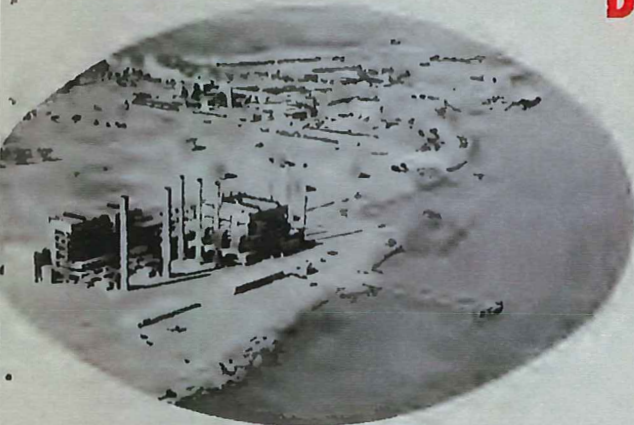


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Preliminary Edition



Bulletin No. 76

DELTA WATER FACILITIES



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EDMUND G. BROWN
Governor
State of California



December, 1960

HARVEY O. BANKS
Director
Department of Water Resources



STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

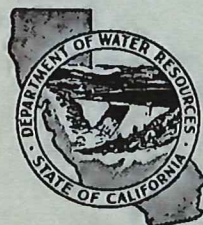
Bulletin No. 76

REPORT TO THE
CALIFORNIA STATE LEGISLATURE
ON THE

DELTA WATER FACILITIES

AS AN INTEGRAL FEATURE OF
THE STATE WATER RESOURCES DEVELOPMENT SYSTEM

EDMUND G. BROWN
Governor



HARVEY O. BANKS
Director

December, 1960

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Letters

HARVEY O. BANKS
DIRECTOREDMUND G. BROWN
GOVERNORADDRESS REPLY TO
P. O. BOX 946 SACRAMENTO 2
1112 N STREET MICHAEL B 4711STATE OF CALIFORNIA
Department of Water Resources
SACRAMENTO

December 30, 1960

Honorable Edmund G. Brown, Governor
Members of the Legislature of the
State of California

Gentlemen:

I have the honor to transmit herewith a preliminary edition of Bulletin No. 76, "Delta Water Facilities". This bulletin summarizes the results of investigations conducted pursuant to the Abshire-Kelly Salinity Control Barrier Act of 1955 and 1957, Chapter 1434, Statutes of 1955, and Chapter 2092, Statutes of 1957, as amended by Chapters 1765 and 2038, Statutes of 1959.

Bulletin No. 76 presents findings and conclusions regarding the feasibility of alternative plans for the Delta feature of the State Water Facilities included in the Burns-Porter Act approved by the electorate on November 8, 1960. The Delta water facilities would (1) provide adequate water supplies throughout the Delta, (2) transport water across the Delta without undue loss or deterioration in quality, (3) provide flood and seepage control to Delta islands, (4) provide improved vehicular transportation access, and (5) minimize effects on existing recreation development and enhance recreation growth. All of the alternative plans would accomplish the first two objectives, and two alternative plans would also accomplish the other objectives.

Further planning for Delta water facilities should include consideration of joint financing and construction by federal, state and local interests. Facilities for flood and seepage control, vehicular transportation and recreation would not have to be constructed unless local governmental agencies desire these works and are willing to share in certain costs thereof. There would be some conflicts of interest in operation of these facilities which must be resolved prior to a decision by local interests regarding the extent of local participation. To this end, it is recommended that a period of a few months be allowed for local review and resolution of differences, after which public hearings should be held by the California Water Commission and the department. Following the public hearings, a final edition of Bulletin No. 76, incorporating any necessary modifications, should be published.

Very truly yours,

HARVEY O. BANKS
Director

BOARD OF CONSULTING ENGINEERS

November 16, 1960

Mr. Harvey O. Banks, Director
Department of Water Resources
Sacramento, California

Dear Mr. Banks:

This Board of Consulting Engineers which was active in 1958 was reconvened in April, 1960 and has met from time to time with your staff. Thus we have followed the preparation of this report and have commented to you following each meeting.

The Delta Water Facilities constitute needed works vital to the transfer of northero water into and across the Delta to provide water for use in the Delta and for export to water deficient areas along the Coast, in the San Joaquin Valley and to Southern California, to be financed under the California Water Resources Development Bond Act. The Board is of the opinion that the gross future water requirements for municipal and industrial purposes in the Delta have been very liberally estimated.

The Board is of the opinion that the engineering studies, designs and estimates are adequate for the purpose of this planning report and we support the conclusions and recommendations embodied therein.

We believe that the Chipps Island Barrier Project should not be authorized or constructed owing to its high cost of nearly \$200 million which substantially exceeds project benefits.

The Delta Water Project, including such economically desirable flood control, seepage control, transportation and recreational features as may be agreed upon by local Delta beneficiaries willing to share in costs, would meet all water requirements with maximum net project benefits, and should be constructed under the Bond Act.

Respectfully submitted,

H. A. Einstein

H. A. Einstein

O. C. Porter

O. C. Porter

Ray K. Lineley

Ray K. Lineley

Samuel B. Morris, Chairman

Samuel B. Morris, Chairman

Preface

This bulletin summarizes the engineering and economic conclusions and recommendations concerning the feasibility of providing salinity control, water supply, flood and seepage control, transportation facilities, and recreation development for the Sacramento-San Joaquin Delta, and conserving and making the most beneficial use of a major portion of the water resources of the State. Alternative plans for accomplishing some or all of these objectives are presented and compared to indicate their relative merits and to guide the selection of facilities to be constructed.

Findings presented herein are the result of intensive studies conducted during a five-year period. Previous studies and cooperative investigations by various public and private agencies and individuals were utilized in development of the plans. The cooperation of these individuals and agencies is gratefully acknowledged.

Study procedures and analyses are summarized in six supporting office reports, which are available to interested agencies and individuals. The subjects and titles of these reports are:

- Salinity Incursion and Water Resources
- Delta Water Requirements
- Channel Hydraulics and Flood Channel Design
- Recreation
- Plans, Designs, and Cost Estimates
- Economic Aspects

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Salinity Control Studies

1879-1880, WM. HAM. HALL

Salinity incursion into the Delta, which was recorded in 1841 and 1871, was recognized by the early settlers as a potential problem to water supplies, and a salt water barrier was proposed in the 1860's. State Engineer Wm. Ham. Hall subsequently studied a barrier in conjunction with flood control and concluded that, while a physical barrier could be constructed, the costs would exceed the benefits.

1924-1928, WALKER YOUNG INVESTIGATION

A series of subnormal water supply years began in 1917 and various proposals for barriers were advanced during the early 1920's. In cooperation with the State of California and the Sacramento Valley Development Association, the U. S. Bureau of Reclamation, under the direction of Walker Young, extensively investigated four alternative barrier sites and concluded that it was ". . . physically feasible to construct a Salt Water Barrier at any one of the sites investigated . . ." It was recognized that without a barrier, ". . . salinity conditions will become more acute unless mountain storage is provided to be released during periods of low river discharge . . ." Economic analyses of barriers were not made by Mr. Young.

1929-1931, BULLETINS NOS. 27 AND 28

Following investigation of the physical feasibility of barriers, the State Division of Water Resources studied the phenomena of salinity incursion and the economics of barriers. In Bulletin No. 27, "Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay," it was concluded that ". . . invasion of salinity . . . as far as the lower end of the . . . Delta is a natural phenomenon which, in varying degree, has occurred each year as far back as historical records reveal." It was also concluded that the Delta could be protected from saline invasion and be assured of ample and dependable water supplies if mountain storage were utilized to provide a controlled rate of outflow from the Delta.

In Bulletin No. 28, "Economic Aspects of a Salt Water Barrier," it was concluded that it was not economically justifiable to construct a barrier. With conditions of upstream water use at that time, it was concluded that the most economical solution to salinity incursion and provision of adequate water supplies in the Delta could be achieved by constructing upstream storage and controlling rates of outflow during periods of insufficient natural outflow.

1953, ABSHIRE-KELLY SALINITY CONTROL BARRIER ACT

Shasta Reservoir on the Sacramento River was constructed and began operation in 1944 for salinity control and other purposes. Expanding water requirements in the Central Valley and San Francisco Bay area stimulated reconsideration of barrier plans for water conservation and related purposes. Seven alternative plans for barriers in the Bay and Delta system were investigated by a Board of Consultants and the State Division of Water Resources for the California Water Project Authority. The Board of Consultants concluded that barriers in the San Francisco Bay system would not be functionally feasible due to the uncertainty of the quality of water in a barrier pool. It was recommended by the Division of Water Resources that "Further consideration be given only to . . . barriers . . . at or upstream from the Chipps Island site" at the outlet of the Delta.

1955, ABSHIRE-KELLY SALINITY CONTROL BARRIER ACT

Additional legislation specified study of a system of works in the Delta, referred to as the Junction Point Barrier Plan, and the Chipps Island Barrier Plan. The principal purposes of these studies were to develop complete plans for water supply in the San Francisco Bay area and to provide salinity control and urgently needed flood protection in the Delta.

CHAPTER 1434

An act to provide for a study of the junction point barrier and appurtenant facilities, the Abshire-Kelly Salinity Control Barrier Act of 1955, relating to barriers for salinity and flood control purposes, declaring the urgency thereof, to take effect immediately.

[Approved by Governor June 27, 1955. Filed with Secretary of State June 28, 1955.]

The people of the State of California do enact as follows:

SECTION 1. There is hereby appropriated to the Water Project Authority the sum of one hundred thousand dollars (\$100,000), payable from the Flood Control Fund of 1946, to initiate the further investigation and study of the Junction Point Barrier and Chipps Island Barrier and appurtenant facilities, as such barriers and facilities are described in the report of the Water Project Authority to the Legislature entitled "Feasibility of Construction by the State of Barriers in the San Francisco Bay System," dated March, 1955, for the purposes of developing complete plans of the means of accomplishing delivery of fresh water to the San Francisco Bay area, including the Counties of Solano, Sonoma, Napa, Marin, Contra Costa, Alameda, Santa Clara, San Benito, and San Mateo, and the City and County of San Francisco, providing urgently needed flood protection to agricultural lands in the Sacramento-San Joaquin Delta, conducting subsurface exploration work in the delta and designing facilities appurtenant to the cross-delta aqueduct, obtaining more complete information on the hydrology of the delta, and studying integration of the proposed project in the California Water Plan.

SEC. 2. The Water Project Authority may contract with such other public agencies, federal, state, or local, as it deems necessary for the rendition and affording of such services, facilities, studies, and reports to the Water Project Authority as will best assist it to carry out this act. The Water Project Authority may also employ, by contract or otherwise, such private consulting engineering and other technical services as it deems necessary for the rendition and affording of such services, facilities, studies, and reports as will best assist it to carry out this act.

SEC. 3. It is the intent of the Legislature that in conducting the study and investigation the Water Project Authority shall confer and exchange information with and shall seek the participation of the United States Navy, the United States Bureau of Reclamation, the United States Corps of Engineers and the local port districts to the extent possible.

SEC. 4. The Water Project Authority shall report to the Legislature the result of its study and investigation not later than March 30, 1957.

SEC. 5. This act shall be known and may be cited as the Abshire-Kelly Salinity Control Barrier Act of 1955.

SEC. 6. This act is an urgency measure necessary for the immediate preservation of the public peace, health or safety within the meaning of Article IV of the Constitution and shall go into immediate effect. The facts constituting such necessity are:

The areas adjacent to the San Francisco Bay urgently need an adequate supply of fresh water for domestic and industrial uses. It is essential to the public health, safety and welfare that a study of salinity control barriers as a means of securing such a supply of fresh water, be undertaken without delay.

A four-year investigation was contemplated, and an interim report, Bulletin No. 60, "Salinity Control Barrier Investigation", was published in March 1957, by the Department of Water Resources. This report outlined a water plan for the San Francisco Bay area, and recommended that the North Bay Aqueduct be authorized for construction. The North Bay Aqueduct was authorized by the Legislature in 1957. The report also compared the Biemond Plan, a system of works in the Delta, with the Chipps Island Barrier Plan, and recommended that further study be limited to the Biemond Plan.

1957, ABSHIRE-KELLY SALINITY CONTROL BARRIER ACT

The Legislature concurred in limiting further study to the Biemond Plan and stressed the need for improving the quality of water in the Delta and making the most beneficial use of the water resources of the State. A report on the further studies was scheduled for release by March 30, 1959.

CHAPTER 2092

An act relating to barriers for salinity and flood control purposes.

[Approved by Governor July 8, 1957. Filed with Secretary of State July 10, 1957.]

The people of the State of California do enact as follows:

SECTION 1. The Department of Water Resources may limit its studies of salinity control barriers to the Biemond Plan as described in Bulletin No. 60 of the Department of Water Resources entitled "Salinity Control Barrier Investigation," dated March, 1957, subject to such modifications thereof as the department may adopt, said studies being for the purposes of developing complete plans of the means of accomplishing delivery of fresh water to the Counties of Solano, Sonoma, Napa

and Marin, providing urgently needed flood protection to agricultural lands in the Sacramento-San Joaquin Delta, accomplishing salinity control, improving the quality of water exported from the delta to the San Francisco Bay area, San Joaquin Valley, and southern portions of California, making the most beneficial use of the water resources of the State, and studying integration of the proposed project in The California Water Plan.

SEC. 2. The department may contract with such other public agencies, federal, state or local, as it deems necessary for the rendition and affording of such services, facilities, studies, and reports to the department as will best assist it to carry out this act.

SEC. 3. It is the intent of the Legislature that in conducting the study and investigation the department shall confer and exchange information with and shall seek the participation of the United States Navy, the United States Bureau of Reclamation, the United States Corps of Engineers, and the local port districts to the extent possible.

SEC. 4. The department shall submit a report to the Legislature stating the result of its study and investigation not later than March 30, 1959.

SEC. 5. This act shall be known and may be cited as the "Abshire-Kelly Salinity Control Barrier Act of 1957."

1959, ADDITIONAL LEGISLATION

The potential expansion of water requirements of the urban and industrial complex in the western Delta area, and greater upstream water use with resultant depletion of inflow to and outflow from the Delta, indicated need for more concentrated study of the water requirements and supplies of the Delta. Legislation was enacted in 1959 to undertake studies of the type and extent of future water requirements of lands which can be served from present channels in the western Delta, effects of upstream water uses on Delta supplies, plans for water service and costs thereof, and economic and financial feasibility of the plans. Additional legislation authorized studies of the most economical and efficient procedures of constructing levees for flood control.

CHAPTER 1765

An act providing for the investigation of water supplies and flood control levees for the Sacramento-San Joaquin Delta and making an appropriation therefor.

[Approved by Governor July 10, 1959. Filed with Secretary of State July 13, 1959.]

The people of the State of California do enact as follows:

SECTION 1. The Department of Water Resources shall investigate the water supplies for the Sacramento-San Joaquin Delta. The investigation shall include, among other things: (1) the type and extent of the future water requirements of lands which can be served from present channels in the western Delta; (2) the extent and nature of effects of upstream water developments on water supply available to such lands; (3) the development of plans for water service to such lands and estimates of costs thereof; and (4) economic and financial analyses of such plans. In carrying out the investigation, the department shall seek the co-operation and assistance of the counties and other local agencies and entities in the Sacramento-San Joaquin Delta and of the United States; may enter into contracts with such entities to assist it in carrying out the purposes of such investigation, and shall consult with and keep appropriate legislative committees informed of the progress of this work.

Sec. 2. There is appropriated from the California Water Fund to the Department of Water Resources the sum of two hundred thousand dollars (\$200,000) to be expended for the purposes of this act.

Sec. 3. Section 4.5 is added to the Atshire-Kelly Salinity Control Barrier Act of 1957 (Chapter 2092, Statutes of 1957), to read:

Sec. 4.5. As a part of the studies being performed hereunder and to obtain such information as may be required to implement the plan included in the report referred to in Section 4, the department may conduct studies and investigations to determine the most economical and efficient type and methods and procedures of construction to provide an adequate levee system in the Delta.

Sec. 4. There is hereby appropriated to the Department of Water Resources from the California Water Fund the sum of two hundred thirty thousand dollars (\$230,000), of which one hundred eighty thousand dollars (\$180,000), may be expended for the studies and investigations authorized by Section 3 hereof, and fifty thousand dollars (\$50,000) may be expended for such remedial work as may be necessary in connection with levee tests being performed as a part of the studies and investigations authorized by Section 3 hereof.

Intensive studies were made of the future economic growth of lands which can be served from channels in the western Delta. Particular attention was given to the future municipal and industrial water needs in the area and the future water supplies available in the Delta. Due to the expanded scope of the studies, the report was delayed.

CHAPTER 2038

An act to amend Section 4 of Chapter 2092, Statutes of 1957, relating to barriers for salinity and flood control purposes.

[Approved by Governor July 17, 1959. Filed with Secretary of State July 20, 1959.]

The people of the State of California do enact as follows:

SECTION 1. Section 4 of Chapter 2092, Statutes of 1957, is amended to read:

Sec. 4. The department shall submit a report to the Legislature stating the result of its study and investigation not later than January 2, 1961.

The unique character of the water supply problems of the Delta was recognized by the State Legislature when it amended the California Water Code in 1959 to include general policy regarding the Delta. This legislation calls for provision of salinity control and adequate water supplies in the Delta and states that water to which the users within the Delta are entitled should not be exported. The policy in this act is basic to the planning and operation of all works in the Delta or diversions therefrom.

CHAPTER 1766

An act to add Part 4.5 (commencing at Section 12200) to Division 6 of the Water Code, relating to delivery of surplus water into, and extractions thereof for exportation from, the Sacramento-San Joaquin Delta.

[Approved by Governor July 10, 1959. Filed with Secretary of State July 13, 1959.]

The people of the State of California do enact as follows:

SECTION 1. Part 4.5 (commencing at Section 12200) is added to Division 6 of the Water Code, to read:

PART 4.5. SACRAMENTO-SAN JOAQUIN DELTA

CHAPTER 1. GENERAL POLICY

12200. The Legislature hereby finds that the water problems of the Sacramento-San Joaquin Delta are unique within the State; the Sacramento and San Joaquin Rivers join at the Sacramento-San Joaquin Delta to discharge their fresh water flows into Suisun, San Pablo and San Francisco Bays and thence into the Pacific Ocean; the merging of fresh water with saline bay waters and drainage waters and the withdrawal of fresh water for beneficial uses creates an acute problem of salinity intrusion into the vast network of channels

SDWA 253
and sloughs of the Delta; the State Water Resources Development System has as one of its objectives the transfer of waters from water-surplus areas in the Sacramento Valley and the north coastal area to water-deficient areas to the south and west of the Sacramento-San Joaquin Delta via the Delta; water surplus to the needs of the areas in which it originates is gathered in the Delta and thereby provides a common source of fresh water supply for water-deficient areas. It is, therefore, hereby declared that a general law cannot be made applicable to said Delta and that the enactment of this law is necessary for the protection, conservation, development, control and use of the waters in the Delta for the public good.

12201. The Legislature finds that the maintenance of an adequate water supply in the Delta sufficient to maintain and expand agriculture, industry, urban, and recreational development in the Delta area as set forth in Section 12220, Chapter 2, of this part, and to provide a common source of fresh water for export to areas of water deficiency is necessary to the peace, health, safety and welfare of the people of the State, except that delivery of such water shall be subject to the provisions of Section 10505 and Sections 11460 to 11463, inclusive, of this code.

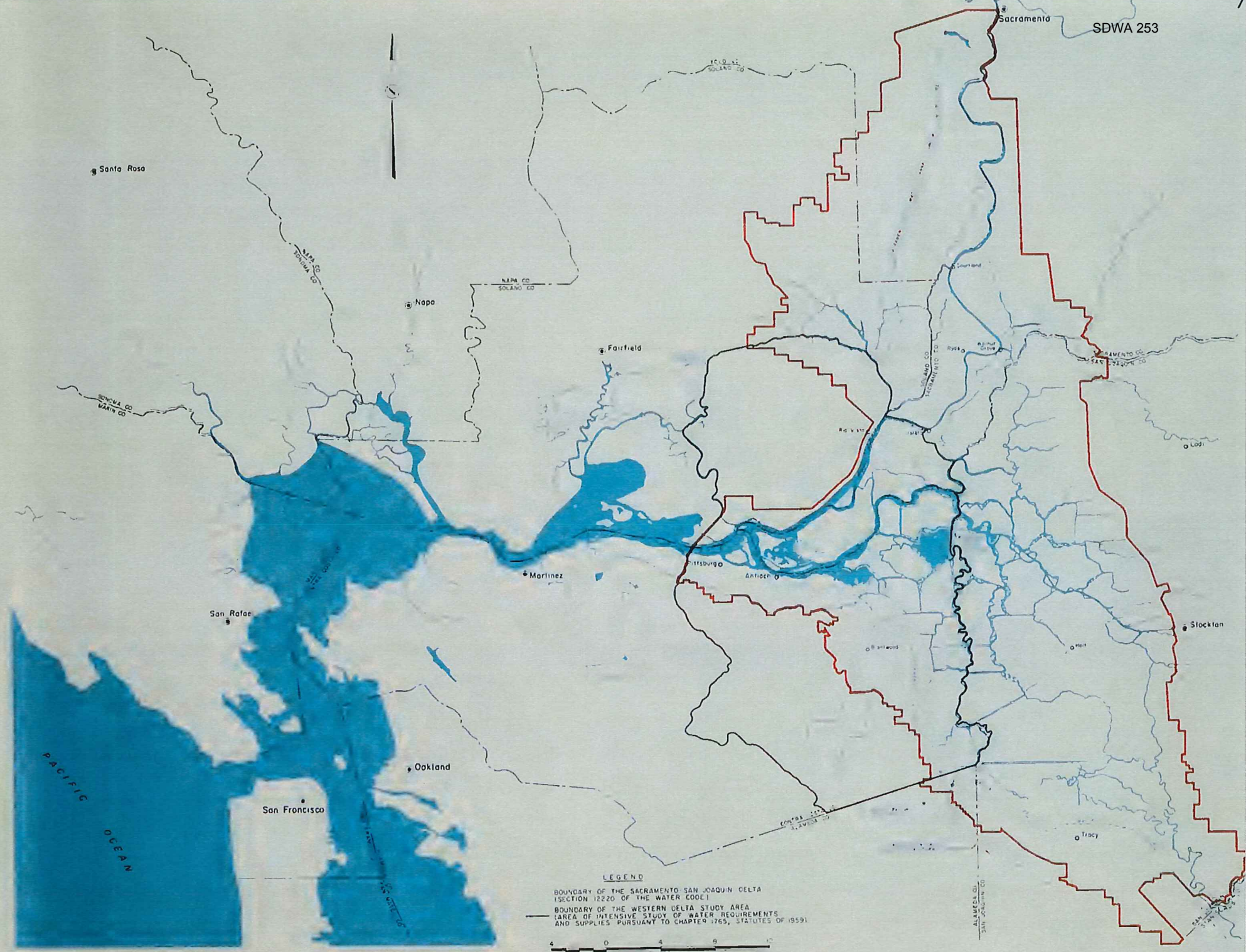
12202. Among the functions to be provided by the State Water Resources Development System, in coordination with the activities of the United States in providing salinity control for the Delta through operation of the Federal Central Valley Project, shall be the provision of salinity control and an adequate water supply for the users of water in the Sacramento-San Joaquin Delta. If it is determined to be in the public interest to provide a substitute water supply to the users in said Delta in lieu of that which would be provided as a result of salinity control no added financial burden shall be placed upon said Delta water users solely by virtue of such substitution. Delivery of said substitute water supply shall be subject to the provisions of Section 10505 and Sections 11460 to 11463, inclusive, of this code.

12203. It is hereby declared to be the policy of the State that no person, corporation or public or private agency or the State or the United States should divert water from the channels of the Sacramento-San Joaquin Delta to which the users within said Delta are entitled.

12204. In determining the availability of water for export from the Sacramento-San Joaquin Delta no water shall be exported which is necessary to meet the requirements of Sections 12202 and 12203 of this chapter.

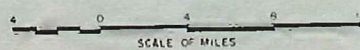
12205. It is the policy of the State that the operation and management of releases from storage into the Sacramento-San Joaquin Delta of water for use outside the area in which such water originates shall be integrated to the maximum extent possible in order to permit the fulfillment of the objectives of this part.

This legislation also described the area of the Delta to which the general policy applies. The boundary of the Delta, as described in Section 12220 of the Water Code, is indicated on the facing map. The area considered in the intensive studies of water requirements and supplies is described as the Western Delta Study Area.

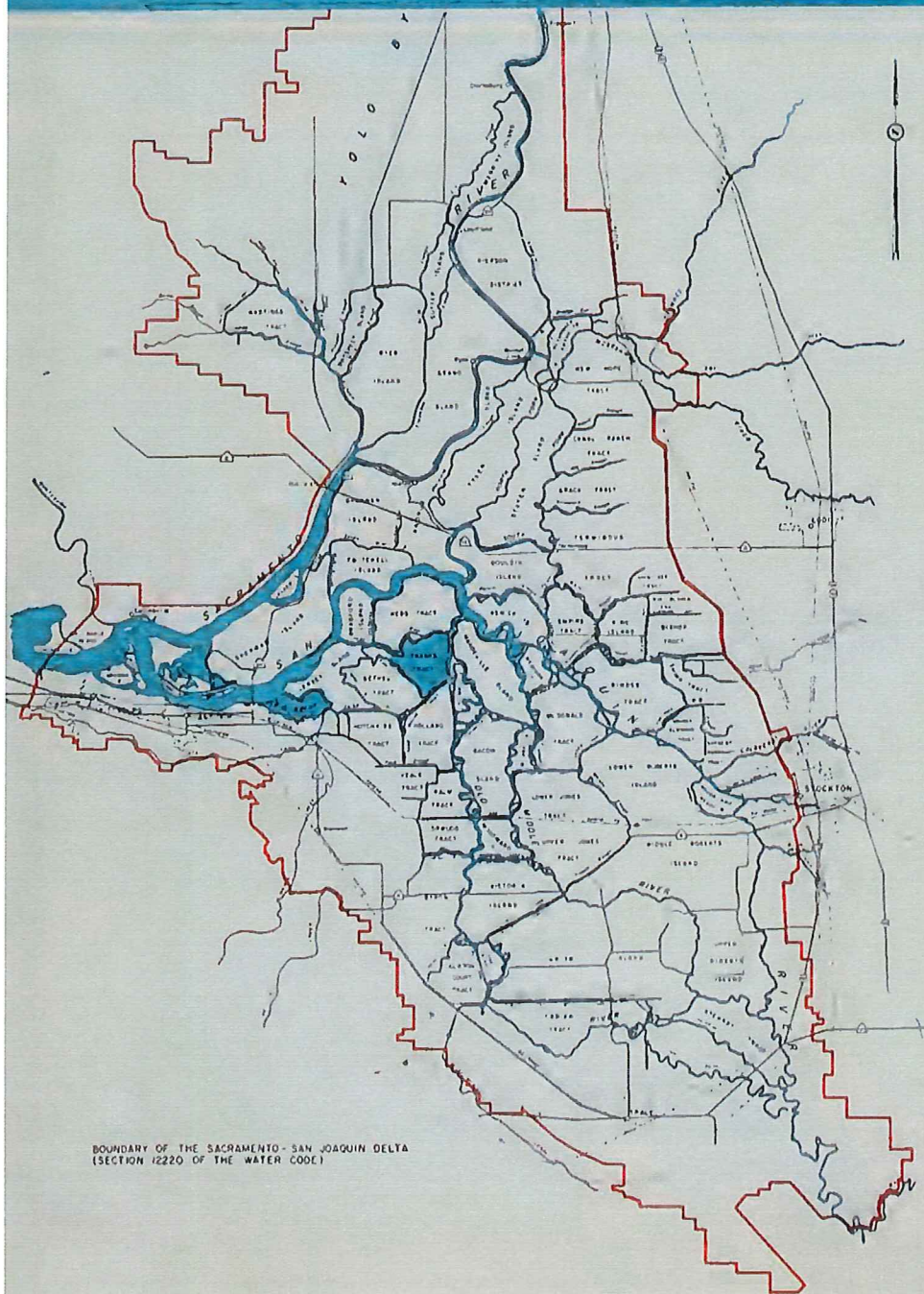


LEGEND

— BOUNDARY OF THE SACRAMENTO-SAN JOAQUIN DELTA (SECTION 12220 OF THE WATER CODE)
 — BOUNDARY OF THE WESTERN DELTA STUDY AREA (AREA OF INTENSIVE STUDY OF WATER REQUIREMENTS AND SUPPLIES PURSUANT TO CHAPTER 1765, STATUTES OF 1959)



The Delta—its geography and economy



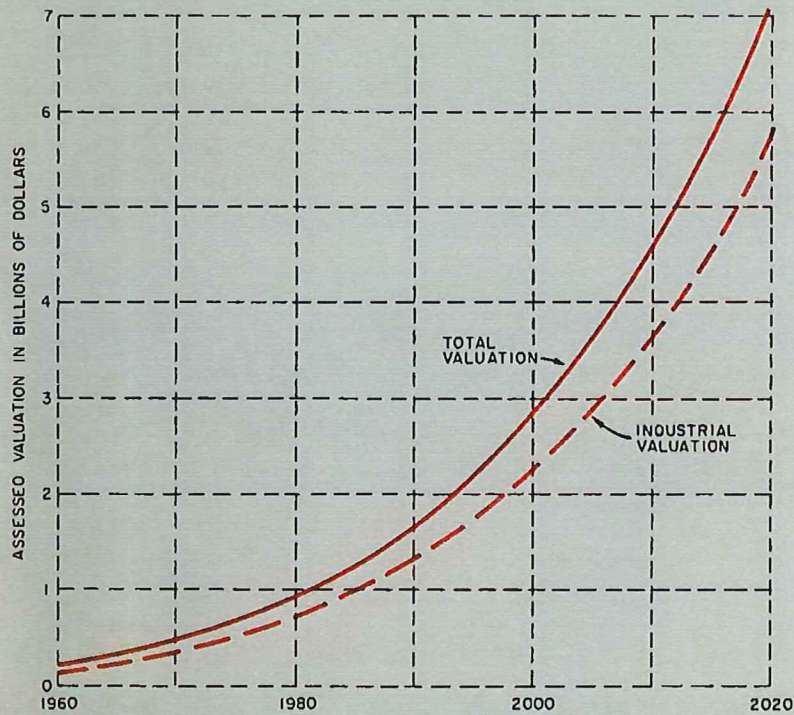
BOUNDARY OF THE SACRAMENTO-SAN JOAQUIN DELTA
(SECTION 1220 OF THE WATER CODE)

The Delta, located at the confluence of the Sacramento and San Joaquin Rivers system, is a unique feature of the California landscape. The Delta encompasses some 738,000 acres, interlaced with 700 miles of meandering waterways covering 50,000 acres. About 415,000 acres of land, referred to as Delta Lowlands, lie between elevations of 5 feet above and 20 feet below sea level. This area is composed of peat, organic sediments, and alluvium, and is protected from flood water and high tides by man-made levees. The extensive waterways afford opportunity for shipping and provide a wonderland for boating and water sports. These same waterways must safely discharge flood waters of the Central Valley.

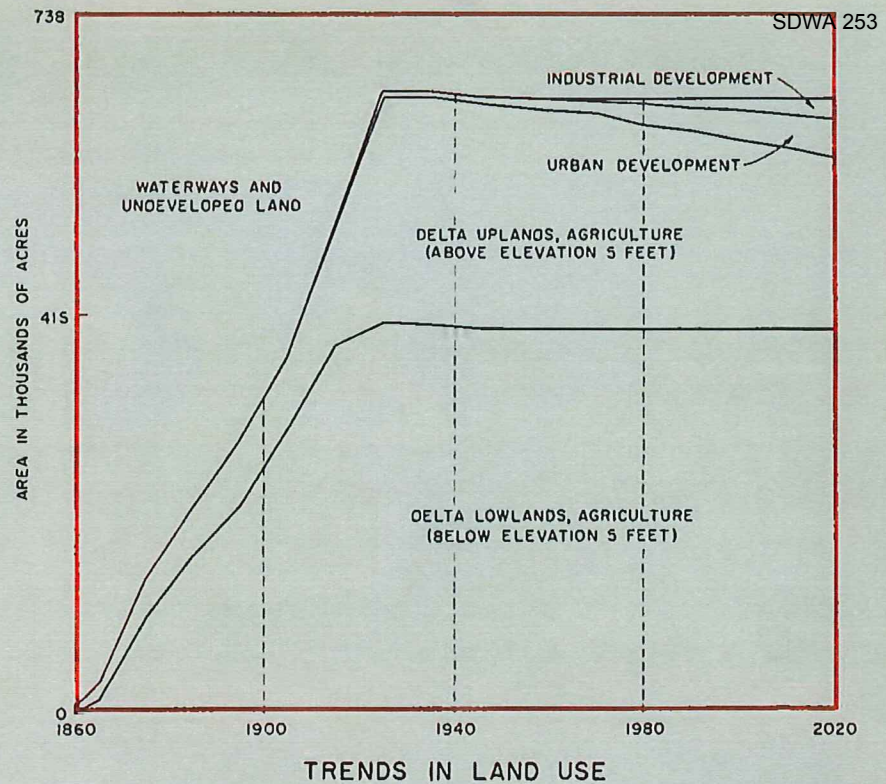
The fortunate combination of fertile soils, convenient water supplies, and shallow-draft shipping to central California markets led to development of an intensified agricultural economy in the Delta. Initial reclamation of the marshlands began slowly in the 1850's, but rapidly expanded after state assistance was provided by a swampland act in 1861. By 1930, all but minor areas of the swamplands had been leveed and were in production.

The Delta has historically been noted for its asparagus, potatoes, celery, and varied truck crops. Recently, greater emphasis has been placed on field corn, milo, grain, and hay, although the Delta still produces most of the nation's canned asparagus. The Delta's agricultural economy for many years was dependent upon repulsion of ocean salinity by fresh water outflow, which fluctuated widely, but during the past sixteen years has been protected largely by releases from upstream reservoirs of the Federal Central Valley Project during summer months.

Several towns and cities are located in the upland areas and an industrial complex is expanding in the western part of the Delta. Early industrial development centered around food and kindred products, steel production, fibreboard, lumber, and ship-building activity. Large water-using industries, such as steel, paper products, and chemicals, have developed in the western area where water, rail, and highway transportation, coupled with water supplies, has stimulated growth. The manufacturing employment in this area was about 10,000 people in 1960.



PROJECTED ASSESSED VALUATIONS WITHIN THE WESTERN DELTA STUDY AREA



A deep-draft ship channel serving commercial and military installations terminates at Stockton, and another is being constructed to Sacramento. Water-borne shipments in the Delta amounted to about 6,000,000 tons annually in recent years.

The Delta encompasses one of California's most important high quality natural gas fields. Since 1941 the field has produced about 300,000,000 cubic feet of methane gas for use in the San Francisco Bay area.

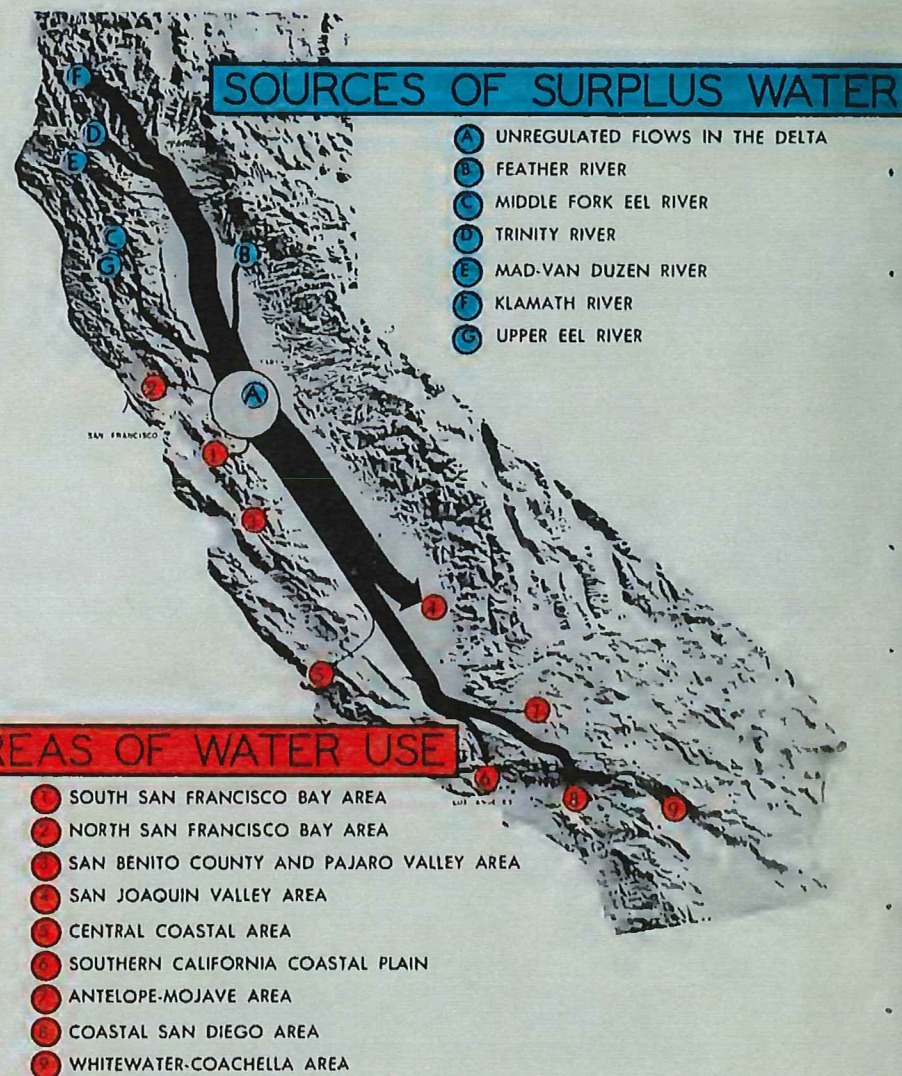
With the growing significance of recreation, the Delta has blossomed into a major recreation area at the doorsteps of metropolitan development in the San Francisco Bay area, Sacramento, and Stockton. In 1960, nearly 2,800,000 recreation-days were enjoyed in this boating wonderland.

The Delta — its role in California's water development

In 1959, the State Legislature enacted the California Water Resources Development Bond Act to finance construction of the State Water Resources Development System. The bond act was approved by the California electorate in November 1960. The State Water Facilities, the initial features of this system, will complement continuing local and federal water development programs and include the very necessary works in the Delta.

One of the principal objectives of the State Water Resources Development System is to conserve water in areas of surplus in the north and to transport water to areas of deficiency to the south and west. The Delta is important in achieving this objective, since it receives all of the surplus flows of Central Valley rivers draining to the ocean during winter and spring months and is the last location where water not needed in the Delta or upstream therefrom can conveniently be controlled and diverted to beneficial use. Surplus water from the northern portion of the Central Valley and north coastal rivers will be conveyed by the natural river system to the Delta, where it must be transferred through Delta channels to export pumping plants without undue loss or deterioration in quality. Aqueducts will convey the water from the Delta to off-stream storage and use in areas of deficiency to the south and west.

In addition to being an important link in the interbasin transfer of water, the Delta is a significant segment of California's economy, and its agricultural, municipal, and industrial water supply problems, and flood control and related problems, must be remedied. A multipurpose system of Delta water facilities, which will comprise one portion of the State Water Resources Development System, is the most economical means of transferring water and solving Delta problems.



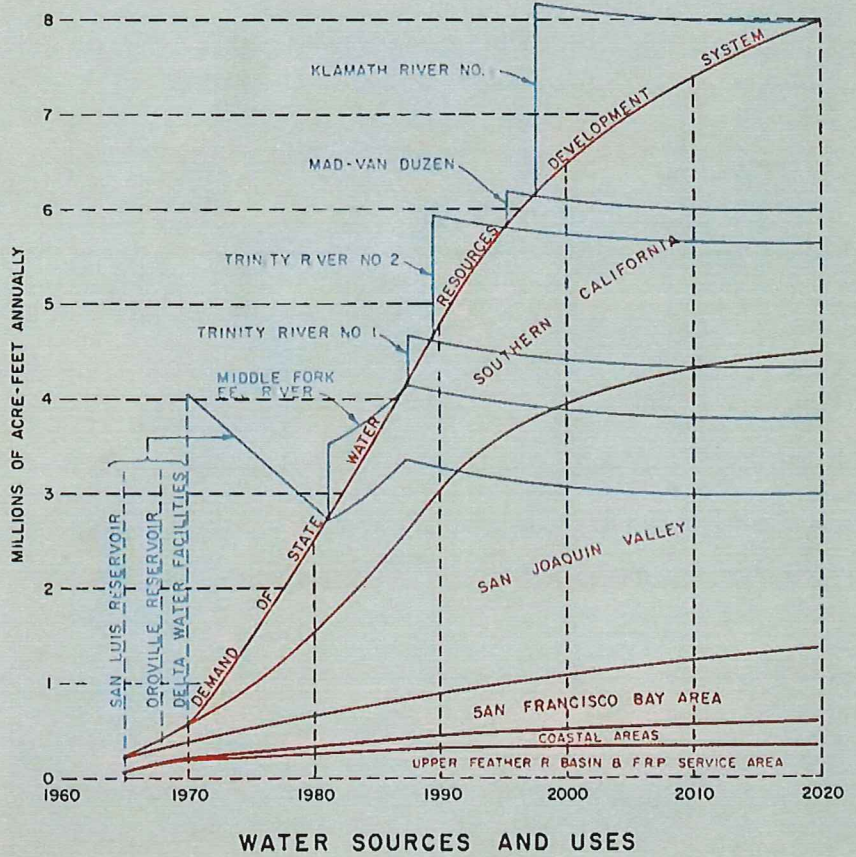


Tracy Pumping Plant

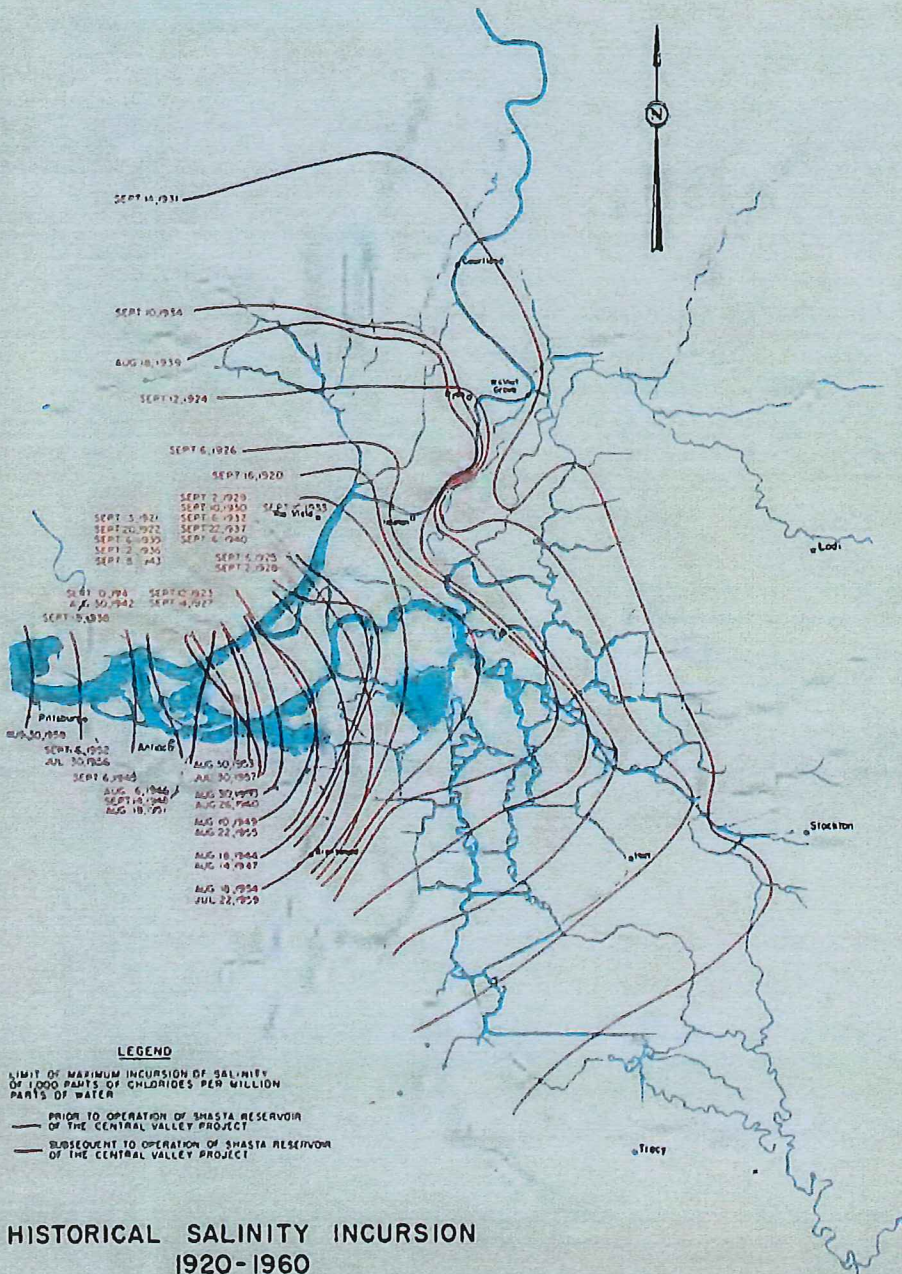
Full demands on the State Water Resources Development system can be met until about 1981 from surplus water in and tributary to the Delta with regulation by the proposed Oroville and San Luis Reservoirs. However, upstream depletions will reduce the available surplus supplies and water will have to be imported from north coastal sources after that year. It is anticipated that coordinated operation of the State Water Resources Development System and the Federal Central Valley Project will afford a limited increase in usable surplus Delta supplies beginning in 1981. As indicated in the chart, upstream depletions will continue to decrease the available surplus supplies.

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The coordinated use of surplus water in and tributary to the Delta and of regulated or imported supplements to this supply, as required, is referred to as the Delta Pooling Concept. Under this concept of operation the State will ensure a continued supply of water adequate in quantity and quality to meet the needs of export water users. Advantage will be taken of surplus water available in the Delta, and as the demand for water increases and the available surplus supply is reduced by further upstream uses, the State will assume the responsibility of guaranteeing a firm supply of water, which will be accomplished by construction of additional storage facilities and import works. At the same time, the water needs of the Delta will be fully met.



Delta Problems — salinity incursion and water supplies



Salinity incursion into the Delta results from the flooding and ebbing of ocean tides through the San Francisco Bay and Delta system during periods when the fresh water outflow from the Delta is insufficient to repel the saline water. The natural fresh water outflow from the Central Valley was historically inadequate to repel salinity during summer months of some years. The first known record of salinity encroachment into the Delta was reported by Cmdr. Ringgold, U. S. Navy, in August 1841, whose party found the water at the site of the present city of Antioch very brackish and unfit for drinking. Since that time, and particularly after the turn of the century, with expanding upstream water use salinity incursion has become an increasingly greater problem in Delta water supplies. The maximum recorded extent of salinity incursion happened in 1931, when ocean salts reached Stockton. Since 1944 extensive incursion has been repulsed much of the time by fresh water releases from Central Valley Project storage in Shasta and Folsom Reservoirs. Without such releases, saline water would have spread through about 90 percent of the Delta channels in 1955 and 1959. Although upstream uses might not have reached present levels in the absence of the Central Valley Project, salinity problems would still have been very serious during most years.

Further increase in water use in areas tributary to the Delta will worsen the salinity incursion problem and complicate the already complex water rights situation. To maintain and expand the economy of the Delta, it will be necessary to provide an adequate supply of good quality water and protect the lands from the effects of salinity incursion. In 1959 the State Legislature directed that water shall not be diverted from the Delta for use elsewhere unless adequate supplies for the Delta are first provided.