquin Valley and over the Tehachapi mountains to the South Coastal plain. This northern water added to present supplies is expected to take care of our growth for perhaps the next generation, but as growth continues, the time will come when still greater quantities of water will be needed, from still more distant sources. We cannot get more from the natural supply of the Colorado River than we are taking already. That stream is over-committed now, and unless its flow is augmented by some means California may even have to reduce her present use.



CALIFORNIA DEVELOPMENTS ON THE COLORADO

Colorado River water serves three major economic functions in Southern California, in addition to the recreational aspects of the river. These are: water for irrigation, mostly in the southeastern desert areas; water supply for the metropolitan coast; and hydro-electric power.

Nearly all the agricultural use of the water takes place in the hot, naturally barren Colorado desert, north and south of the famous Salton Sea in the southeastern part of the state, and along Colorado River near Blythe, California and across from Yuma, Arizona. Much of the Salton Basin is below sea level. In these areas summer temperatures often soar above 120 degrees, frosts are rare, and growing seasons are as long as the calendar. Annual rainfall, averaging only

three inches, is sometimes less than half an inch. Nevertheless, the irrigated agriculture there supplies the nation a large part of its fresh winter fruits and vegetables, and many other products of the soil. All told more than a million acres of irrigable land in California are within organized irrigation districts being served from the Colorado, of which about 600,000 acres are now irrigated, producing some \$300,000,000 worth of food and fiber annually. In this desert, enterprising Californians undertook the first major diversions from the lower river, and still make the largest single diversion anywhere in the seven states of the river basin.

Water from the Colorado is brought to and distributed throughout the coastal plain from Ventura to Mexico, for domestic, municipal, industrial and minor agricultural use. Southern California gets over three billion kilowatt-hours a year of electricity from generating stations on the river. The bountiful effects of the vast industry supported by this water and power fan out over the earth, occasionally to the moon, and even into outer space.

Six large public agencies own among them the major rights in Southern California to water and power from the Colorado, and operate the works which bring those commodities to the users. These are: Palo Verde Irrigation District, located along the river about 100 miles north of the Mexican border; Imperial Irrigation District, in Imperial County south of Salton Sea; Coachella Valley County Water District, in

Riverside County north of Salton Sea; The Metropolitan Water District of Southern California, covering most of the coastal area; the City of Los Angeles and its Department of Water and Power, and the San Diego County Water Authority, both major components of The Metropolitan Water District, having pooled their Colorado River water rights with those of the District.

These six agencies receive Colorado River water through three great projects: (1) the Palo Verde Diversion Dam and Canal; (2) the Imperial Dam and desilting works and the All-American Canal which serve both Imperial Irrigation District and the Coachella Valley County Water District, plus the Yuma Federal Reclamation Project, a small portion of which is in California; and (3) the Colorado River Aqueduct, diverting at Parker Dam and carrying a billion gallons of water a day to The Metropolitan Water District, which wholesales the water to its member agencies for retailing.

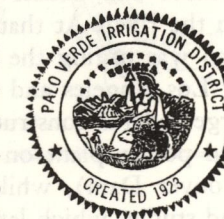
The Department of Water and Power of the City of Los Angeles, and the Southern California Edison Company, operate the power plant at Hoover Dam, and their own transmission lines carry much of the energy to the consumers. Electric energy generated at the river plants is used by The Metropolitan Water District to lift its water from the river more than 1600 feet, to an elevation from which it flows by gravity to the coast.

Palo Verde Irrigation District

California's active interest in the use of water from the Colorado dates from 1877 when water was first appropriated for the Palo Verde area, which is riparian to the river. This appropriation is the first of record on the lower Colorado River.

Palo Verde Irrigation District which succeeded to the original rights was created by Act of the State Legislature in 1923, and has the number one priority in California to the waters of Colorado River. The district centers around the town of Blythe, named after the man who made the first water appropriation. Blythe obtains its municipal water supply from wells sunk in the valley floor, but the irrigation supply is all brought from the river.

The irrigation district covers an area of about 120,000 acres extending along the river for nearly 30 miles. Approximately 90,000 acres are now irrigated. Principal products are alfalfa, cotton, lettuce, melons and livestock.



Imperial Irrigation District

The largest irrigation development in the desert area of Southern California is that of the Imperial Valley, which was initiated under water appropriations made in the 1890's. Irrigation began in June of 1901 when water was first delivered from the river by an unlined canal.

Because of topographic obstacles the first diversion works were only a short distance above the Mexican boundary, and the canal ran almost 80 miles through Mexico, before re-entering the United States. Since 1941, however, the Imperial Irrigation District has been served by a canal lying entirely within the United States, the great All-American Canal, built by the Federal Bureau of

Reclamation and heading at Imperial Dam, 22 miles north of the international boundary.

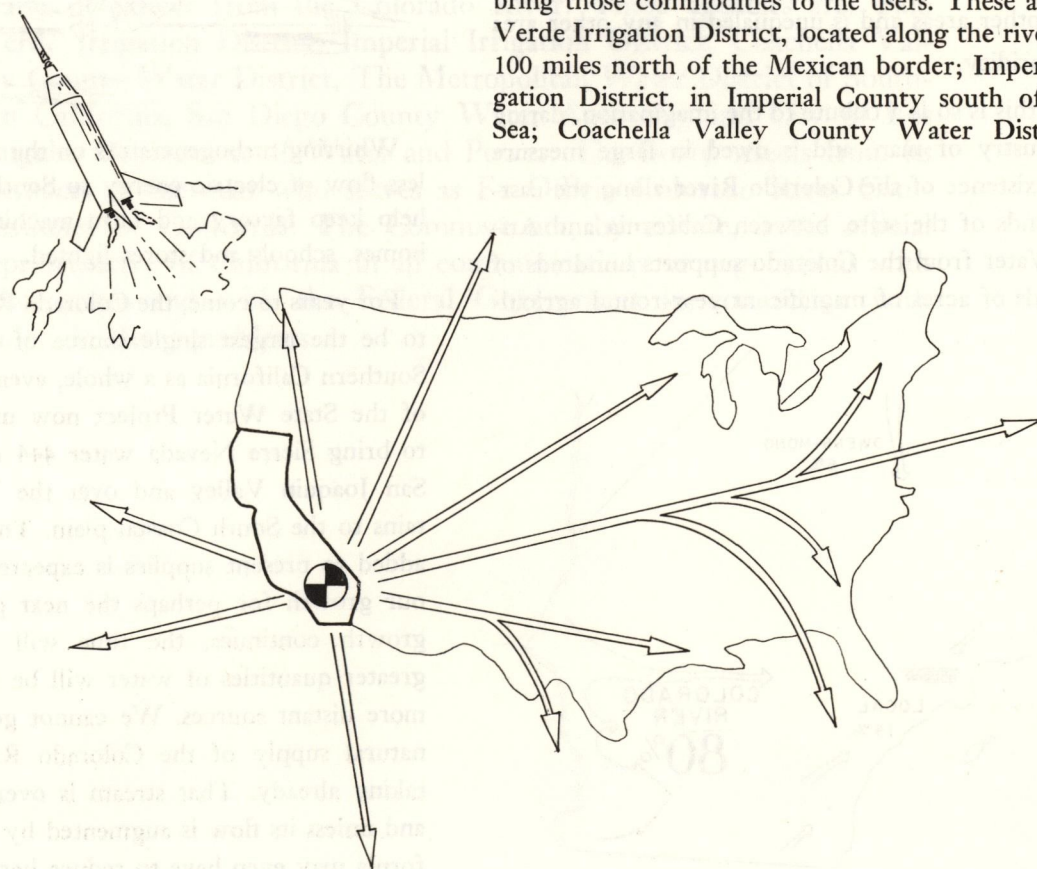
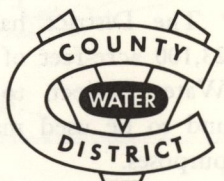
Imperial Irrigation District, the largest single operating irrigation project in the nation, was organized in 1911. It now comprises 910,000 acres, of which about half are irrigated, all at or below sea level. Annual district crop yields and livestock feeding have made Imperial County the fourth highest agricultural producer in the nation. Winter vegetables are a specialty. Other crops include cotton, alfalfa, sugar beets and melons.

Domestic and industrial water requirements in the valley are supplied with treated canal water.

Coachella Valley County Water District

Irrigation of the Coachella Valley was started in 1902 by water supplies obtained from the artesian basin underlying the valley. Coachella Valley County Water District was organized in 1918 for the initial purpose of conserving local supplies and replenishing the underground basin, but when it was realized that the local supply was insufficient to serve the irrigable area, the District turned its attention to Colorado River and cooperated with Imperial Irrigation District in planning the All-American Canal to serve the entire Salton Basin with river water. In 1949 Colorado River water first reached Coachella Valley through a 124-mile branch of the All-American Canal. About 80,000 acres are under irrigation, all with Colorado River water.

All the dates grown commercially in the United States are produced in Coachella Valley. Other prin-





cial crops include citrus, table grapes, winter vegetables and cotton. Livestock feeding operations are important contributors to the economy.

The District contains a gross area of 660,000 acres, including within its service area about 161,000 acres of irrigable agricultural land and about 65,000 acres suitable for urban development. Most of the agricultural land is below sea level. The towns and cities, of which the largest is Indio, still obtain their water supplies from wells. Palm Springs, famous winter resort, is in Coachella Valley, though not a part of the County Water District.

The District has contracted with the State for 23,100 acre-feet of water per annum from the State Water Project, to be delivered beginning in 1972 and to be used mainly for domestic and municipal purposes.

Yuma Reclamation Project, California Portion

Construction of the Yuma Federal Reclamation Project, on both sides of the Colorado in Yuma Valley at the Mexican boundary, was authorized in 1904 as one of the first projects to be developed under the authority of the Reclamation Act of 1902 and the first on the Colorado. Gross area of the California portion is about 25,000 acres. Irrigation was started in 1907, and now extends to about 11,000 acres. The Arizona portion of the project is the larger.

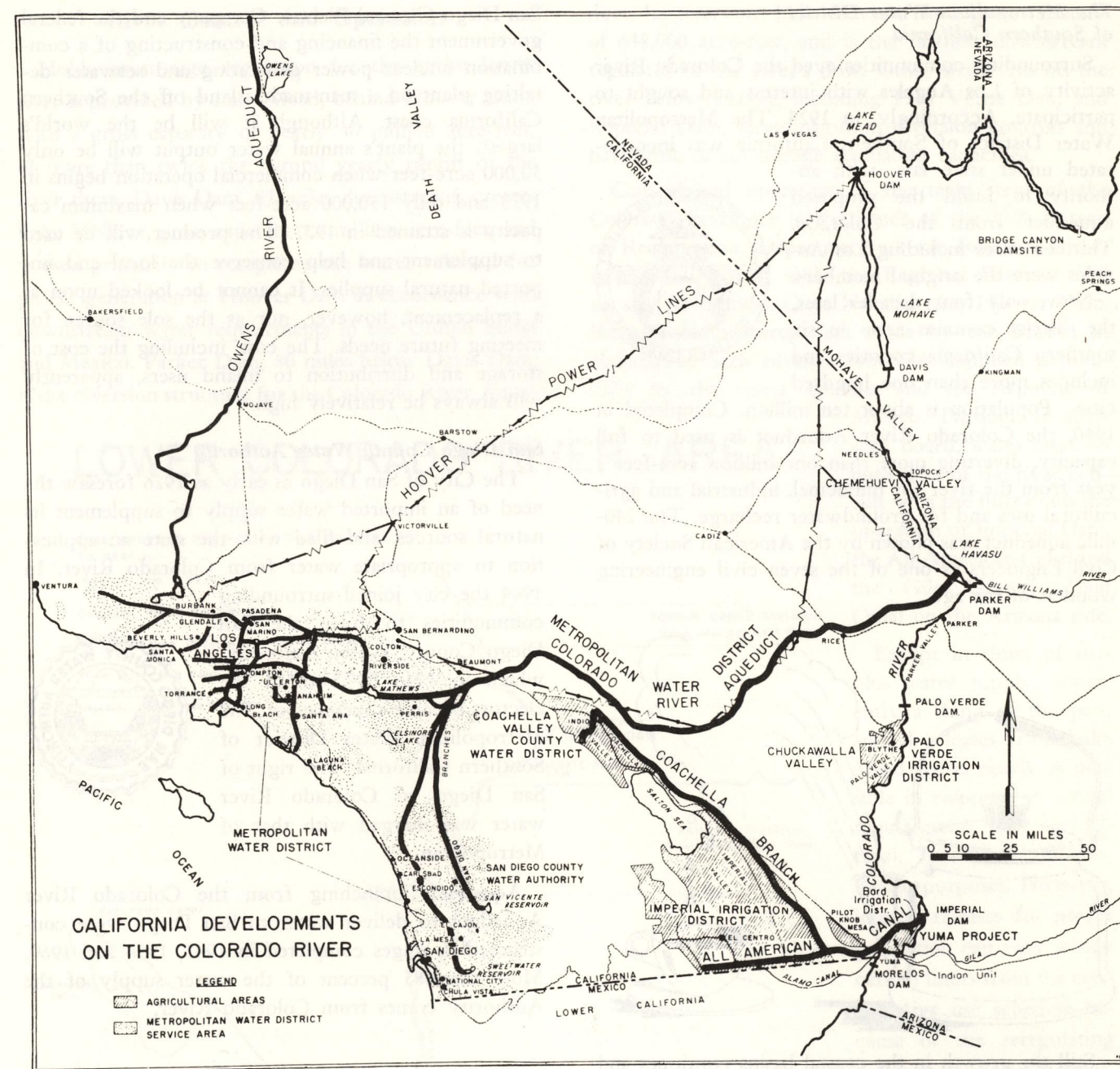
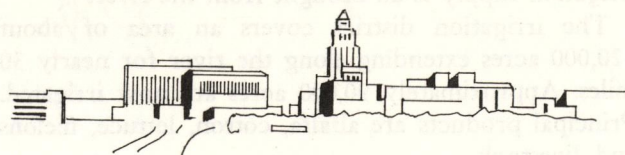
City of Los Angeles and its Department of Water and Power

The coastal plain of Southern California has known one of the most rapid increases in population and economic development of any comparable area in the country. Early development depended for water upon small local streams and upon thousands of wells pumping or flowing by pressure from the underground supplies. Discovery and development of these vast groundwater resources gave the area one of its first land booms, prior to 1900. It became apparent about the turn of the century, however, that the local water supply would be inadequate to meet increasing demands. In a bold move under the leadership of William Mulholland, the City of Los Angeles in 1913 completed a 250-mile aqueduct from the closed basin of the Owens River Valley at the eastern foot of the Sierra Nevada Mountains. Later the Mono Basin, 100 miles farther north, was also tapped. The Owens-Mono aqueduct still furnishes the city about 65 percent of its water supply.



The new supply of excellent water obtained in 1913 helped the city grow so fast, however, that before long it needed still more water. The tax base increased too, so that the city could afford to look still farther afield. In 1923 preliminary surveys were begun to establish the feasibility of an aqueduct from Colorado River to Los Angeles, and a water right filing under state law was made in 1924. It was evident that in order to insure water for the city in dry periods, and to satisfy the needs of senior appropriators, large flood control and conservation storage would be needed on the river. At that time Imperial Irrigation District also was urging the need for storage, so the citizens of Los Angeles and Imperial Valley joined forces to urge federal construction of a large storage reservoir and power plant on the river (now Lake Mead and Hoover Dam), while the city continued its surveys and studies which later materialized into the Colorado River Aqueduct.

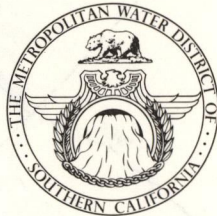
Los Angeles has under construction a second Owens River aqueduct, to increase the supply from that source by half.



The Metropolitan Water District of Southern California

Surrounding communities eyed the Colorado River activity of Los Angeles with interest and sought to participate. Accordingly, in 1928, The Metropolitan Water District of Southern California was incorporated under state law, with authority to build the proposed aqueduct from the Colorado. Thirteen cities including Los Angeles were the original members.

Now, only four decades later, the district contains areas in six southern California counties and includes more than one hundred cities. Population is about ten million. Completed in 1940, the Colorado River Aqueduct is used to full capacity, diverting more than one million acre-feet a year from the river for municipal, industrial and agricultural uses and for groundwater recharge. The 240-mile aqueduct was chosen by the American Society of Civil Engineers as one of the seven civil engineering wonders of the age.



Still the growth in the coastal basins continues and still there is substantial overdraft on local groundwater storage in order to meet all demand. So the Metropolitan Water District has contracted with the state for water to be brought south from northern California streams by the State Water Project now under construction. Delivery from this source will begin in 1971 and will be as much as two million acre-feet a year, to full capacity, probably by 1990.

In addition, the district is planning, in cooperation with the Los Angeles Department of Water and Power, the Southern California Edison Company, the

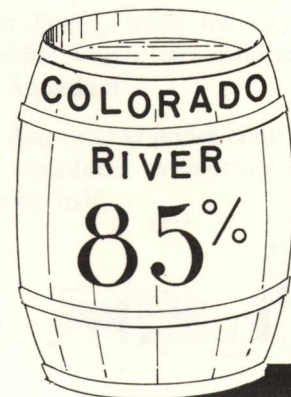
San Diego Gas and Electric Company and the federal government the financing and constructing of a combination nuclear power generating and seawater desalting plant on a man-made island off the Southern California coast. Although it will be the world's largest, the plant's annual water output will be only 50,000 acre-feet when commercial operation begins in 1973 and only 150,000 acre-feet when maximum capacity is attained in 1977. The product will be used to supplement and help conserve the local and imported natural supplies. It cannot be looked upon as a replacement, however, nor as the sole source for meeting future needs. The cost, including the cost of storage and distribution to inland users, apparently will always be relatively high.

San Diego County Water Authority

The City of San Diego as early as 1926 foresaw the need of an imported water supply to supplement its natural sources, and filed with the state an application to appropriate water from Colorado River. In 1944 the city joined surrounding communities to form the San Diego County Water Authority, which in 1946 by vote of the electors became a member of The Metropolitan Water District of Southern California. The right of San Diego to Colorado River water was merged with that of Metropolitan.



Aqueducts branching from the Colorado River Aqueduct to deliver water to San Diego were constructed in stages completed in 1947, 1954 and 1960. More than 85 percent of the water supply of the Authority comes from Colorado River.



River Control and Operation

Holdover storage regulation for the entire lower river is provided by Lake Mead, behind Hoover Dam, with a gross capacity of nearly 30 million acre-feet, or more than twice the natural yearly runoff of the river there. Davis Dam, 67 miles downstream, creates Lake Mohave, gross capacity 1.8 million acre-feet, and is used primarily to reregulate the water released for power generation at Hoover Dam in accordance with downstream water requirements in the United States and Mexico. Parker Dam, 80 miles below Davis Dam, is the diversion structure for the Colorado River Aque-

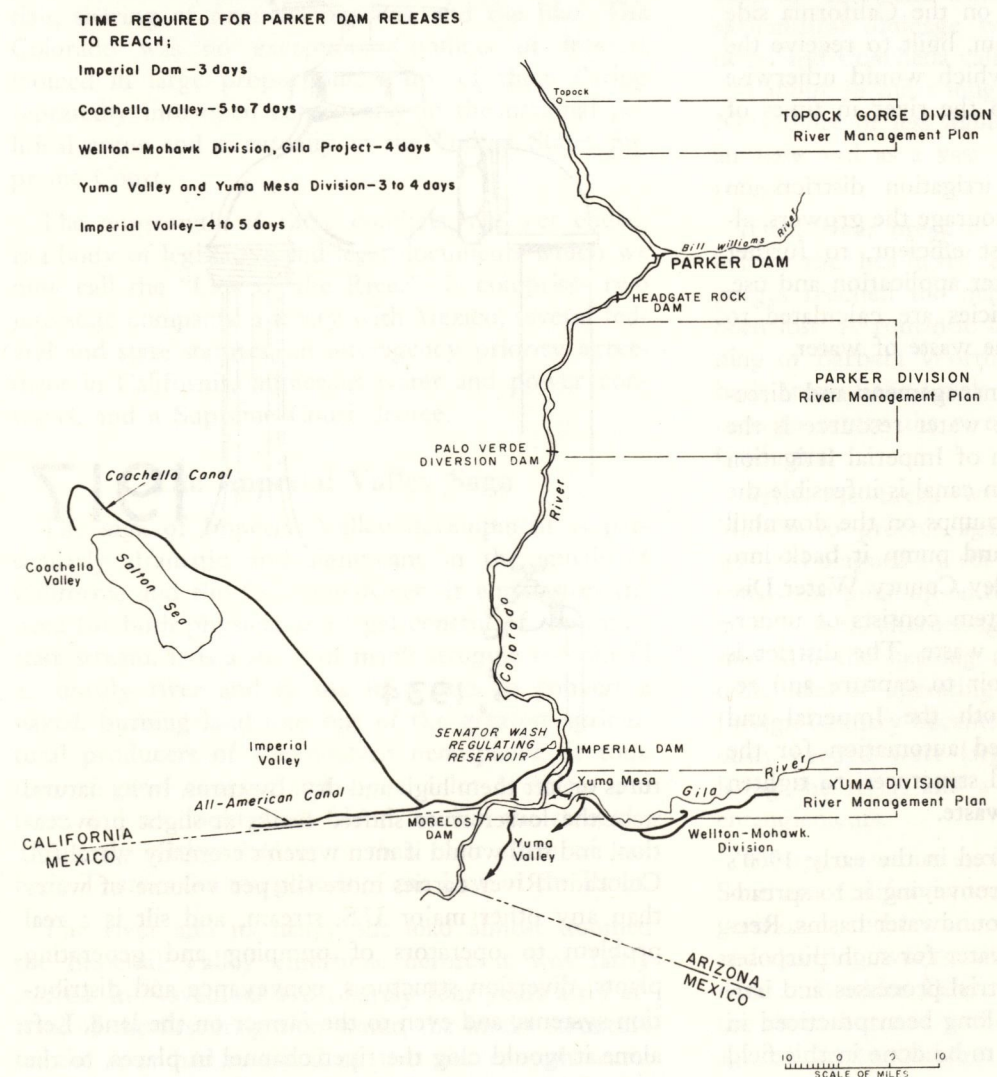
duct. Its reservoir, Lake Havasu, has a gross capacity of 648,000 acre-feet, and is the farthest downstream regulator of the river's flow. Other structures on the river below Parker, including Palo Verde Dam and Imperial Dam, serve mainly as diversion controls and have little or no storage regulating capacities.

Control and operation of the main stem of the Colorado River are in the hands of the U.S. Bureau of Reclamation, Department of the Interior. Direct responsibility rests with the Regional Director and his staff at Boulder City, Nevada, near Hoover Dam. Releases from storage are made by the Bureau in accordance with advance schedules supplied periodically by the water agencies and the Republic of

Mexico. Through an advisory board, water users on both sides of the river consult with the Bureau on the operation of Imperial Dam, the All-American Canal and the Gila Gravity Main Canal on the Arizona side.

Except in times of surplus water supply, apparently a thing of the past, annual releases from Lake Mead are as nearly as possible in response to annual requirements for agricultural, municipal and domestic purposes. However, interim releases for power generation can vary within certain limits from the consumptive use schedule because of the reregulating capacity of Lake Mohave. An integrating committee representing the City of Los Angeles, the Southern California Edison Company and the Secretary of the Interior determines Hoover power generating patterns annually in advance, and makes interim revisions as needed.

LOWER COLORADO RIVER AREA



Water Conservation

Users of Colorado River water in Southern California, as well as all water users throughout the arid southwestern United States, always have been keenly aware of the need for conservation, salvage and efficient use of water. They have had to be.

Southern California agencies which supply Colorado River water to consumers do not view lightly their shares of the responsibility to achieve efficient management of the river and prevent waste. They schedule their orders carefully, and revise them as quickly as possible in response to changes in the weather or in other factors. They fully endorse and support the program of the Bureau of Reclamation to straighten and shorten the river channel, reduce backwaters and riverbottom vegetation, and to improve facilities and methods of control. The agencies joined the Department of the Interior and similar Arizona agencies in the 1967 dedication of Senator Wash Reservoir, an off-channel facility on the California side of the river above Imperial Dam, built to receive the unavoidable excess deliveries which would otherwise be wasted, and return them to the river in times of deficient deliveries.

Officials of the California irrigation districts on Colorado River continually encourage the growers, already among the world's most efficient, to further improve their efficiency of water application and use. District rules and pricing policies are calculated to minimize over-orders and undue waste of water.

Typical of the concern of management and directors for the husbanding of the water resource is the aggressive canal lining program of Imperial Irrigation District. Where lining of a main canal is infeasible the district has installed wells and pumps on the downhill side to recover seeped water and pump it back into the canal. In the Coachella Valley County Water District the entire distribution system consists of underground pipes, which minimize waste. The district is constructing a terminal reservoir to capture and redistribute excess deliveries. Both the Imperial and Coachella districts have adopted automation for the operation of canals and control structures, to tighten delivery schedules and lessen waste.

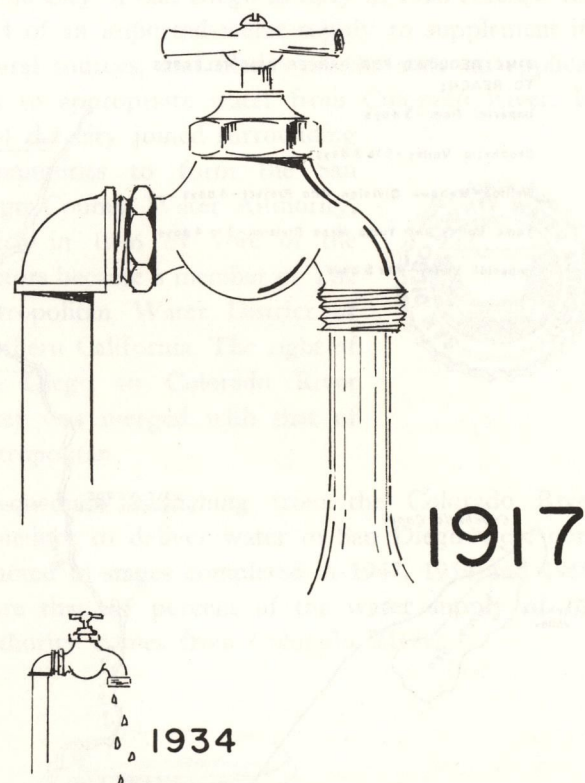
Southern Californians pioneered in the early 1900's in capturing storm runoff and conveying it to spreading areas for recharge of the groundwater basins. Reclamation and reuse of sewage water for such purposes as groundwater recharge, industrial processes and irrigation of non-food crops have long been practiced in the coastal area. Much remains to be done in this field

and more is planned, although there are economic limits as well as difficult engineering and esthetic problems. Practically all public water supplies for domestic use in Southern California are fully metered, and the prices are generally high enough to discourage extravagance.

Early Struggles

The story of California's developments on and rights in the Colorado covers many decades of progressive planning and construction. It is one of foresight, initiative, courage and tenacity, rife with physical and political problems.

The river is naturally capricious, its flow fluctuating widely, from flood to drought to flood again. The maximum recorded annual flow is 4.37 times the minimum. Colorado River has washed out diversion struc-



tures or left them high and dry, by turns. In its natural state the lower river shifted banks at slight provocation, and still would if men weren't eternally watchful. Colorado River carries more silt per volume of water than any other major U.S. stream, and silt is a real problem to operators of pumping and generating plants, diversion structures, conveyance and distribution systems, and even to the farmer on the land. Left alone it would clog the river channel in places, to the

detriment of sport and recreation, as well as river operations.

Men soon realized that in order to develop the full potential of beneficial use of the lower Colorado, heroic measures would be needed to prevent the recurring damage of flood and drought, to conserve and regulate the high flows, to provide a more uniformly dependable supply in dry periods, and to control the channel and its silt load. Such measures were conceived, proposed and debated in the early decades of this century, but emergent political problems delayed physical accomplishment until the middle of the fourth decade, when Hoover Dam and powerplant were finished. Other facilities followed.

Any move to tamper with an interstate stream, for better or worse, soon uncovers a multiplicity of human problems—problems of authority to construct, operate and control, of interstate and intersectional priority of water rights, safeguarding of future potentials, sharing of financial burdens, and the like. The Colorado was no exception. Conflicts of interest loomed in large proportions, many of them flaring repeatedly into open controversy in the national political arena and eventually in the United States Supreme Court.

The outgrowth of these conflicts, not yet ended, is a body of legislative and legal documents which we now call the "Law of the River". It comprises two interstate compacts, a treaty with Mexico, several federal and state statutes, an interagency priority agreement in California, numerous water and power contracts, and a Supreme Court decree.

The Imperial Valley Saga

The saga of Imperial Valley development is particularly dramatic and significant in the annals of California and the Colorado River. It emphasizes the need for both physical and legal control of the interstate stream. It is a story of man's struggle to control an unruly river and to use its waters to convert a naked, burning land into one of the greatest agricultural producers of the western hemisphere. It took men of great courage and vigor, a lot of sweat and tears, and no doubt some blood, to win the struggle. The early settlers had more than their share of bad luck. Therein lies the genesis of the Law of the River.

The river and its heavy silt load almost doomed the Imperial Valley enterprise before it was fairly started. In November 1905, barely four years after arrival of the first irrigation water, the intake structure on the river had so silted up that not enough water

could be diverted into the canal, and the crops were in danger. A temporary intake was cut in the soft river bank farther downstream, in Mexico.

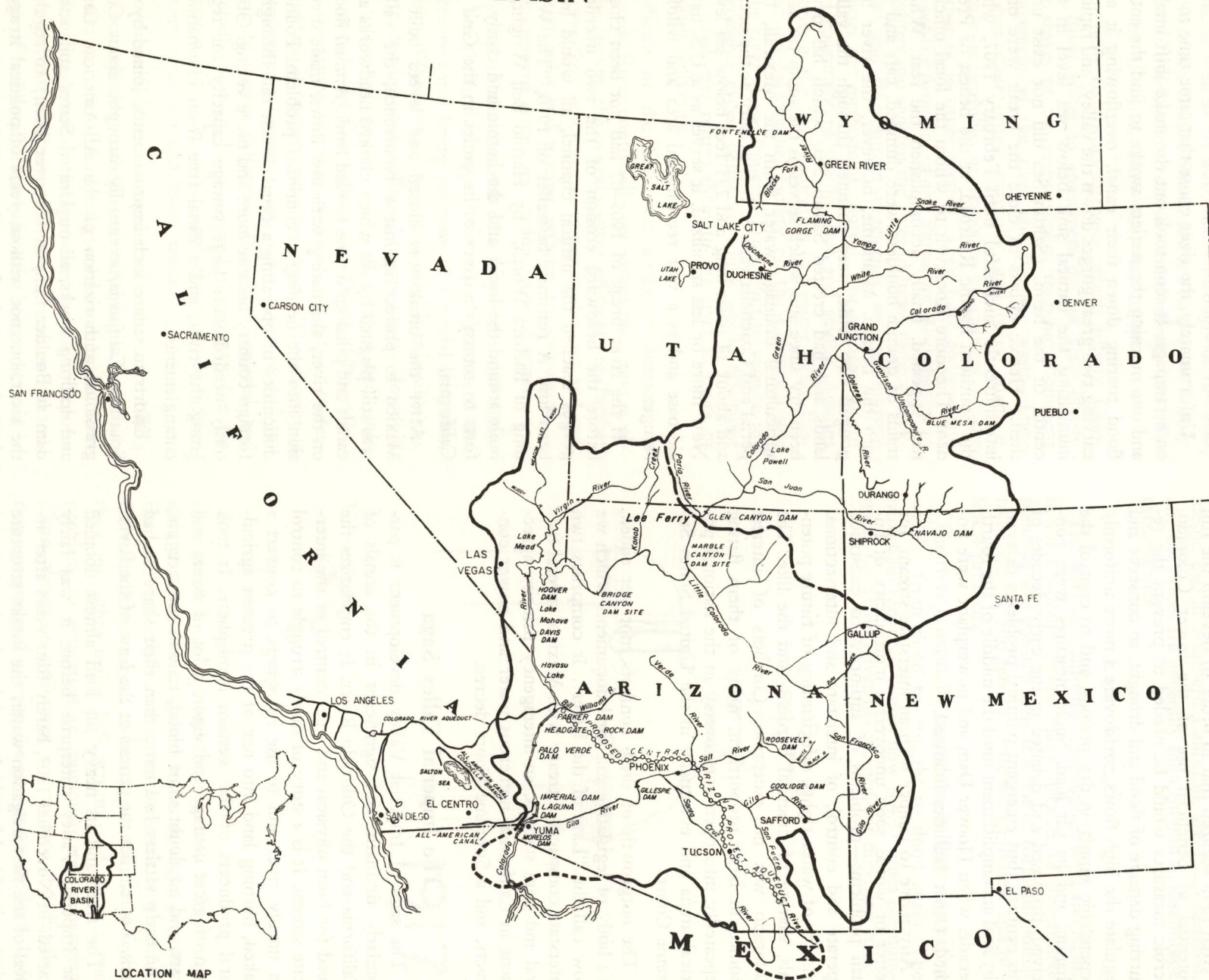
Unfortunately, the river chose that same time to go on a rampage. It soon took out the make-shift intake, and one morning the settlers awoke to find the entire flood roaring down their canal, overflowing it and carving two great gorges down the valley, and rapidly inundating the natural sink below sea level in the center of the basin. (Salton Sea did not exist until then.) Heroic efforts to close the break were only intermittently successful until February 1907, when the Southern Pacific Railroad, at the behest of President Theodore Roosevelt to whom the local officials had appealed, finally accomplished the feat. Whole trains of granite boulders were dumped, cars and all, into the breach. Meantime, however, the river had gouged two wide, deep channels through the valley lands and had created Salton Sea, which has never been dry since and which serves as the sump for salty agricultural drainage water from the Mexicali, Imperial and Coachella valleys. It is as salty as the ocean, and about 34 miles long and 235 feet below sea level. Now more or less stabilized, it serves as a U.S. naval air base and as a vast recreational area and wildlife refuge.

If the river break of 1905-07 had not been closed before the headward erosion of the two overflow gorges reached the natural channel, all would have been lost. A romantic bestseller of 1910, "The Winning of Barbara Worth," by Harold Bell Wright, is built around the break and the heroic and costly efforts to return the river to its outlet in the Gulf of California.

After the break was closed and levees built in Mexico to protect against a recurrence, the valley was still plagued by silt which choked headworks and canals and piled up on the leveled lands. Annual floods on the river, alternating with low flows, made diversion into the heading a continual problem. Political difficulties of operating a canal which ran through a foreign country became more and more vexing. Obviously needed were large storage capacity for regulating the river, and a canal free from international entanglements.

Efforts to secure such improvements, joined by all Southern California, eventually brought about Congressional authorization of the All-American Canal and desilting works, all on United States' soil, and a dam at Boulder Canyon (Hoover Dam) to regulate the river, but not without years of political struggle against strong criticism and opposition.

COLORADO RIVER BASIN



THE LAW OF THE RIVER

Colorado River Compact

California's rapid development and its plans for further development on the Colorado had raised such concern among the slower-starting states of the basin that an interstate agreement as to division of the waters of the river was necessary before the Boulder Canyon Project Act could become law. The resulting Colorado River Compact of 1922, although it did not apportion water among all the states as originally intended, did apportion water between the upper and lower parts of the Colorado River Basin, and thus to some extent insulated the upper states against unlimited expansion in the lower states. The dividing line between the sub-basins coincides with a natural geographic divide crossing the river at Lee Ferry, Arizona, near the southern boundary of Utah and upstream from the Grand Canyon.

Briefly, the Compact, Article III(a), apportions from the Colorado River and its tributaries to each of the Basins, Upper and Lower, the exclusive beneficial consumptive use of 7,500,000 acre-feet of water per annum. In addition, the Lower Basin is given the right, Article III(b), to increase its beneficial consumptive use by 1,000,000 acre-feet per annum. Unfortunately, the Compact negotiators, on the basis of records prior to 1922, overestimated the dependable flow of the river, and apportioned more water than it produces as a long-term average. Therein lies one of our major troubles now.

The Compact also provides, Article III(d), that the states of the Upper Division (Wyoming, Colorado, Utah and New Mexico) "will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years . . ."

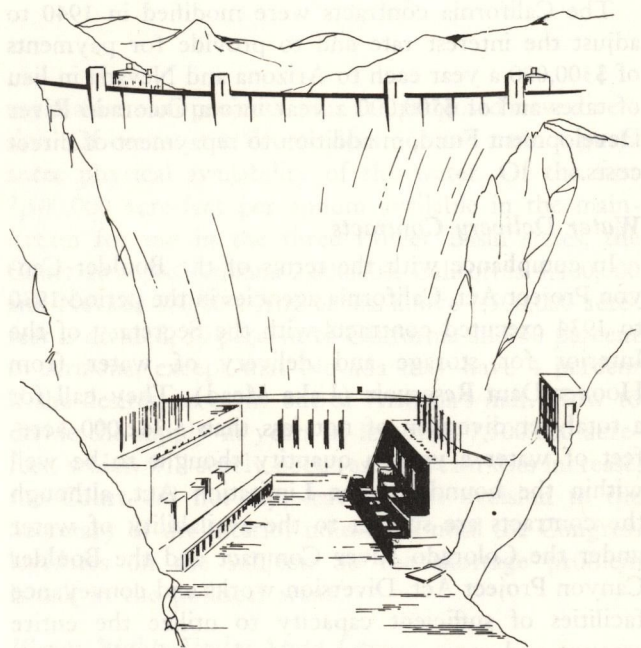
Six of the seven basin states ratified the Compact in 1923, but Arizona refused until 21 years later.

Boulder Canyon Project Act

Not until December 1928, six years after the negotiation of the Compact, did Congress adopt the Boulder Canyon Project Act authorizing construction of Hoover Dam and powerplant and of the All-American Canal to Imperial and Coachella Valleys. In view of Arizona's reluctance to ratify the Compact, the Congress finally waived that requirement, provided that California would adopt legislation, which it did, setting a limit on its use of Colorado River water (California Limitation Act). President Herbert Hoover on

June 25, 1929, declared the Boulder Canyon Project Act and the Colorado River Compact in effect. (Arizona ratified the Compact in 1944.)

The Project Act required as a prerequisite to the start of construction that the Secretary of the Interior, who was to build and operate the project, execute power and water contracts guaranteeing repayment of costs, and forbade anyone to use the stored water except by such contract, even though he held valid rights and was already using water. Section 4(a) authorized a compact to divide the Lower Basin's share of the Colorado River Compact apportionment of water use among Arizona, California and Nevada, but this the states have never been able to accomplish.



California Limitation Act

On March 4, 1929, the California legislature, as required by the Boulder Canyon Project Act, agreed that California's annual consumptive use of Colorado River water shall not exceed 4,400,000 acre-feet of the 7,500,000 acre-feet apportioned to the Lower Basin states by Article III(a) of the Colorado River Compact, plus "not more than one-half of any excess or surplus waters unapportioned by said compact . . ."

Hoover Dam Power Contracts

In 1930 the Secretary executed a contract under which the City of Los Angeles Department of Water and Power and the Southern California Edison Company became lessees of the Hoover powerplant, obligated to generate energy at cost to other allottees, of which The Metropolitan Water District of Southern California was the major one, under a separate energy purchase contract with the Secretary. Ultimately other California entities and the states of Arizona and Nevada contracted for the purchase of energy. The general effect of the 1930 contracts, however, was to obligate the California contractors for 100 percent of the firm energy. In essence, they underwrote the entire cost, since the Arizona and Nevada arrangements were on a "take or relinquish" basis. (See Appendix 1) Arizona and Nevada have since contracted for their shares, and now the great plant is a tremendous boon to the entire Southwest.

The California contracts were modified in 1940 to adjust the interest rate and to provide for payments of \$300,000 a year each to Arizona and Nevada in lieu of taxes and of \$500,000 a year into a Colorado River Development Fund, in addition to repayment of direct costs.

Water Delivery Contracts

In compliance with the terms of the Boulder Canyon Project Act, California agencies in the period 1930 to 1934 executed contracts with the Secretary of the Interior for storage and delivery of water from Hoover Dam Reservoir (Lake Mead). They call for a total net diversion of not less than 5,362,000 acre-feet of water a year, a quantity thought to be well within the bounds of the Limitation Act, although the contracts are subject to the availability of water under the Colorado River Compact and the Boulder Canyon Project Act. Diversion works and conveyance facilities of sufficient capacity to utilize the entire amount and more are constructed and in operation.

Seven-Party Agreement

Prior to execution of the water contracts and in response to a request by the Secretary, the California entities in 1931 agreed among themselves as to their relative priorities of right to Colorado River water. This seven-party priority agreement was made a part of each water delivery contract. The first three priorities go to the agricultural agencies, leaving The Metropolitan Water District relatively low on the scale, except for certain rights to water in Lake Mead accumulated to its credit by reason of reduced diversions.

Total of the first three is 3,850,000 acre-feet a year, leaving Metropolitan only 550,000 acre-feet of the 7,500,000 apportioned to the Lower Basin by the Compact, since California by its Limitation Act is held to only 4,400,000 acre-feet of that basic quantity. The remaining 662,000 acre-feet a year of Metropolitan's right, and any additional water for the agricultural agencies, must come from the "excess or surplus" referred to in the Project Act and Limitation Act. (See Appendix 2)

At the time the seven-party agreement was reached in 1931, it was generally believed that there would be ample "excess or surplus" water beyond the 4.4 million acre-feet basic quantity to provide the remaining 662,000 acre-feet of Metropolitan's contract amount, plus additional water for the agricultural agencies.

Mexican Water Treaty

For its last 75 miles, Colorado River flows through Mexico, and even before 1922 a considerable area of land south of the border was irrigated from the stream. Mexican officials watched with some apprehension the rapid rise in water use in the United States, and about 1940 began negotiations with this country as to an international division of the water.

In 1945 the Mexican Water Treaty was ratified, over the opposition of California and Nevada, guaranteeing Mexico 1,500,000 acre-feet a year of Colorado River water, twice as much as was anticipated in the United States prior to the negotiations. Because the Treaty guarantee is a first lien on the river, it creates a legal water shortage in the United States to be added to the natural shortage that has been developing since 1930 by reason of a drop in the natural flow of the Colorado.

A primary function of Davis Dam, completed on the Colorado by the United States in 1950, is to regulate the flows released from Hoover Dam into the delivery schedules set up under the terms of the Treaty.

Upper Colorado River Basin Compact

California is, of course, not signatory, but the Upper Colorado River Basin Compact is of interest because of the method used in it to divide water among the signatory states, because of some of its terms and definitions and because it is a part of the Law of the River. Although the interpretations of some terms and provisions adopted by the Upper Basin negotiators are contrary to views held in California, the negotiators expressly denied that the Upper Basin Compact alters, amends, modifies or repeals the Boulder Canyon Proj-

ect Act or the 1922 Colorado River Compact, or that it is binding upon or impairs the rights of any state not signatory to it.

The Upper Colorado River Basin Compact was entered into in 1948 by the states of Arizona, Colorado, New Mexico, Utah and Wyoming. It apportions 50,000 acre-feet a year to Arizona and divides the remainder of the Upper Basin's share of Colorado River System water in these percentages: Colorado, 51.75; New Mexico, 11.25; Utah, 23.00; and Wyoming, 14.00. Arizona, New Mexico and Utah have areas in both the Upper and Lower Basins as they are defined in the 1922 Compact.

Colorado River Storage Project Act

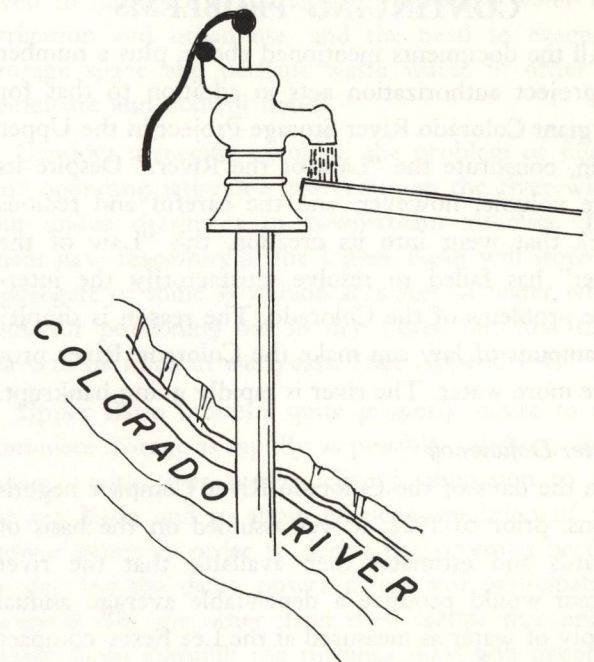
In 1956 the Congress enacted Public Law 84-485 authorizing major developments in the Upper Basin, consisting initially of four large storage units and eleven "participating" water-use projects (since increased in number). The participating projects, for irrigation and other purposes, share in the benefits of a basin fund deriving mostly from the sale of electric power generated at the storage units.

Because of many unanswered questions as to the potential effects of the Project upon the Lower Basin, California was constrained to oppose its authorization. Although the bill was passed and construction of the Project is far advanced, many of those fundamental interbasin issues remain unresolved. At California's insistence, however, the Act does direct the Secretary of the Interior in operation of the facilities to comply with all other documents in the Law of the River, including contracts entered into thereunder.

U. S. Supreme Court Decree in Arizona v. California

Failure of the three Lower Basin states to achieve agreement as to sharing the water, despite long years of negotiation and controversy, led finally to the Supreme Court suit filed by Arizona in 1952, known familiarly as Arizona v. California, et al. The filing was triggered by the refusal of a House of Representatives committee in 1951 to approve a bill to authorize federal construction of the Central Arizona Project, a proposal to pump more than a million acre-feet of water annually from the main river into the Phoenix area. California had opposed repeated attempts at project authorization, chiefly on the ground that the river would not supply that quantity of water permanently in addition to supplying the then existing uses and commitments.

The decree, handed down March 9, 1964, was favorable to Arizona, in confirming the right of the state to enough mainstream water to take care of her exist-



ing mainstream projects, plus the proposed new diversion. Of course, the decree does not and cannot guarantee physical availability of the water. Of the first 7,500,000 acre-feet per annum available in the mainstream for use in the three Lower Basin states, the Court awarded Arizona 2,800,000, California 4,400,000 and Nevada 300,000. Any excess above 7,500,000 acre-feet is divided, 50 percent to California and 50 percent to Arizona, except that Nevada may have 4 percent if she desires, to come out of Arizona's half. How to divide the supply in years of less than 7,500,000 acre-feet, which will surely occur as upstream uses increase, the Court did not say, leaving that decision to the Secretary of the Interior unless and until the Congress legislates on the subject. So the shortage problem is still in the political arena.

Water Rights Under State Law

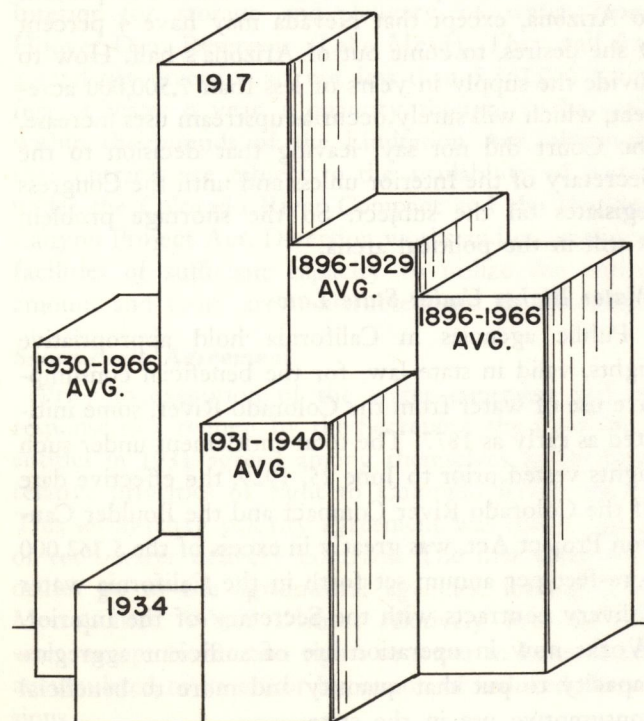
Public agencies in California hold appropriative rights, valid in state law, for the beneficial consumptive use of water from the Colorado River, some initiated as early as 1877. The total entitlement under such rights vested prior to June 25, 1929, the effective date of the Colorado River Compact and the Boulder Canyon Project Act, was greatly in excess of the 5,362,000 acre-feet per annum set forth in the California water delivery contracts with the Secretary of the Interior. Works now in operation are of sufficient aggregate capacity to put that quantity and more to beneficial consumptive use in the state.

CONTINUING PROBLEMS

All the documents mentioned above, plus a number of project authorization acts in addition to that for the giant Colorado River Storage Project in the Upper Basin, constitute the "Law of the River." Despite its large volume, however, and the careful and tedious work that went into its creation, this "Law of the River" has failed to resolve satisfactorily the interstate problems of the Colorado. The reason is simple: no amount of law can make the Colorado River produce more water. The river is rapidly going bankrupt.

Water Deficiency

In the days of the Colorado River Compact negotiations, prior to 1922, it was assumed on the basis of records and estimates then available that the river system would produce a dependable average annual supply of water as measured at the Lee Ferry compact point of at least 17 million acre-feet. Records made since 1922 have forced the hydrologists to lower their estimates drastically. Now they know that the long-time average, say since 1896, is scarcely 15 million acre-feet; that the average since Compact negotiations is a little less than 14 million; and that the average of the years since 1930 is only 13 million. (See Appendix 3)



These figures are in terms of undepleted flow at Lee Ferry, that is, the quantities that would flow past that point if there were no uses or storage accumulations upstream.

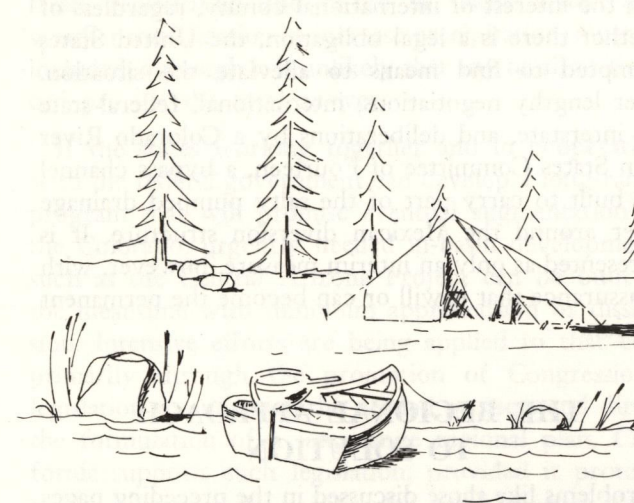
Nature has dealt the basin a foul blow. The river simply does not produce enough water to meet the needs. The growing deficiency cannot be overcome by better conservation, salvage and use or by more studies based solely on the known resources of the Colorado River System. More water must be found.

Since as early as 1945 California has repeatedly warned that the waters of the Colorado River System were in great danger of being overcommitted, and that additional developments should be authorized only after careful consideration of the water budget and only with proper safeguards for prior existing uses. Nevertheless, the pressure for new projects in other states continued, and controversy over the right to use of the water sharpened accordingly. California in self-protection and in order to alert the entire basin and the Congress to the oncoming water shortage was forced to oppose the authorization of new projects until the water budget of the entire basin could be more accurately evaluated and the riddle of apportionment of water among the states resolved. Despite California's crusade, more projects were authorized, and now the Colorado River System water supply definitely is overcommitted.

Still the pressure continues, and the competition for water increases, accompanied by competition for Congressional attention and for federal funds with which to build projects. More projects are being proposed in the Upper Basin as well as in Arizona; still more are being planned, and are indeed needed, to insure the economic well-being and growth which is in the interest of the entire nation. But before they all can function, more water must be added to the river.

Problems of River Management

Water needs of the public in this modern era are becoming greater and more diverse. In addition to the necessity for water for domestic, sanitation and industrial uses, for raising and processing essential foods and fibres, for air-conditioning and for generation of electric energy, the need for water-oriented recreational opportunity is great. In recent years the lower Colorado River has become a mecca for tens of thousands of people from Southern California and elsewhere



seeking sport and relaxation in hunting, fishing, swimming, boating, water-skiing, camping, picnicking, sight-seeing, bird-watching and like activities.

In a water-short river, conflicts are bound to arise even among the different interests and needs of the same people. For example, what's good for duck hunting, such as a lagoon, marsh or side channel, is not good for conservation of water. What's fine for water-skiing and boat racing, such as a straight clear channel, does not necessarily enhance fishing or sight-seeing.

The lower river channel is far from stable. The water is continually scouring out or depositing sediment, cutting banks or building bars, in ever-changing manner and place. Maintenance of a hydraulically efficient channel, to insure delivery of water to using agencies when and as ordered, demands constant attention and labor by the U.S. Bureau of Reclamation which manages the river and reservoirs, dredging and filling, building revetments and cutting through oxbows. Such activities are not always looked upon with favor by rod and gun clubs.

Of recent years proposals by the Bureau of Reclamation for large-scale endeavors to maintain and improve control of the river channel and to conserve water have roused acute controversy among the varied public interests, despite the fact that reservoirs and channel improvements already built have made the river much more delightful to humans, fish and wildlife than it was before it was brought under control.

In somewhat lesser degree, conflicts of interest are inherent in the operation of the reservoirs on the river, as among the need for high reservoir levels for power generation, resulting in high evaporation losses, the

need to minimize evaporation to conserve water for irrigation and urban use, and the need to evacuate storage space and perhaps waste water in order to anticipate and control floods.

Consider a specific example: the problem of filling and operating large new reservoirs on the river without undue detriment to downstream interests. The giant new reservoirs in the Upper Basin will store an aggregate of some 34 million acre-feet of water when full, for portioning out in dry years, but first they have to be filled in wet years. (See Appendix 4)

Upper Basin interests quite properly desire to accumulate storage as rapidly as possible, to insure compliance with their water delivery obligation to the Lower Basin and to attain efficient operation of the power plants in order to derive the revenues needed to pay for the dams, power plants and participating projects. On the other hand they realize that unless water flows through the turbines they will generate neither power nor revenues. Lower Basin interests, also quite properly, want water to keep flowing into Lake Mead, to maintain efficient operation of Hoover power plant and to insure adequate reserve storage of water for downstream use. In order to serve all these purposes, bountiful flows in the river would be needed for several years following initial closure of the new dams.

Foreseeing that the opposite could happen, the Colorado River Board of California and other Lower Basin interests urged the need of operating rules that would protect downstream users against the coincidence of a series of low runoff years with the time when the new reservoirs would be ready for filling. Several years of cooperative engineering study and negotiations by representatives of both basins and the Secretary of the Interior resulted in the 1962 promulgation by the Secretary of "General Principles to Govern, and Operating Criteria for, Glen Canyon Reservoir (Lake Powell) and Lake Mead During the Lake Powell Filling Period."

Those principles partially eased the situation but not entirely, mostly because low water yields persisted on the Colorado. Neither basin is wholly pleased although both sides try to be fair. The Secretary has exercised considerable leeway in application of the principles, as in 1964 when he modified them to permit draw-down of Lake Mead below the minimum level previously prescribed, in order to hasten the attainment of power head at Glen Canyon.

Water Quality Problems

The problem of water quality is interrelated with and equal in importance to the problem of water quantity in the development and use of Colorado River. Of particular concern to California is the dissolved mineral content (salinity) of the water. Salinity in water is of large economic importance in most types of water use including irrigated agriculture. Generally speaking, commercial crops are not tolerant of heavy concentrations of dissolved minerals either in the soils or in the irrigation water. Excess water must be applied to the fields in order to force through the soils and drain away as much salt as is carried onto the fields by the irrigation water, or more for good measure—hence the term “salt balance.”

California agriculture is particularly vulnerable on this score, because it is at the lower end of the 1400-mile river which because of many diversions and uses of water, accompanied by returns of excess diversions and drainage, becomes progressively saltier as it flows from its headwaters to the sea. The already mineralized lower river will become more saline in the future as upstream irrigation activities increase. As it does, more water will have to be applied to the same unit of land in the lower river area in order to maintain salt balance and achieve the same rate of crop production.

Troublesome legal questions are involved in the matter of water quality, questions which are bound with interstate and even international relations.

The Federal Water Quality Act of 1965 (PL 89-234) provides for establishment and enforcement of water quality standards for such interstate waters as the Colorado River System. It provides that if the states do not do this, the federal government will. States of the Colorado River Basin in general deem it advisable that they work together to find as large an area of agreement as they can, within which each state may then establish more specific criteria to apply to those portions of the stream system within or along its boundaries. This is not an easy task. Inevitably some points will be found upon which seven-state accord will be difficult if not impossible.

On the international front, sharp controversy with Mexico arose in 1961 when an Arizona project began pumping highly saline water from its underground basin into Colorado River, to mingle with the surface water in the stream at the boundary. Violent protests were forthcoming immediately from south of the border.

In the interest of international comity, regardless of whether there is a legal obligation, the United States attempted to find means to alleviate the situation. After lengthy negotiations, international, federal-state and interstate, and deliberations by a Colorado River Basin States Committee of Fourteen, a bypass channel was built to carry part of the salty pumped drainage water around the Mexican diversion structure. It is represented as only an interim measure, however, with no assurance that it will or can become the permanent solution.

THE REGIONAL APPROACH TO SOLUTION

Problems like those discussed in the preceding pages will always be with us. None will resolve itself, and probably few can be resolved to perfection by even the most diligent efforts of the experts, because of differing needs and views and of changing conditions and techniques. Nevertheless efforts must continue.

If the Colorado were a bounteous river the task would be simpler, but that isn't the case. The deficiency of water, hence the intensity of the difficulties, will increase as the population and economy of the Southwest grow.

Since the date of the Supreme Court decision in *Arizona v. California*, a spirit of interstate cooperation has begun to replace controversy on the Colorado. That spirit must be fostered. In all the basin states, major interests are now convinced of the futility of fighting over water shortages, and of the necessity of adopting together a regional program to augment the water supply of the entire Southwest, particularly the Colorado, for the assurance of an additional supply offers the only real hope of an enduring solution to some of the problems.

Augmentation of the flow of the Colorado would benefit the entire basin. It would swing the pendulum of interstate relations back from the vexing difficulty of sharing water shortages to the more pleasant prospect of dividing wet water. Furthermore, water from a purer source commingled with the native water of the river would alleviate problems associated with the poor chemical quality of the lower Colorado.

Obviously then, one of the key considerations is an inventory of all alternative sources of water supply to determine where there is surplus water that could be used to augment the overcommitted Colorado without detriment to areas of surplus, now or in the future. Possibilities of economical conversion of sea water to

fresh, reclamation and re-use of waste water, and weather modification to increase precipitation, must be included, although it is unlikely that any or all of these can provide the total answer.

If the states working together and in cooperation with the federal government can develop a long-range program that will promise eventual augmentation of the Colorado, urgently needed in-basin developments such as the Central Arizona Project can be built in the meantime with minimum apprehension or dissension. Intensive efforts are being applied to that end, primarily through the promotion of Congressional legislation to authorize the needed projects and direct the formulation of a long-range regional plan. California supports such legislation, provided it protects to the extent legally possible the state's existing Colorado River projects as against new in-basin projects and provided it initiates meaningful steps toward water augmentation.

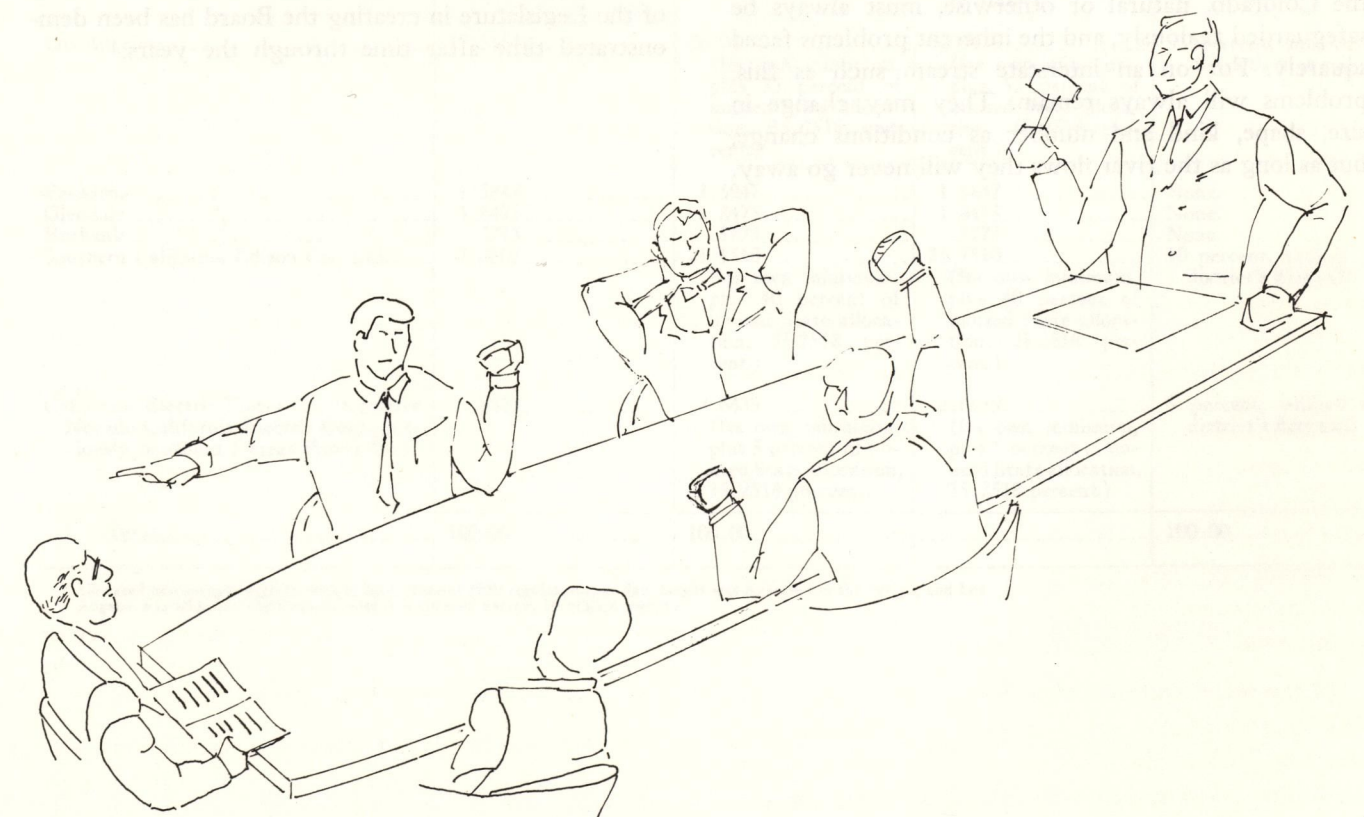
The search for additional water must cover broad horizons, both conceptually and geographically. It must envision the possibility of huge man-made rivers

carrying water over long distances from water-rich areas to water-poor areas like the Colorado River Basin and the Southwest. Not years but decades are required to plan such endeavors, to allay parochial fears and reach agreement, secure authorization, arrange financing, and to design and construct facilities.

The concept involves the entire West; it transcends political boundaries. Indeed it is now generally recognized that coordinated water planning among all the western states is essential to the sound economic growth of the area as a whole.

Accordingly the governors of eleven western states including California in 1965 directed the organization of the Western States Water Council, comprising representatives of the seven Colorado River Basin states and the four Pacific Northwest states, to foster the solution of water problems on a west-wide basis.

No one can be so naive as to think that the regional approach to water resource development will end all intersectional problems, but there is increasing awareness that a cooperative regional approach will be a vast improvement over the piecemeal sectional approach of the past.



THE COLORADO IN CALIFORNIA'S FUTURE

The Colorado will always be of vital importance to California. It now furnishes about 20 percent of the supply used in the entire state, and about 80 percent of the quantity used south of the Tehachapis. Although the requirements of Southern California will mushroom, and although the natural supply of the river available to California may be diminished by new uses in other states, the Colorado will still meet a large portion of the area's water requirements for decades to come.

The Colorado is the only presently feasible source of water for irrigation of the desert areas, Imperial, Coachella, Palo Verde and Yuma valleys, where such enormous quantities of our nation's food and fiber are grown. It is the basis for the investment of \$200 million by the citizens of the Southern California coastal plain in The Metropolitan Water District's Colorado River Aqueduct, an investment they should not be asked to write off. They cannot afford to have the aqueduct go dry.

California's interests in and rights to the waters of the Colorado, natural or otherwise, must always be safeguarded zealously, and the inherent problems faced squarely. For on an interstate stream such as this, problems will always remain. They may change in size, shape, kind and number as conditions change, but as long as the river flows they will never go away.

THE COLORADO RIVER BOARD

During the second and third decades of this century several committees, commissions or similar bodies were established at various times in California to deal with Colorado River matters, but always on a temporary basis. With the rapid growth of the economy and the increase in developments on the river, the number of interstate problems grew and their complexity increased. As the burden of protecting California's interests became more pressing and its continuous character more clear, the necessity of a state agency to exercise continuous and comprehensive jurisdiction over the problems of the river became evident. It was recognized that the problems in the future would be too vast and complicated to be handled by interim bodies or by volunteer and perhaps uncoordinated action. Accordingly, the Legislature in 1937 created the Colorado River Board of California. Similar or counterpart agencies exist in all the other basin states.

Since its creation the Board has maintained, with the essential aid of the executive and legislative departments of the state, the cohesion among California interests which is indispensable to dealing with interstate and foreign relations with a united front. The wisdom of the Legislature in creating the Board has been demonstrated time after time through the years.

APPENDIX No. 1 ALLOCATION OF HOOVER DAM ENERGY UNDER REGULATIONS OF MAY 20, 1941 *

Allottee	Firm energy (4,330,000,000 kilowatt-hours per year, diminishing 8,760,000 kilowatt-hours per year)			Secondary energy (percentage)
	Minimum which United States must supply (percentage)	Allottee's obligation if energy is available (percentage)	Maximum which allottee may demand under various conditions (percentage)	
Arizona-----	17.6259-----	None-----	21.5428-----	None.
Nevada-----	17.6259----- (To each State for use in the State only.)	None----- (Each State has the option to take and relinquish energy on specified notice.)	21.5428----- (To each State its own allocation plus 3.9169 percent not taken by the other State prior to Apr. 26, 1950; the total for both States not to exceed 35.2518 percent.)	None.
Metropolitan Water District-----	35.2517----- (For pumping Colorado River water into and in its aqueduct.)	35.2517-----	70.5035----- (Its own minimum, plus first call on unused energy allotted to States.)	First call on all secondary energy.
Los Angeles-----	17.5554-----	36.9439----- (Its own minimum, plus 55 percent of unused State allocation, 35.2518 percent.)	36.9439----- (Its own minimum, plus 55 percent of unused State allocation, 35.2518 percent.)	55 percent, subject to district's first call.
Pasadena-----	1.5847-----	1.5847-----	1.5847-----	None.
Glendale-----	1.8475-----	1.8475-----	1.8475-----	None.
Burbank-----	.5773-----	.5773-----	.5773-----	None.
Southern California Edison Co., Ltd.-----	7.0503-----	21.1510----- (Its own minimum, plus 40 percent of unused State allocation, 35.2518 percent.)	21.1510----- (Its own minimum, plus 40 percent of unused State allocation, 35.2518 percent.)	40 percent, subject to district's first call.
California Electric Power Co. (formerly Nevada-California Electric Corp., previously Southern Sierras Power Co.)-----	.8813-----	2.6439----- (Its own minimum, plus 5 percent of unused State allocation, 35.2518 percent.)	2.6439----- (Its own minimum, plus 5 percent of unused State allocation, 35.2518 percent.)	5 percent, subject to district's first call.
Total-----	100.00-----	100.00-----	-----	100.00

* Allocated percentages slightly revised from those of 1930 regulations, as dam height was increased in the design, and Los Angeles was allocated the total increase in estimated energy, 90 million kwh/yr.