STATE OF CALIFORNIA
The Resources Agency
Department of Water Resources

THE DELTA
AND THE STATE WATER PROJECT

Memorandum Report

JUNE 1969

State of Californ

The Resources Agency

Memorandum

To : Mr. William R. Gianelli

Date : JUN 9 1969

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Subject: Memorandum Report - The Delta and the State Water Project

From : John R. Teerink
Deputy Director
Department of Water Resources

This memorandum report summarizes the Department's plans for the Sacramento-San Joaquin Delta as part of the State Water Project and the effect of those plans on the Delta.

It brings together pertinent information concerning Delta water problems and their solutions that have been accumulated over the past several years. It includes: (1) a brief description of the California Water Plan, the State Water Project, and the Delta; (2) problems of water resource development and protection of the Delta; (3) the background and accomplishments of the proposed Peripheral Canal; (4) a summary of Delta water entitlement negotiations; (5) an evaluation of increasing the degree of salinity control beyond that agreed to in the November 19, 1965 Delta Water Quality Criteria; and (6) an analysis of legal problems with respect to Delta water rights and salinity control.

It also includes nine appendices relating to the following subjects: (a) Delta Water Quality Criteria; (b) water entitlement agreements with western Delta interests; (c) Delta water requirements; (d) project water quality objectives; (e) proposals to upgrade salinity control standards; (f) economic aspects of salinity control; (g) cost of water from North Coastal projects; (h) Delta economic statistics; and (i) interim fish protective measures in the Delta.

SYNOPSIS

For more than 40 years the Bureau of Reclamation, the Department of Water Resources and its predecessors, and others, have been studying the Delta and its relationship to California and its total water needs. The objective of these studies has been to develop a plan that would meet the Delta's water requirements, and also use the Delta as a pooling point for export of surplus water to other parts of the State. Specifically, the goals of the Department of Water Resources in such a plan are:

SURNAME				

1. To insure a water supply for the Delta of adequate quality to meet the needs of its agricultural, municipal, and industrial water users. These uses constitute an important segment of California's economy and any water development plan must recognize and preserve these uses of water;

2. To provide water quality in the Delta which will preserve or enhance factors of environment that affect fish and wildlife, recreation, and the Delta's esthetic character;

3. To protect fully all vested rights to water in the Delta. These include rights guaranteed to Delta landowners by the Constitution and laws of the State, including the Delta Water Protection Act (Water Code Sections 12200 to 12220), the Area of Origin Law, and the County of Origin Law;

4. To provide project services to the extent possible which are desired by Delta water users on a contractual basis comparable to that of the Department's water contractors for other areas; and

5. To utilize surplus water supplies tributary to the Delta for export to water-deficient areas of the State.

Use of water flowing into the Delta must be maximized to accomplish these objectives. Works must be constructed that will permit the economy of the Delta to be maintained and expanded without the waste of large quantities of water to control salinity intrusion by means of an excessive hydraulic barrier. The plan of the Department of Water Resources for meeting the objectives set forth above contains the following principal elements:

1. Construction and operation of the Peripheral Canal is the key element. Operation of the Canal will make the most effective use of water available in the Delta by eliminating the commingling of export water with saline water in the western Delta and by planned releases into various Delta channels. Quality in interior Delta channels will be kept high and an outflow will be controlled. Water quality will be maintained at or better than the levels established in the Delta Water Quality Criteria of November 19, 1965. In most years the quality will be better for a substantial period of time.

Freshwater releases from the Peripheral Canal will preserve and substantially enhance the environment for the Delta fishery. The environment will be stabilized; fish food supplies will be increased; and the adverse effects of flow reversals due to export pumping will be eliminated, with a likely increase in the fish population. The Peripheral Canal will convey good-quality water to the aqueducts of the state and federal projects, including the Kellogg Project, or a similar project to serve Contra Costa County, without the release of large quantities of water to control salinity which would otherwise be required.

2. Construction of overland facilities to supply substitute water to agricultural areas in the western 10 percent of the Delta. This is the area of the Delta that is not guaranteed a dependable water supply of adequate quality by the November 19, 1965 Criteria. Salinity control releases do not now, and cannot economically in the future, provide acceptable-quality water in the adjacent channels at all times in the western Delta. Such releases would involve an unreasonable and wasteful use of water which is proscribed by the State Constitution and state law. While the November 19 Criteria will limit salinity intrusion to essentially that experienced since the Central Valley Project began operation in 1944, future upstream diversions will cause a reduction (below the historic average) in the number of days good-quality water will be available in adjacent channels. A substitute water supply furnished through overland facilities, in lieu of that which would be provided by salinity control releases, would add no financial burden to the water users solely by virtue of such substitution. To the extent that these facilities would provide a betterment, the water user would be expected to pay the added costs.

3. Compensate municipal and industrial water users in Contra Costa County for any increased costs due to loss of availability of good-quality water caused by operation of the State Water Project. A reduction of the number of days per year that good-quality offshore water will be available to industry and communities in the County is anticipated. Substitute water can be purchased from the Contra Costa Canal supplemented by the Kellogg Unit or some similar project (which will be necessary in any event to meet the expanding needs in the County); and industrial cooling equipment can be modified to operate independently of the effects of salinity.

4. Assume responsibility for developing solutions to any problem caused by the project, that adversely affects the Delta environment relating to fish and wildlife, recreation, and esthetics. Careful monitoring will be done to detect incipient problems and to verify that a solution to them is adequate. It would be inappropriate to make substantial expenditures or to waste substantial quantities of water to solve alleged problems that may not occur.

Water quality standards for the Delta have been established under provisions of the federal Water Quality Act of 1965, and approved by the Secretary of the Interior. These standards include salinity control provisions which are essentially the same as those contained in the November 19, 1965 Delta Water Quality Criteria. At hearings conducted in connection with these standards, however, several proposals were made for increasing the degree of salinity control beyond that provided by the November 19 Criteria. Further consideration of these higher standards was deferred so that they could be reviewed in connection with water rights hearings for the state and federal projects, since the only present means for controlling salinity is by releases of stored water from these projects. The Department has opposed these proposals for increased salinity control for the following reasons:

1. Increased salinity control would require: (a) denial of water users the water supplies they have contracted for and made advanced payments for; or (b) construction of new water conservation and transportation facilities upstream from the Delta; or (c) both.

2. Costs are excessive in relation to benefits. Estimated capital costs range from $0.3 to $2.9 billion and average annual costs range from $17 million to $154 million, depending on the particular proposal. Estimated average annual benefits are less than $5.7 million.

3. There is a more practical alternative. The estimated average annual costs to furnish substitute water supplies through overland conveyance facilities and to modify certain industrial cooling systems is about $1 million to $1.5 million.

4. None of the proposals would have a measurable effect on the water requirements for recreation, esthetics, and fish life. People can recreate on slightly saline water as well as on fresh. The relatively small change of salinity (from present levels) will be insufficient to materially alter the esthetics, and overall, fish and wildlife would not be appreciably benefited.

5. Increased salinity control would constitute a wasteful and unreasonable use of water. Large additional quantities of stored water would be required for release during a critical period such as 1928 to 1934 (from 4 million to 37 million acre-feet, depending on the particular proposal), to push the salt water back farther. Water is a limited resource in California and water used for salinity control would preclude its use for some alternative purpose.

The basic question inherent in these proposals is whether large quantities of water should be developed at high cost and then released from storage to increase salinity control in the Delta; or whether a program should be established to protect and serve the Delta on a basis which takes into account California's plan for water development to meet the needs of all its citizens. These statewide needs must be weighed against any possible increase in benefits the Delta area could derive from additional freshwater releases which would flow to the Bay and ocean and be lost to other uses.

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INTRODUCTION

The purpose of this memorandum report is to set forth the Department's plan for the Sacramento-San Joaquin Delta relative to salinity control, the State Water Project, and California's overall plan for water development.

The State Water Project, which constitutes the initial facilities of the State Water Resources Development System, is being constructed to help meet the expanding water needs throughout the State. The project has a contractual commitment to deliver 4.23 million acre-feet of water annually to the water users that is expected to occur in about 1990. In addition to meeting delivery commitments, an adequate water supply and salinity control must be provided in the Delta in cooperation with the Federal Central Valley Project.

The Department has applied for water rights to store and divert water for the project. Decision D-1275 makes these rights subject to the "Delta Water Quality Criteria" which were agreed to on November 19, 1965, as a result of negotiations by the Department of Water Resources, Bureau of Reclamation, and local Delta interests. In compliance with the Water Quality Act of 1965, P.L. 89-234, 79 Stat. 903 (1965), federal water quality standards in the Delta have been established. Further federal consideration on salinity control, however, has been deferred until after a decision is made by the State Water Resources Control Board based on the water rights hearings which will commence in July 1969.

This report examines the problems associated with water development in the Delta and covers in depth, an evaluation of increasing the degree of control over the intrusion of saline water into the western Delta. The report also discusses the events leading to the selection of the Peripheral Canal concept and covers briefly the description, a concept for operation, and the accomplishments of the Canal.

Water entitlement negotiations are currently under way with local agricultural, municipal, and industrial interests in the western Delta. A discussion of these negotiations, as well as an analysis of the legal problems with respect to water rights of the Delta water user, is also presented in this report.

California's Water Problems

The past and future growth of California has been and will continue to be dependent on the development of its water resources.

California leads the nation in its value of agricultural products -- both crops and livestock. She supplies 25 percent[1] of the nation's table foods. Farm income exceeds $4 billion annually with 95 percent of this value coming from products grown on irrigated lands. Irrigation is necessary because most precipitation does not occur when and where it is needed.

Since 1940, population in California has grown faster than the national average -- from 6.9 million to almost 20 million[2]. With nearly 20 million people, California leads the nation in population. By 1990, the population is expected to reach 35 million.

Agricultural production and the need for irrigation will also increase. Water requirements for municipal and industrial use also grow, and at an even faster rate. This is caused by higher per-capita use of water resulting from increased use of air conditioners, automatic washers, garbage disposals, etc.

There are three basic problems to be solved in developing California's water resources.

First, over 70 percent of the State's water occurs in the northern 1/3 of the State; whereas, 77 percent of the water demand is in the southern 2/3 of the State.

Second, most precipitation and runoff occur in the winter and spring; whereas, the greatest demand for water is in the summer.

Third, this maldistribution of water is aggravated by years of drought when water supplies, both north and south, are less than normal.

California Water Plan

In 1959, the Legislature adopted the California Water Plan. This plan, as published in DWR Bulletin No. 3, is a concept or framework which is intended to serve as a guide to all levels of government (local, state, and federal) and private interests in the further development of California's water resources. It does not cover the many phases of interim uses and transfer of water that will inevitably occur during a step-by-step implementation of the ultimate plan. It is a flexible, long-range plan that indicates the general manner in which California's water resources should be developed to satisfy the potential ultimate water requirements of the State. It demonstrates that California has enough water to meet foreseeable needs if prudently developed and used.

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[1] California State Chamber of Commerce Brochure, "What California Agriculture Means to You".

[2] Department of Finance, "California Population, 1968".

The plan envisions major storage reservoirs to capture and control waters in water-producing areas and extensive conveyance systems to transport the surplus waters to areas of need throughout the State. Figure 1 illustrates schematically the distribution of surplus water in the north to areas of need in the south under the State Water Resources Development System of the California Water Plan.

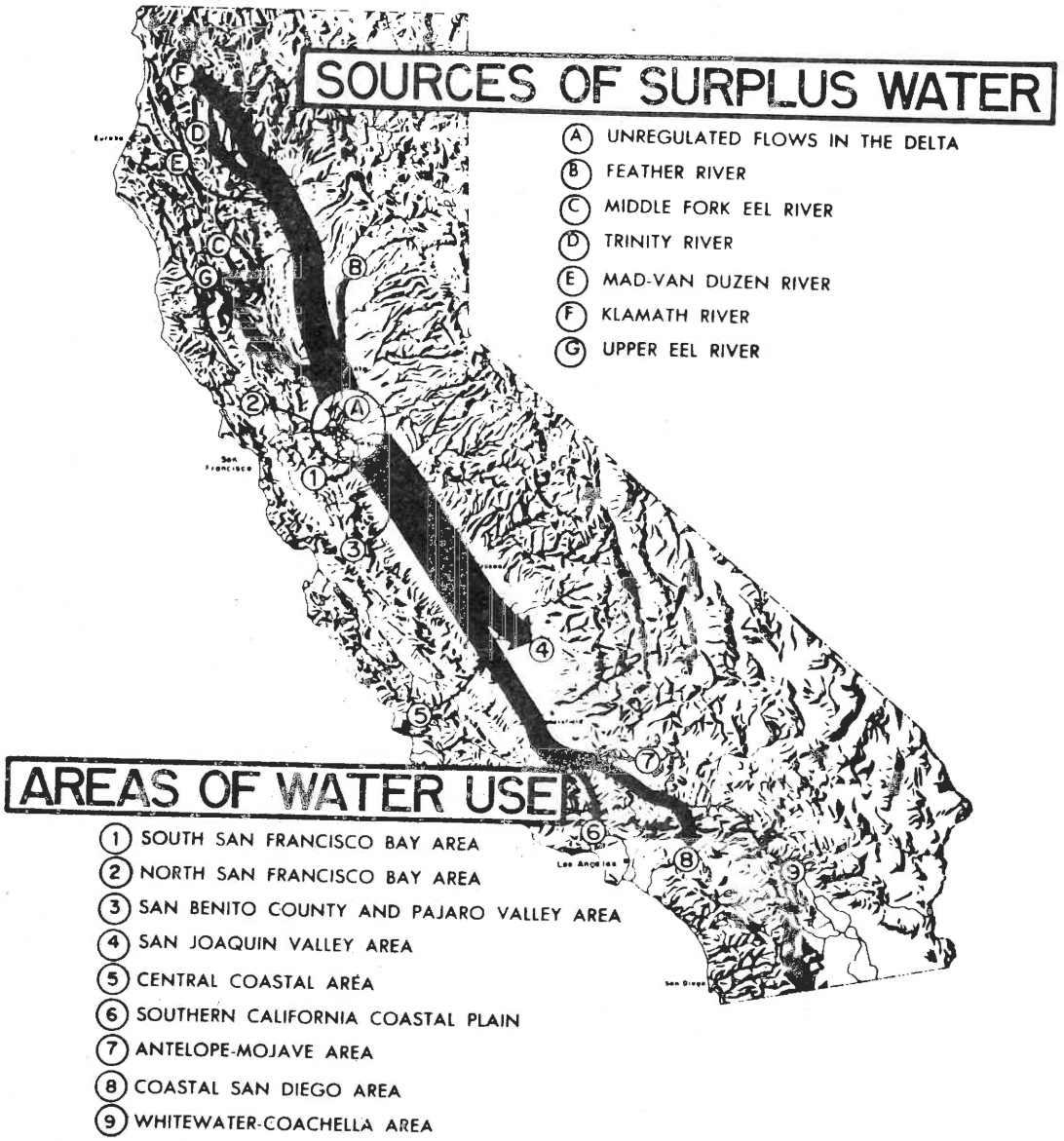


Figure 1. Schematic Distribution of Water Under the State Water Resources Development System of the California Water Plan.

"The plan gives consideration to water conservation and reclamation; to flood control and flood protection; to the use of water for agricultural, domestic, municipal, and industrial purposes; to hydroelectric power development; to salinity control and protection of the quality of fresh waters; to navigation; to drainage; and to fish, wildlife, and recreation."

The Delta is important in achieving the major objectives of the California Water Plan. It is a common point where waters, both regulated and unregulated, of the Central Valley rivers system naturally flow and where surplus water from the north coastal streams can readily be brought. These factors combine to make it the logical point where surplus waters not needed, in, or north of, the Delta can be conveniently controlled and diverted to areas of deficiency to the west and south for beneficial use.

State Water Project

In 1959, the Legislature enacted the California Water Resources Development Bond Act to assist in financing the construction of the State Water Resources Development System. This Act was ratified by California voters in November 1960.

Figure 2. Major Features of the State Water Project.

The State Water Resources Development System is a broad term used to designate a system of works in connection with the long-range development of the California Water Plan. One of its principal objectives is to conserve water in areas of surplus and to transport it to areas of need. It is designed to help adjust the imbalance of California's water resources to her water needs. The State Water Project constitutes the initial features of the system and such additional features as the Department deems necessary to meet local needs and to augment water supplies in the Delta. The major features of the State Water Project are shown on Figure 2.

The 1959 Bond Act includes, as part of the State Water Project, Delta facilities "...for water conservation, water supply in the Delta, transfer of water across the Delta, flood and salinity control, and related functions ...."

In March of 1966, the Director of the Department issued a Project Order that authorized construction of the Peripheral Canal as the Delta water transfer and distribution facilities portion of the State Water Project (see Figure 7 on page 23). Additional facilities for local water supply in the western Delta will be defined at a later date as a result of water entitlement negotiations presently in progress.

The Delta Pooling Concept

The coordinated use of the surplus water in the tributaries to the Delta, and of regulated or imported supplements to this supply, is referred to as the "Delta Pooling Concept". Set forth below, and included in this concept, the areas of origin where the surplus flows originate are guaranteed that they will not be deprived of a water supply. The state system's demands in Central and Southern California, as well as a substantial measure of the Federal Central Valley Project demands, will be met by diverting from the Delta pool both the regulated and surplus water that would otherwise waste to the ocean.

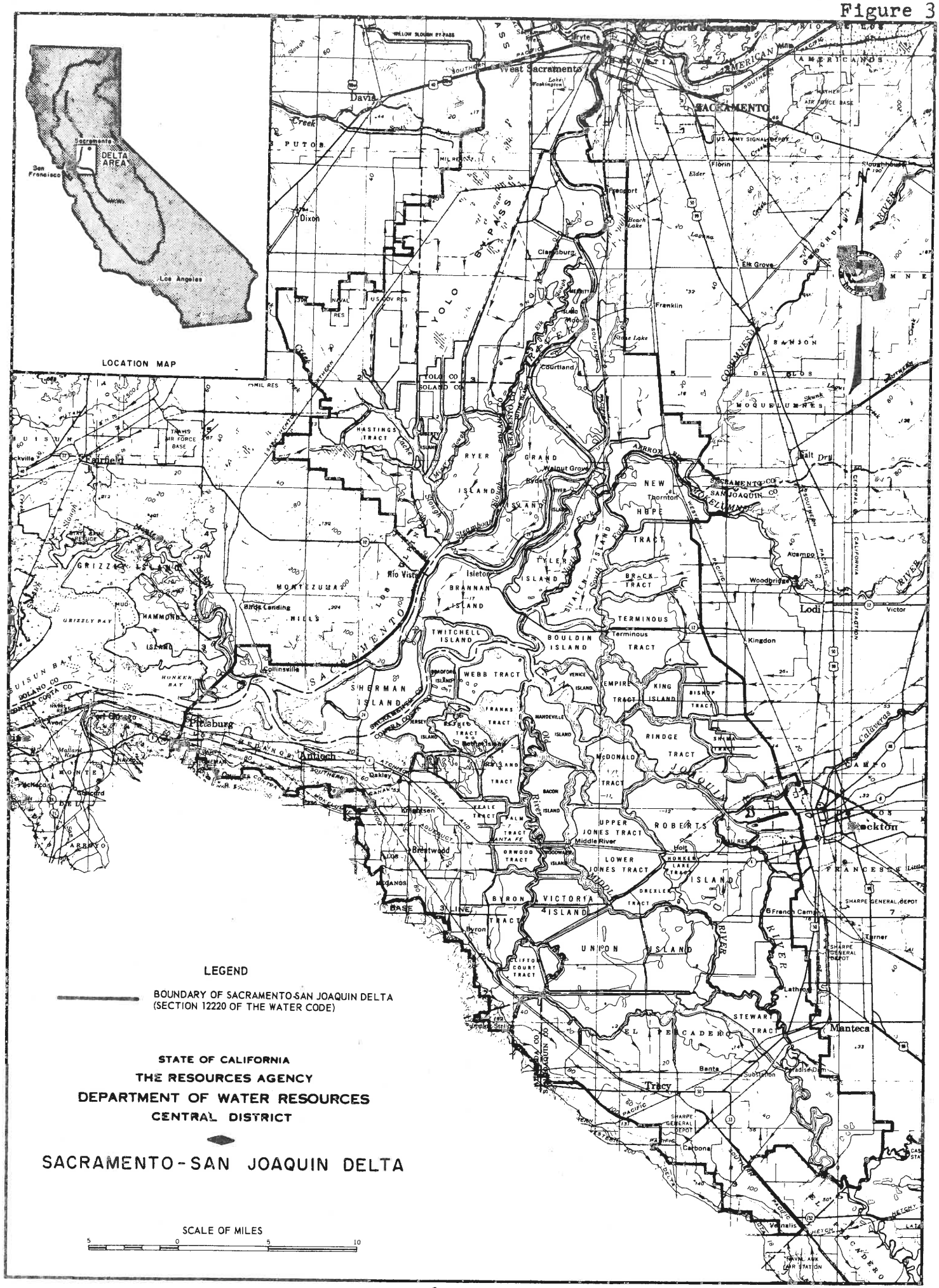
The present surplus flows in the Delta will be diminished in the future due to further development and increased use of water in the upstream tributary areas to the Delta, particularly in the Sacramento River Basin. Interconnected to the funding for construction of the State Water Project are funds for the construction of such additional water development facilities in the Sacramento Valley and north coastal streams as are necessary to meet local needs and to augment the water supplies in the Delta. As demands for Delta water increase and/or as upstream uses deplete the flow to the Delta, additional water may be brought to the Delta pool from the north coastal sources, where large surpluses now exist, to fully meet future water needs. This is the significance of the offset provision in the Water Resources Development Bond Act for additional facilities. It insures a continuing program of construction to meet the expanding needs in all areas without the threat of depleting the water supply of one area of the State for the benefit of another. It recognizes that construction, not litigation, is the final answer for meeting California's present and future needs for water.

Location and Description of Delta

The Sacramento-San Joaquin Delta is located at the confluence of the Sacramento and San Joaquin Rivers, which together drain the Central Valley of California. These two rivers unite near the City of Pittsburg, and discharge their flows by way of Suisun, San Pablo, and San Francisco Bays into the Pacific Ocean. Together they drain about 37 percent of the total land areas of the State of California, and contribute more than 47 percent of the full natural runoff of the State, which without development, control, and utilization, would find its way to the Pacific Ocean (see Figure 3).

The statutory Delta (Section 12220 of the California Water Code) encompasses about 738,000 acres and is interlaced with about

Figure 3


LOCATION MAP
Sacramento
DELTA AREA
San Francisco
Los Angeles
LEGEND
BOUNDARY OF SACRAMENTO-SAN JOAQUIN DELTA (SECTION 12220 OF THE WATER CODE)
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
CENTRAL DISTRICT
SACRAMENTO-SAN JOAQUIN DELTA
SCALE OF MILES
5 0 5 10
West Sacramento
Davis
Dixon
Clarksburg
Courtland
Isleton
Rio Vista
Collinsville
Pittsburg
Antioch
Oakley
Brentwood
Byron
Tracy
Lathrop
Manteca
Stockton
Lodi
Woodbridge
Terminous
Kingdon
Thornton
Walnut Grove
Elk Grove
Franklin
Florin
Freeport
Fairfield
Suisun Bay
Grizzly Bay
Honker Bay
Montezuma Hills
Grizzly Island
Hammond Island
Twitchell Island
Brannan Island
Tyler Island
Grand Island
Hastings Tract
Webb Tract
Sherman Island
Empire Tract
King Island
Bishop Tract
Rindge Tract
McDonald Tract
Upper Jones Tract
Lower Jones Tract
Middle River
Victoria Island
Union Island
Clifton Court Tract
Stewart Tract
El Pescadero
Bouldin Island
Hope Tract
Brack Tract
Holland Tract
Bacon Island
Mandeville Island
Venice Island
Roberts Island
Woodward Island
Orwood Tract
Palm Tract
Veale Tract
Bethel Island
Jersey Island
Franks Tract
Bradford Island
Holt
Byron Tract
Drexler Tract
Carbona
Banta
Vernalis
Sharpe General Depot
Travis AFB
Mare Island
Concord
Pacheco
Martinez
Benicia
Suisun
Fairfield
Vacaville
Solano Co
Contra Costa Co
Yolo Co
San Joaquin Co
Sacramento Co
Yolo Bypass
Sacramento River
San Joaquin River
Mokelumne River
Cosumnes River
Calaveras River
Stanislaus River
Tuolumne River
Old River
Middle River
Delta Cross Channel
Montezuma Slough
Suisun Slough
Cache Slough
Lindsey Slough
Barker Slough
Steamboat Slough
Sutter Slough
Georgiana Slough
Three Mile Slough
Little Potato Slough
Beaver Slough
Snodgrass Slough
Dead Horse Cut
Connection Slough
Threemile Slough
Elk Slough
Prospect Slough
Shag Slough
Lookout Slough
Lindsey Slough
Barker Slough
Cache Slough
Ryer Island
Pacific Ocean
Suisun Bay
Carquinez Strait
Mallard Reef
Roe Island
Middle Ground
Chipps Island
Frank's Tract
Bethel Island
Jersey Island
Bradford Island
Webb Tract
Sherman Island
Empire Tract
King Island
Bishop Tract
Rindge Tract
McDonald Tract
Upper Jones Tract
Lower Jones Tract
Middle River
Victoria Island
Union Island
Clifton Court Tract
Stewart Tract
El Pescadero
Bouldin Island
Hope Tract
Brack Tract
Holland Tract
Bacon Island
Mandeville Island
Venice Island
Roberts Island
Woodward Island
Orwood Tract
Palm Tract
Veale Tract
Byron Tract
Drexler Tract
Carbona
Banta
Vernalis
Sharpe General Depot
Travis AFB
Mare Island
Concord
Pacheco
Martinez
Benicia
Suisun
Fairfield
Vacaville
Solano Co
Contra Costa Co
Yolo Co
San Joaquin Co
Sacramento Co
Yolo Bypass
Sacramento River
San Joaquin River
Mokelumne River
Cosumnes River
Calaveras River
Stanislaus River
Tuolumne River
Old River
Middle River
Delta Cross Channel
Montezuma Slough
Suisun Slough
Cache Slough
Lindsey Slough
Barker Slough
Steamboat Slough
Sutter Slough
Georgiana Slough
Three Mile Slough
Little Potato Slough
Beaver Slough
Snodgrass Slough
Dead Horse Cut
Connection Slough
Threemile Slough
Elk Slough
Prospect Slough
Shag Slough
Lookout Slough
Lindsey Slough
Barker Slough
Cache Slough
Ryer Island
Pacific Ocean
Suisun Bay
Carquinez Strait
Mallard Reef
Roe Island
Middle Ground
Chipps Island

700 miles of waterways covering 50,000 acres. These waterways meander among more than 50 reclaimed islands and tracts, many of which are below sea level. About 415,000 acres of land in the Delta, commonly known as the Delta lowlands, lie between elevations 5 feet above and 20 feet below mean sea level, and are protected from floodwaters and tides by manmade levees.

Delta Economy

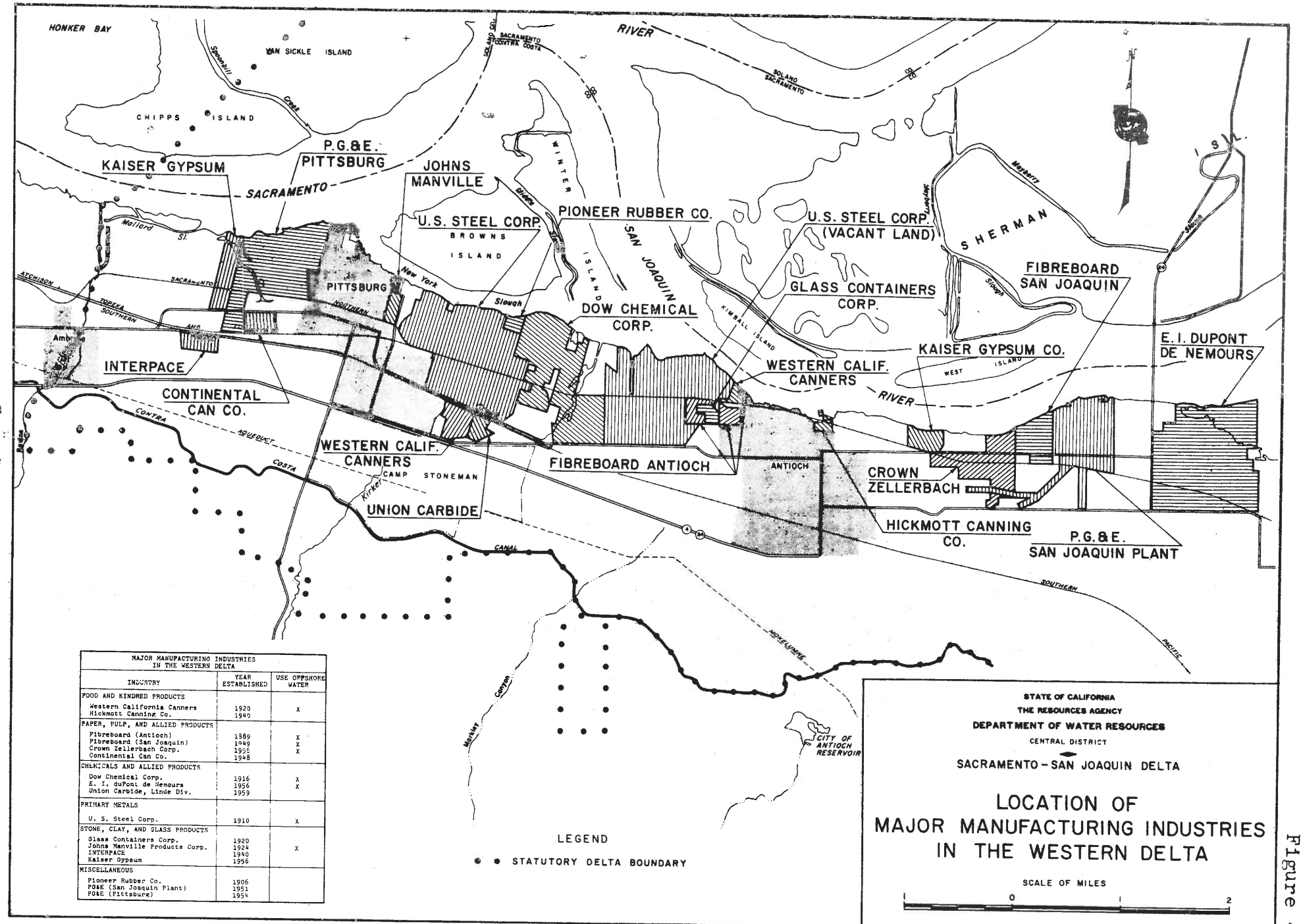
Historical development of the Sacramento-San Joaquin Delta has led to a number of water-associated activities that contribute significantly to the economy of California.

Within the statutory Delta, there are approximately 550,000 acres of rich agricultural land composed of peat, organic sediments, and alluvium. These lands produce a gross farm income of approximately $140 million per year (excluding livestock and poultry), which contributes to the economy of California and the nation. A summary of the broad categories of Delta land-use acreages, crop statistics, and farm income for the statutory Delta is presented in Appendix H.

Several towns and cities are located in the upland area and an industrial complex is centered in the western part of the Delta in the Pittsburg-Antioch area of Contra Costa County. Between 1950 and 1960, industrial growth in the western Delta area expanded at an average rate of over $20 million per year in capital investment, either through establishment of new industries or the expansion or modernization of old industries. The total market value of the industrial complex in the western Delta was estimated to be over $500 million as of 1960. Figure 4 shows the location of the major manufacturing industries in the western Delta and gives the name, year of establishment, and type of product manufactured for each major industry. Of these, only seven use water directly from offshore.

The Delta channels, particularly the San Joaquin and Sacramento Rivers, are used for commercial shipping. The Port of Stockton has been a regular port of entry since 1933; and since the completion of the Sacramento Deep-Water Channel in 1963, the Port of Sacramento is fast becoming a major port of call. Commercial traffic consists of both shallow and deep-draft vessels. Barges carry mainly petroleum products, but large amounts of farm produce are also shipped.

The Delta is within two hours driving time of the greater San Francisco Bay area and the growing metropolitan centers of Sacramento, Stockton, and the Pittsburg-Antioch area. The 700 miles of waterways are a haven to fishermen and boaters. These two factors have, in recent years, caused the Delta to blossom into a major recreation area, serving a host of water-oriented activities. The fishing resource is abundant and varied. The secluded sloughs are ideal for cruising and long stretches of water are enjoyed by the water-skiier. Gross annual income from Delta recreation has been estimated to range between $12 million and $27 million.



MAJOR MANUFACTURING INDUSTRIES IN THE WESTERN DELTA		
INDUSTRY	YEAR ESTABLISHED	USE OFFSHORE WATER
FOOD AND KINDRED PRODUCTS		
Western California Canners	1920	X
Hickmott Canning Co.	1940	
PAPER, PULP, AND ALLIED PRODUCTS		
Fibreboard (Antioch)	1889	X
Fibreboard (San Joaquin)	1949	X
Crown Zellerbach Corp.	1956	X
Continental Can Co.	1948	
CHEMICALS AND ALLIED PRODUCTS		
Dow Chemical Corp.	1916	X
E. I. duPont de Nemours	1956	X
Union Carbide, Linde Div.	1959	
PRIMARY METALS		
U. S. Steel Corp.	1910	X
STONE, CLAY, AND GLASS PRODUCTS		
Glass Containers Corp.	1920	
Johns Manville Products Corp.	1924	X
INTERPACE	1940	
Kaiser Gypsum	1956	
MISCELLANEOUS		
Pioneer Rubber Co.	1906	
PG&E (San Joaquin Plant)	1951	
PG&E (Pittsburg)	1954	

Figure 4

A recreation-use survey within the Delta conducted in 1962-63, revealed about 2.4 million recreation days[3]. Of this amount, about 1-1/2 million recreation days were devoted to fishing, with the remainder being devoted to nonfishing activities.

Striped bass population supported 60 percent[3] of the fishing activity in the Delta. In addition, the salmon which migrate through the Delta and spawn in the Sacramento and San Joaquin River systems, support about 80 percent of California's 8-million-pound commercial salmon catch, which produces a net income of about $3 million annually[4]. These salmon also support sport fishery in the ocean, Bay, and many thousands of angling days annually along streams tributary to the Delta. Conservative estimates of future recreation use indicate a fivefold increase by the year 2020.

The Delta channels also serve as conduits for waters of the Federal Central Valley Project and the State Water Project. A joint state-federal Peripheral Canal around the Delta's eastern edge is planned to serve this latter purpose.

The importance of the Delta to the State's economy and the well-being of its citizens should be obvious.

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[3] Interagency Delta Committee Task Force Report, "Coordinated Plan", September 1964.

[4] Delta Fish and Wildlife Protection Study, Report No. 7, "Water Development and the Delta Environment", December 1967.

PROBLEMS OF WATER DEVELOPMENT IN THE DELTA

The physical conditions of the Delta, the hydrologic conditions tributary to the Delta, and the many activities of man in and upstream from the Delta have resulted in numerous problems associated with Delta water development. The interrelated problems discussed include: salinity intrusion, local water supply, transfer of water across the Delta, and fishery resources dependent on the Delta. Emphasis is placed on salinity control as it relates to the other problems.

Salinity Intrusion

There are many sources of poor-quality water in the Delta, such as poor quality tributary inflow from the San Joaquin River (during periods of low flow), rising poor-quality ground waters, poor-quality drainage water from Delta irrigation, municipal and industrial waste discharges, and the intrusion of saline ocean water from the San Francisco Bay.

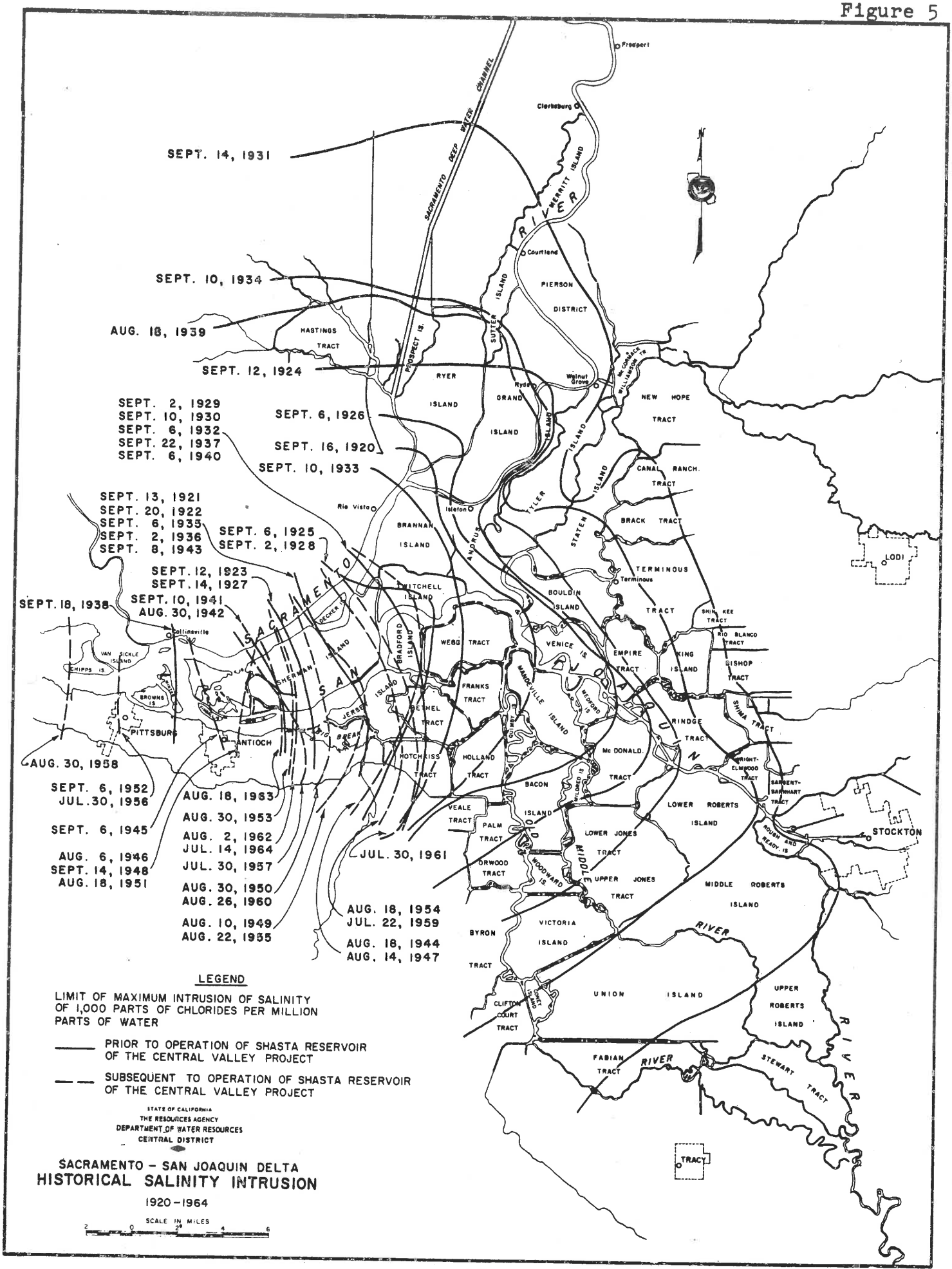
Annual outflow from the Delta to the Bay varies depending on whether the year is wet or dry. It is estimated that prior to any development by man, this outflow averaged about 30 million acre-feet per year. Under today's conditions of water development, such Delta outflow averages about 18 million acre-feet per year due to water use upstream from the Delta, and to exports from the Delta.

Freshwater runoff from the Sacramento River, San Joaquin River, and other tributaries only partially controls the extent of salinity intrusion into the Delta. Even under natural conditions, before any significant upstream water development, there was a natural deficiency of water supply for controlling salinity as far upstream as Antioch during summer months of dry years. The first recorded reference to salinity intrusion into the Delta was reported by Commander Ringgold of the U. S. Navy in 1841. During August of that year, Commander Ringgold encamped near the present site of Antioch and reported the river water as being brackish and unfit to drink.

With increasing use of water in the Central Valley, salinity intrusion became more frequent and intruded farther into the Delta. The yearly maximum extent of salinity intrusion from 1920 to 1964 is illustrated on Figure 5. This figure shows that, prior to operation of Shasta Reservoir of the Federal Central Valley Project (1944), salinity intrusion into the interior Delta was a common occurrence. Moderate to extreme salinity intrusion occurred every two or three years on the average. During the 25 years prior to operation of Shasta Reservoir, there were 7 years of severe salinity intrusion in the interior Delta.

In the summer of 1931, saline water was drawn into the Delta from Suisun and San Pablo Bays and intruded beyond Stockton. This condition occurred because tributary inflow for a period of about 3 months was not sufficient to supply all water being extracted for local use, primarily for agriculture. Similar but less severe conditions occurred in other years.

Figure 5


SEPT. 14, 1931
SEPT. 10, 1934
AUG. 18, 1939
SEPT. 12, 1924
SEPT. 2, 1929
SEPT. 10, 1930
SEPT. 6, 1932
SEPT. 22, 1937
SEPT. 6, 1940
SEPT. 6, 1926
SEPT. 16, 1920
SEPT. 10, 1933
SEPT. 13, 1921
SEPT. 20, 1922
SEPT. 6, 1935
SEPT. 2, 1936
SEPT. 8, 1943
SEPT. 6, 1925
SEPT. 2, 1928
SEPT. 12, 1923
SEPT. 14, 1927
SEPT. 10, 1941
AUG. 30, 1942
SEPT. 18, 1938
AUG. 30, 1958
SEPT. 6, 1952
JUL. 30, 1956
SEPT. 6, 1945
AUG. 6, 1946
SEPT. 14, 1948
AUG. 18, 1951
AUG. 18, 1953
AUG. 30, 1953
AUG. 2, 1962
JUL. 14, 1964
JUL. 30, 1957
AUG. 30, 1950
AUG. 26, 1960
AUG. 10, 1949
AUG. 22, 1955
JUL. 30, 1961
AUG. 18, 1954
JUL. 22, 1959
AUG. 18, 1944
AUG. 14, 1947
Freeport
Clarksburg
Courtland
Isleton
Rio Vista
Collinsville
Pittsburg
Antioch
Stockton
Lodi
Tracy
Terminous
Walnut Grove
Ryde
SACRAMENTO RIVER
SAN JOAQUIN RIVER
SACRAMENTO DEEP WATER CHANNEL
OLD RIVER
MIDDLE RIVER
GEORGIANA SLOUGH
MERRITT ISLAND
SUTTER ISLAND
PIERSON DISTRICT
HASTINGS TRACT
RYER ISLAND
GRAND ISLAND
TYLER ISLAND
ANDRUS ISLAND
BRANNAN ISLAND
MITCHELL ISLAND
BRADFORD ISLAND
SHERMAN ISLAND
VAN SICKLE ISLAND
CHIPPS IS.
BROWNS IS.
JERSEY ISLAND
WEBB TRACT
FRANKS TRACT
BETHEL TRACT
HOTCHKISS TRACT
HOLLAND TRACT
VENICE IS.
MANDEVILLE ISLAND
WEMPORD IS.
BOULDIN ISLAND
STATEN ISLAND
BRACK TRACT
CANAL RANCH TRACT
NEW HOPE TRACT
EMPIRE TRACT
KING ISLAND
SHIN KEE TRACT
RIO BLANCO TRACT
BISHOP TRACT
SHIMA TRACT
RINDGE TRACT
Mc DONALD TRACT
BACON ISLAND
WILLOW IS.
WRIGHT-ELMWOOD TRACT
SARGENT-BARNHART TRACT
LOWER ROBERTS ISLAND
ROUGH AND READY IS.
VEALE TRACT
PALM TRACT
ORWOOD TRACT
WOODWARD IS.
LOWER JONES TRACT
UPPER JONES TRACT
MIDDLE ROBERTS ISLAND
VICTORIA ISLAND
BYRON TRACT
CLIFTON COURT TRACT
UNION ISLAND
UPPER ROBERTS ISLAND
FABIAN TRACT
STEWART TRACT
LEGEND
LIMIT OF MAXIMUM INTRUSION OF SALINITY OF 1,000 PARTS OF CHLORIDES PER MILLION PARTS OF WATER
PRIOR TO OPERATION OF SHASTA RESERVOIR OF THE CENTRAL VALLEY PROJECT
SUBSEQUENT TO OPERATION OF SHASTA RESERVOIR OF THE CENTRAL VALLEY PROJECT
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
CENTRAL DISTRICT
SACRAMENTO - SAN JOAQUIN DELTA
HISTORICAL SALINITY INTRUSION
1920-1964
SCALE IN MILES
2 0 2 4 6

Subsequent to operation of Shasta Reservoir, water released from storage has augmented natural runoff enough to meet local use and to prevent saline water from intruding into the interior Delta. Had there been no releases from storage in Shasta Lake, salt water would have intruded well into the interior Delta in 7 of the 10 years from 1955 through 1964. An estimate of this condition is shown on Figure 6.

Under 1990 conditions of water development, when the presently authorized state and federal projects are operating at near maximum demand and with probable other upstream development, an average Delta outflow of about 9 million acre-feet per year can be expected. Wide variations from the average will continue to occur in wet and dry years. Through continued releases for salinity control, the dry-year conditions in the future will remain similar to dry-year conditions now, and these are the years in which salinity control for the Delta is most important.

Local Water Supply

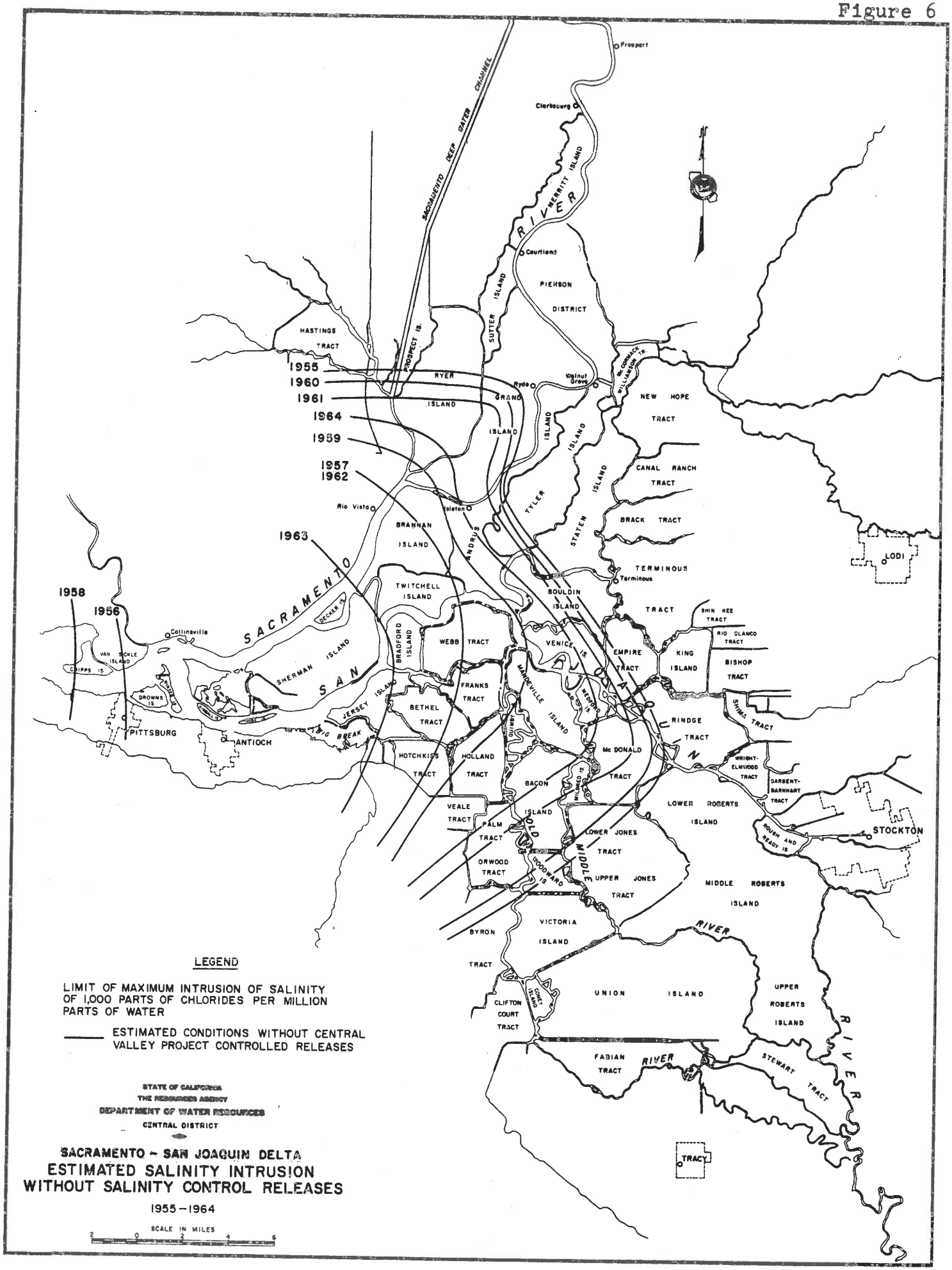
Because the Delta is open to the San Francisco Bay complex and the Pacific Ocean, there is never a shortage of water in the Delta. If the inflow from the Central Valley is insufficient to meet the consumptive needs of the Delta, saline water from the Bay will enter the Delta from the west. Thus, the local water supply problem in the Delta becomes one of water quality, not shortage in quantity. Degradation by agricultural return flows and by municipal and industrial waste discharges compound the problem.

Since 1944, when water releases from Shasta Reservoir for salinity control began, nearly all of the Delta agricultural area has had water of adequate quality, except for those areas diverting from the most westerly channels. In such areas, acceptable water quality has not been available in adjacent channels at all times, and farming practices and cropping patterns have been adapted to meet the prevailing condition. Also, a major portion of the southeastern Delta that is not freshened by Central Valley Project cross-Delta transfer water, has become increasingly degraded over the years, particularly during periods of low flow.

Water released from upstream reservoirs for salinity control has, however, assured a year-round supply of good-quality water to most of the interior Delta and has contributed to its continued development. Such releases will continue as the State Water Project and the Federal Central Valley Project are expanded. The Peripheral Canal (described later) will make these releases more effective in providing water quality control, particularly in the southern Delta.

Municipal and industrial water users in the western Delta area obtain their high-quality water supplies from both offshore diversion and, to a much greater extent, from the Contra Costa Canal. The Canal, the first unit of the Central Valley Project, was completed in 1940 to furnish water to the Contra Costa County Water District because water of suitable mineral quality was not

Figure 6



LEGEND

LIMIT OF MAXIMUM INTRUSION OF SALINITY OF 1,000 PARTS OF CHLORIDES PER MILLION PARTS OF WATER

——— ESTIMATED CONDITIONS WITHOUT CENTRAL VALLEY PROJECT CONTROLLED RELEASES

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
CENTRAL DISTRICT

SACRAMENTO - SAN JOAQUIN DELTA
ESTIMATED SALINITY INTRUSION WITHOUT SALINITY CONTROL RELEASES
1955 - 1964

SCALE IN MILES
2 0 2 4 6

available directly offshore on a year-round basis due to periodic salinity intrusion. Many of these users maintain dual water supply systems -- one to divert offshore water and the other to divert from the Contra Costa Canal. They divert offshore water when the quality is adequate to meet their needs and purchase canal water from the District when it is not. Contra Costa County Water District expects its high-quality water requirement to grow from about 84,000 acre-feet per year at present, to over 200,000 acre-feet per year by 1980, and to about 500,000 acre-feet by 2020. At the same time water requirements are increasing, the number of days of availability of high-quality offshore water will decrease because of increasing use of uncontrolled flows of the Central Valley. In wet years a considerable portion of the requirements can be met from offshore diversion, whereas in a dry year, most of the supply must be obtained from the Contra Costa Canal. The proposed Kellogg Project, or some similar project, is planned to supplement water supplies from the Contra Costa Canal as a solution to this problem.

Many of the industries use large quantities of cooling water, some of which experience problems from saline water. Replacement of poor-quality offshore water for cooling purposes is not feasible because of the large volume required, and alternative solutions must be used.

Transfer of Water Across the Delta

The Delta is the common point of collection and diversion of water to achieve the major objective of the California Water Plan -- that of adjusting the areal imbalance of California's water resources and needs. During 1966, 1.7 million acre-feet[5/] of water was transfered through Delta channels for the Federal Central Valley Project. As shown in Table 1, annual water transfer across the Delta for export with the State Water Project and with new units of the Federal Central Valley Project are expected to increase to almost 5 million acre-feet in 1976 and to about 8.5 million acre-feet in 2020.

5/ U. S. Bureau of Reclamation, "Report of Operations", December 1966.

TABLE 1

ESTIMATED QUANTITIES OF EXPORT PUMPING
(Millions of Acre-Feet)

Year	State Water Project	Federal Central Valley Project	Total
1966	---	1.74	1.74
1970	0.48	2.54	3.02
1976	1.88	3.10	4.98
1980	2.62	3.25	5.87
1990	4.38	3.74	8.12
2020	4.42	4.09	8.51

Studies made by the Department in the spring of 1967, show that by 1976, the combined draft on the Delta by both the state and federal pumps will be so large that, should a dry or critical year occur, there is a 17 percent risk of either not meeting water quality objectives or having to take a deficiency in water deliveries, unless the Peripheral Canal is operational. This is because an increasingly larger part of the export water transferred through existing Delta channels will flow around the western end of the Delta (reverse flow), carrying with it enough salt water from the San Francisco Bay system to seriously affect the quality of water being pumped. As pumping demand increases with time, both the risk and the magnitude of the consequences will become larger.

Through 1975, increasingly greater amounts of fresh water can be released from existing upstream storage reservoirs to provide the required outflow to protect water quality at the pumps. Beginning in 1976, the deterioration in quality would be caused by the continual buildup in export pumping, increase in upstream use, and a lack of sufficient stored water to provide releases for the increase in Delta outflow that would be necessary to protect the quality at the higher pumping rates.

This is the basic reason why Delta water transfer facilities are needed.

Fishery Resources

The Delta comprises a unique and varied environment important to the survival of a large segment of California's fishery resources -- and to the commercial and sport fishing industries that it supports.

Salmon and steelhead are migratory fish that pass through the Delta on their upstream spawning run and the young later move seaward through the Delta. An estimated 80 percent of the 8 million pounds of salmon caught in the ocean off California originate in the Sacramento-San Joaquin River systems. These salmon runs also

support many thousands of angler-days each year along the streams tributary to the Delta.

Striped bass, the most popular Delta sport fish, also migrate from the ocean into the Delta and upstream. An estimated 60 to 70 percent of the 4 to 8 million striped bass spawning each year in California, spawn in the Delta, and the young use the Delta channels as a nursery area[6/]. The striped bass fishery supports 2 million angler-days of sport fishing in the Delta, Bay, and ocean[7/].

Environmental conditions in the Delta can be improved substantially for fish and other aquatic life. The present adverse conditions are due to upstream water development in the San Joaquin River system and to the influence of the federal and state export pumping plants. Under the present method of water transfer, export pumping directly from the southern Delta causes a "reverse-flow" pattern in the western and southern Delta channels. Waste discharges, the effects of which are made more acute by low river flow and flow reversal from pumping, sometimes cause dissolved oxygen sags in the San Joaquin River near Stockton. In addition, a large percentage of "home-stream" water released from upstream water projects on the San Joaquin River and its tributaries is diverted directly to the export pumping plants upon reaching the Delta.

Collectively, the foregoing conditions:

(1) Interfere with the salmon migrating through the Delta.

(2) Draw large numbers of free-floating striped bass eggs and larvae through the louver screens into the export pumps.

(3) Decrease fish food supply in the Delta channels used for water transfer.

Also, under present conditions, the salinity gradient varies greatly over a long distance each season as the outflow from the Delta to the Bay varies from low in summer to high in winter and back to low the following summer. This causes great variation in the abundance and occurrence of marine and freshwater benthic fish food organisms, which cannot tolerate extreme and sudden salinity changes.

These and other problems associated with fish are discussed in a Summary Progress Report (Report No. 7) of the Delta Fish and Wildlife Protection Study, entitled "Water Development and

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6/ Delta Fish and Wildlife Protection Study, Report No. 7, "Water Development and the Delta Environment", December 1967; and USBR Preliminary Feasibility Report on Peripheral Canal, April 1966.

7/ Interagency Delta Committee Task Force Report, "Coordinated Plan", September 1964.

the Delta Environment", December 1967. This is a cooperative study being conducted by the Department of Fish and Game and the Department of Water Resources. The report points out that unless corrective action is taken, damage to fish can only increase with increased export for the state and federal projects.

The Peripheral Canal will change the export diversion points from the southern Delta to the Sacramento River near Hood and thereby eliminate the adverse effects of reverse flow on migrating salmon, striper spawning in the Delta, and fish food organisms. Both the California Department of Fish and Game and the U. S. Fish and Wildlife Service enthusiastically support the Peripheral Canal Plan. In the interim, however, temporary measures will be employed to reduce fishery problems in the Delta (see Appendix I).

Elements of an Acceptable Solution

An acceptable plan to solve the foregoing interrelated problems of the Delta must:

(1) Provide salinity control in the Delta;

(2) Provide a water supply of adequate quality to meet the present and future water requirements in the Delta;

(3) Avoid a complete adjudication of water rights of the entire Central Valley by providing a negotiated settlement that will protect water entitlements in the Delta;

(4) Provide for water transfer across the Delta for the state and federal water projects, without excessive deterioration in quantity or quality;

(5) Provide for meeting the Delta environmental needs, including the protection of fish and other aquatic life; and

(6) Be compatible with statewide water development as a whole so that present and future upstream and export water requirements can be met.

PERIPHERAL CANAL

Over the years the Federal Central Valley Project, the Sacramento River Flood Control Project, the Lower San Joaquin River Flood Control Project, the Sacramento and Stockton Deep-Water Channel Projects, and the State Water Project, have emerged to meet the needs of the people of California. These projects all converge at a common point -- the Delta. The jurisdiction for these projects lies within three principal construction agencies in water development -- the U. S. Bureau of Reclamation, the U. S. Corps of Engineers, and the California Department of Water Resources.

In 1959, the State Legislature passed the Burns-Porter Act, which included Delta water facilities as part of the State Water Project. In 1960, the Department published Bulletin 76, "Delta Water Facilities", a preliminary report on several waterway control plans. At that time, the Bureau of Reclamation and the Corps of Engineers were also in the process of conducting investigations in the Delta. Also, there were about 30 other agencies -- federal, state, and local -- as well as numerous special-interest groups and individuals, that were concerned with activities in the Delta. As would be expected with such a diversity of interest, numerous plans had been advanced, many directed toward solution of specific individual problems. Absence of a truly comprehensive plan for the Delta hindered realization of the separate plans.

This led to formation of the Interagency Delta Committee in late 1961.

Interagency Delta Committee

The Interagency Delta Committee was comprised of representatives from the Department of Water Resources, the Bureau of Reclamation, and the Corps of Engineers.

The main purpose of the Committee was the coordination of the various studies and the formulation of a mutually acceptable plan for the Delta.

Objectives. The objectives of this Committee were to evaluate all the requirements for an acceptable plan, to compare various alternative plans for meeting those requirements, and to recommend a plan which would best meet the requirements and be acceptable to the three construction agencies and to local interests.

The Committee first selected a set of planning objectives to cover the full range of water-associated activities in the Delta, to serve as the basis for selection of the best plan. The objectives included: water quality and transfer, local water supply, flood control, seepage and drainage control, navigation, fish and wildlife, recreation, and vehicular transportation. In the fall of 1963, the Committee presented the objectives before the California Water Commission and received its concurrence.

Identification and Comparison of Alternative Plans. The various plans were then classified into four basic concepts:

(1) Hydraulic Barriers - The transfer of water for export through existing Delta channels, accompanied by large releases of water from upstream storage reservoirs for salinity control;

(2) Physical Barriers - The transfer of water for export through existing Delta channels, with salinity control accomplished by a single barrier (low-level dam) in the bay system west of the Delta;

(3) Waterway Control Plans - The transfer of water for export through hydraulically controlled and modified Delta channels with the present level of salinity control accomplished by a continuation of moderate releases of water from upstream storage reservoirs. Water supply in the western Delta would be provided through overland facilities; and

(4) Peripheral Canal Plans - The transfer of water for export through a new, hydraulically isolated channel around the Delta, with the present level of salinity control accomplished by a continuation of moderate releases from upstream storage reservoirs. Irrigation water of adequate quality would be provided for the Delta by a combination of controlled freshwater releases from the Canal and overland water facilities in the western Delta.

After evaluation of the four concepts on the common basis of their relative ability to meet the established planning objectives, the Peripheral Canal emerged as the one which provided the greatest potential for development and the least interference with established and projected activities.

Selection of Plan. In January 1965, the federal-state Interagency Delta Committee recommended the Peripheral Canal concept as the best alternative for adaptation to the full range of water-associated needs in the Delta, while meeting the water transfer requirements of the state and federal water projects. This recommendation was made after more than three years of careful study of Delta problems. Findings from the first three years of the cooperative "Delta Fish and Wildlife Protection Study" by the Departments of Fish and Game and Water Resources were major considerations in selecting the Peripheral Canal over other alternative plans.

Public hearings were held before the California Water Commission at which time the plan received widespread and general acceptance. Local interests commenting to the Commission included agricultural groups, water districts, county and city levels of government, sportsmen's groups, and the commercial fishing industry.

The Interagency Delta Committee Plan provides for local water supply, flood control, salinity protection, fish and wildlife, recreation, and navigation in the Delta, as well as water conservation and transfer of water across the Delta for state and federal export. It centers on the Peripheral Canal concept and includes other components to fulfill all of the planning objectives. It is not a single project to be designed, constructed, and operated by a single agency. Rather, it is an overall framework within which the needs of many federal, state, and local entities can proceed cooperatively. It fulfills all of the elements of an acceptable solution. The plan includes the following components (the entity with primary responsibility for implementation is indicated in parentheses):

(1) Peripheral Canal (DWR and USBR).
(2) Kellogg Project (USBR).
(3) Western Delta Agricultural Water Facilities (DWR, USBR, and local interests).
(4) Southern Solano County Water Facilities (USBR or DWR).
(5) Delta Levee and Bank Protection Project (CofE).
(6) Stockton Deep-Water Channel Improvement Project (CofE).
(7) Suisun Marsh Management Program (local interests working with USBR and DWR).
(8) Suisun Marsh Recreation Facilities (local interests).
(9) Game Management Areas (California Department of Fish and Game).

The main functions of, and primary responsibility for, the components of the Committee's "Plan of Development, Sacramento-San Joaquin Delta" that are relevant to this report are summarized below:

(1) The Peripheral Canal, to transfer high-quality Sacramento River water to the state and federal pumps, to protect and enhance fishing, and to provide more efficient distribution of water within the Delta for a more uniform water quality for local use. The Department of Water Resources and the Bureau of Reclamation have a joint responsibility for implementation of this component of the overall plan.

(2) The Kellogg Project, to supplement water deliveries from the Contra Costa Canal to meet the expanding municipal, industrial, and agricultural water requirements in the Contra Costa County Water District, to improve the water quality, and to increase the reliability of the Contra Costa Canal delivery system. The present (1967) contracted water service through the Contra Costa Canal is limited to 86,000 acre-feet per year 8/. The Kellogg Project will expand the delivery capability of the Contra Costa Canal sufficient for the 195,000 acre-feet of annual water supply presently allocated from the Federal Central Valley Project; and, when additional conservation features are added, for the projected annual demand of about 440,000

8/ Contra Costa County Water District, "Kellogg Water Project", January 1967.

acre-feet. 8/ The Bureau of Reclamation was designated as having prime responsibility for implementation of this project.

(3) The Western Delta Agricultural Water Facilities, to provide a firm high-quality water supply in the western Delta where salinity control releases will not provide acceptable water quality in the adjacent channels. The extent and nature of these facilities are dependent on the water entitlement negotiations now under way among the Department, the Bureau, and local interests.

Adoption of the Peripheral Canal

In view of the recommendations of the Interagency Delta Committee and the favorable public reaction to the Plan, and as a result of their own independent studies and review of the Plan, the California Department of Water Resources and the U. S. Bureau of Reclamation have adopted the Peripheral Canal, a joint-use state-federal Delta water facility, as the Delta link in the State Water Project and the Federal Central Valley Project.

The Department of Water Resources has authority to construct the Canal alone or by joint venture under the 1959 California Water Resources Development Bond Act. The Bureau of Reclamation has completed a feasibility report on the Peripheral Canal as an additional unit of the Central Valley Project. The report has not yet (April 1969) been released by the Secretary of the Interior for review by interested agencies. Authorization from Congress is needed to proceed as a joint project with the State.

It is envisioned that the Canal will be built and operated generally as described by the Interagency Delta Committee. As such, extensive benefits will accrue to both the export water user and the Delta.

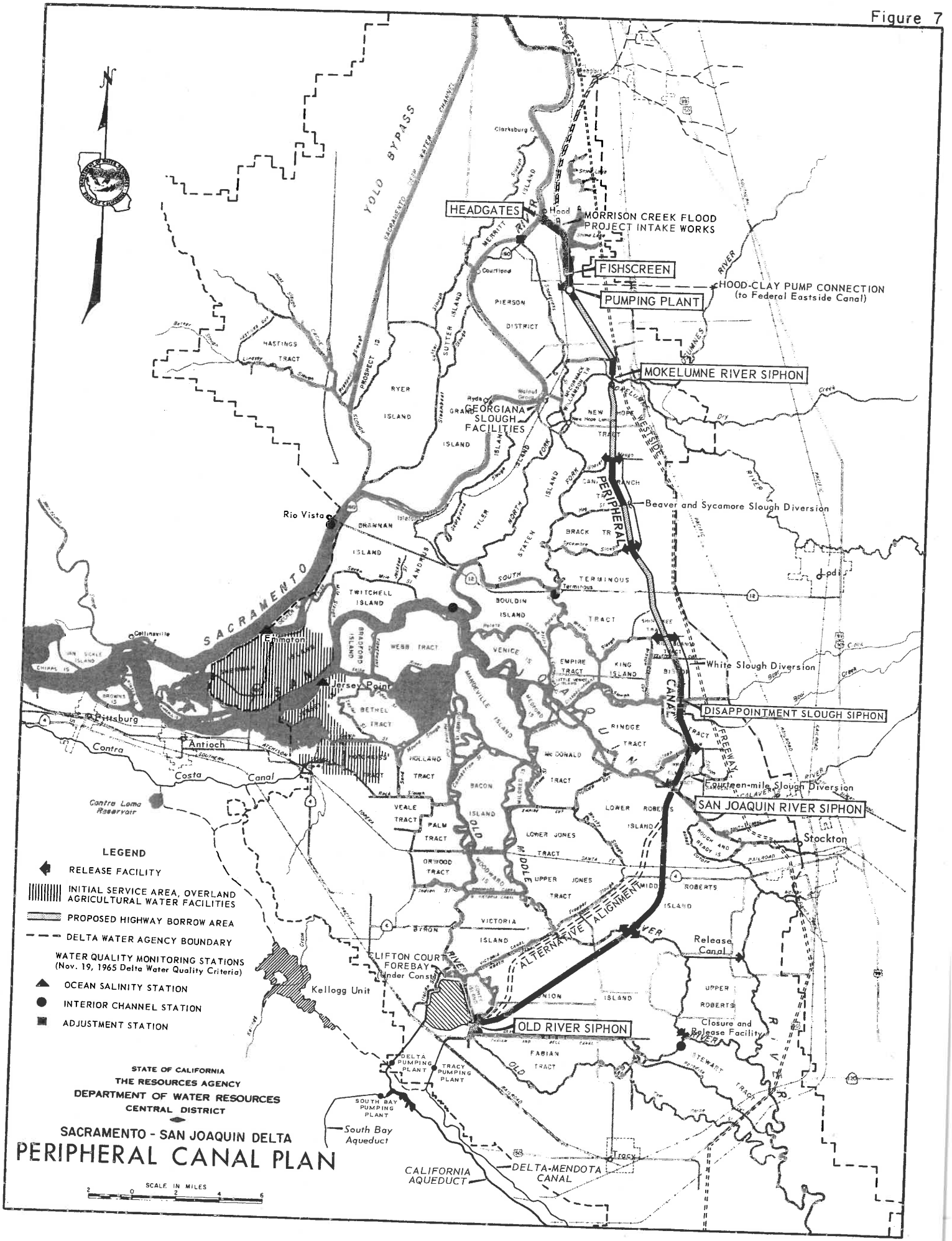
Description

The general location and proposed features of the Peripheral Canal are shown on Figure 7. The Canal will be a 43-mile earth channel skirting the eastern edge of the Delta. It will start from the Sacramento River at Hood, about 20 miles south of Sacramento, and will terminate at the federal and state export pumping plant intake facilities of the Delta-Mendota Canal and the California Aqueduct. The Canal will have an average water surface width of 400 feet, requiring right-of-way width varying from 700 to 1,000 feet, including levees and toe drains. The average depth will be 30 feet.

The Delta will be protected and served by this facility. Works will be included for screening fish at the canal intake, and

8/ Contra Costa County Water District, "Kellogg Water Project", January 1967.

Figure 7


HEADGATES
MORRISON CREEK FLOOD PROJECT INTAKE WORKS
FISHSCREEN
HOOD-CLAY PUMP CONNECTION (to Federal Eastside Canal)
PUMPING PLANT
MOKELUMNE RIVER SIPHON
GEORGIANA SLOUGH FACILITIES
Beaver and Sycamore Slough Diversion
White Slough Diversion
DISAPPOINTMENT SLOUGH SIPHON
Fourteen-mile Slough Diversion
SAN JOAQUIN RIVER SIPHON
Stockton
Release Canal
Closure and Release Facility
OLD RIVER SIPHON
ALTERNATIVE ALIGNMENT
CLIFTON COURT FOREBAY (Under Const.)
Kellogg Unit
DELTA PUMPING PLANT
TRACY PUMPING PLANT
SOUTH BAY PUMPING PLANT
South Bay Aqueduct
CALIFORNIA AQUEDUCT
DELTA-MENDOTA CANAL
Tracy
Rio Vista
Antioch
Pittsburg
Contra Costa Canal
Contra Loma Reservoir
Jersey Point
Collinsville
PERIPHERAL CANAL
SACRAMENTO RIVER
YOLO BYPASS
LEGEND
RELEASE FACILITY
INITIAL SERVICE AREA, OVERLAND AGRICULTURAL WATER FACILITIES
PROPOSED HIGHWAY BORROW AREA
DELTA WATER AGENCY BOUNDARY
WATER QUALITY MONITORING STATIONS (Nov. 19, 1965 Delta Water Quality Criteria)
OCEAN SALINITY STATION
INTERIOR CHANNEL STATION
ADJUSTMENT STATION
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
CENTRAL DISTRICT
SACRAMENTO - SAN JOAQUIN DELTA
PERIPHERAL CANAL PLAN
SCALE IN MILES
2 0 2 4 6

for making releases to Delta channels. Recreation development is planned along the Canal.

The alignments of the Canal and the lower reaches of the floodway for the proposed Morrison Creek Flood Control Project in Sacramento County will be combined and floodflows will be accepted into the Canal. Right-of-way acquisition for the Canal is being coordinated with construction of the Westside Freeway (Interstate 5) in San Joaquin and Sacramento Counties so that excess dirt from the canal prism can be used as fill material for the Freeway. Coordination of the Peripheral Canal with these two projects will result in several hundred acres less land being taken out of agricultural production and cost savings of about $15 million in public funds.

The capacity at the headworks will be 21,800 second-feet (26,800 second-feet with the first 2-1/2 miles enlarged for the Hood-Clay pump connection of the proposed Eastside Canal of the Federal Central Valley Project). The terminal capacity will be 18,300 second-feet. Below the Hood-Clay pump connection, a pumping plant will lift the water 11 feet to provide the required flow. The Canal will be siphoned under the major stream crossings to allow for flood passage, fish migration, and navigation. Water from certain other sloughs and channels will be siphoned under the Canal.

The estimated development cost is $202.6 million[9/] ($208.9 million with the enlarged capacity to serve the Eastside Division). The estimated annual equivalent cost of development, including operation, maintenance, replacement costs, and repayment of development costs is $9.2 million (excluding Eastside Division).

Turnout gates or pumps will be installed at the major rivers and sloughs where the Canal crosses. These are shown by arrows on Figure 7. High-quality water will be released at these points for Delta agriculture, water quality control and aquatic life, to meet the water quality criteria that have been or are now being negotiated with local interests in the Delta.

Concept for Operation

The Peripheral Canal will carry approximately 10.2 million acre-feet of high-quality water annually, divided between 8.5 million acre-feet for export to federal and state service areas, and about 1.7 million acre-feet for local Delta uses and water quality control. This latter amount constitutes a redistribution of a portion of the existing water supply necessary to satisfy local water requirements, including Delta outflow for salinity control. The remaining Delta

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9/ Estimate by Bureau of Reclamation using unit prices prevailing in January 1968. (Does not include possible escalation of construction costs which may occur between date of estimate and the completion of the project.)

requirements would continue to be met from precipitation and water flowing into the Delta via the Sacramento and San Joaquin Rivers and other tributaries.

Of the 8.5 million acre-feet for export, about 4.4 million acre-feet will be used by the State Water Project in the South Bay, San Joaquin Valley, Central Coastal, and Southern California service areas. Approximately 4.1 million acre-feet is for the Federal Delta-Mendota Canal, San Luis, Contra Costa Canal-Kellogg, and San Felipe service areas of the Federal Central Valley Project.

In the future, the water quality of the Sacramento River is expected to average between 100 and 150 ppm[10/] of total dissolved solids annually. This is well within the quality limits specified in the State and Federal Contracts (refer to Appendix D).

Both the U. S. Bureau of Reclamation and the Department of Water Resources plan to operate the joint-use Peripheral Canal, in conjunction with the reservoirs of the Federal Central Valley Project and the State Water Project, so as to meet the requirements of the November 19, 1965 Delta Water Quality Criteria which have been negotiated with local Delta interests (discussed later). Water rights for the State Water Project are conditioned on meeting these criteria (Water Rights Board Decision D-1275 and D-1291). Furthermore, it is probable that the permits for the Federal Central Valley Project will also be conditioned to these criteria since the State Water Resources Control Board has jurisdiction over salinity control in the permits for that project (Water Rights Board Decision D-990).

Briefly, the November 19 Criteria provide that the quality of water in the Sacramento River at Emmaton and in the San Joaquin River at Jersey Point will be prevented from exceeding 1,000 ppm chlorides[11/]. This is essentially equal to the level of salinity control historically resulting as a by-product of transporting and protecting the quality of water pumped at the intakes to the Delta-Mendota and Contra Costa Canals of the Federal Central Valley Project. There are relaxations in critical years that are analogous to a deficiency in water deliveries taken by other project beneficiaries in such years.

The criteria also provide for springtime flushing flows to prevent the quality of water from exceeding an average mean daily chloride content of 200 ppm for at least a consecutive 10-day period during April or May in all but dry or critical years. Furthermore, the criteria specify quality limits at specific locations for the interior Delta channels that will assure Delta water users of irrigation water of adequate quality. The criteria are summarized in Table 2.

10/ IDC Task Force Report, "Coordinated Plan", September 1964.

11/ Average mean daily value for any 10 consecutive days.

TABLE 2

SUMMARY OF
NOVEMBER 19, 1965 DELTA WATER QUALITY CRITERIA

Unit of Measurement	Water Supply Conditions			
	Critical Year	Dry Year	Below Normal Year	Normal (or above) Year
CRITERIA FOR DETERMINING KIND OF WATER YEAR				
Forecasted full natural inflow to Shasta Lake in millions of acre-feet 1/	Equal to or less than 3.2 2/	More than 3.2 but not more than 4.0	More than 4.0 but not more than 4.5	Greater than 4.5
CRITERIA FOR SALINITY CONTROL Emmaton and Jersey Point 3/				
Avg. mean daily Cl^-, in ppm, for any 10-consec.-day period	1,000 except 1,400, 8/1 thru 12/31	1,000	1,000	1,000
Avg. mean daily Cl^-, in ppm, for at least one 10-consec.-day period during Apr.&May	Not required	Not required	200	200
CRITERIA FOR WATER QUALITY CONTROL, INTERIOR DELTA 4/ Terminous, Rio Vista, San Andreas Landing, Clifton Court Ferry, and Bifuracation of Middle & Old Rivers 5/				
Mean 10-day avg. TDS, ppm	700 except 800, 4/1 thru 12/31	700 except 800, 4/1 thru 12/31	700 except 800, 8/1 thru 12/31	700
Mean monthly TDS, ppm	500 except 600, 4/1 thru 12/31	500 except 600, 4/1 thru 12/31	500 except 600, 8/1 thru 12/31	500
Mean annual TDS, ppm (calendar yr.)	450 except 500 6/, 4/1 thru 12/31	450 except 500 6/, 4/1 thru 12/31	450 except 500 6/, 8/1 thru 12/31	450

1/ Determined for current water year, Oct. 1 of preceding calendar year thru Sept. 30 of current calendar year.

2/ A critical year also exists when a total accumulated deficiency (below 4.0 MAF) of 0.8 MAF occurs for the current & preceding consecutive yrs.

3/ After 1980, the locations of the control stations at Emmaton & Jersey Point may be moved upstream to, but not beyond, 3-Mile Slough if operating experience shows that controlling salinity intrusion at Emmaton & Jersey Point creates undue hardship on the state & federal projects.

4/ Values shown may not be exceeded except when the recorded TDS content at Greens Landing on Sacramento River exceeds a mean 10-day or a mean monthly value of 150 ppm TDS, the quality criteria for these stations may be changed by adding to the tabulated values the product of 1-1/2 times the amount by which the recorded TDS content at Greens Landing exceeds 150.

5/ Bifuracation of Middle & Old Rivers applies only after Peripheral Canal goes into operation.

6/ Average of all interior Delta stations shall not exceed 450 ppm.

The location of the Delta water quality monitoring stations specified under these criteria is shown on Figure 7, page 23.

The November 19 Criteria also provide that, after 1980, the locations of the control stations at Emmaton and Jersey Point may be moved upstream as far as Threemile Slough, and that substitute water facilities be provided for the area affected by such a move; if the parties agree that operating experience indicates that controlling salinity at Emmaton and Jersey Point will create undue hardship on the state and federal projects.

The parties also retain their rights under established law to avoid waste of water through the installation of a physical solution for the furnishing of substitute water where it becomes uneconomic to provide high-quality water in the adjacent channels. Some of the control points could then be moved upstream.

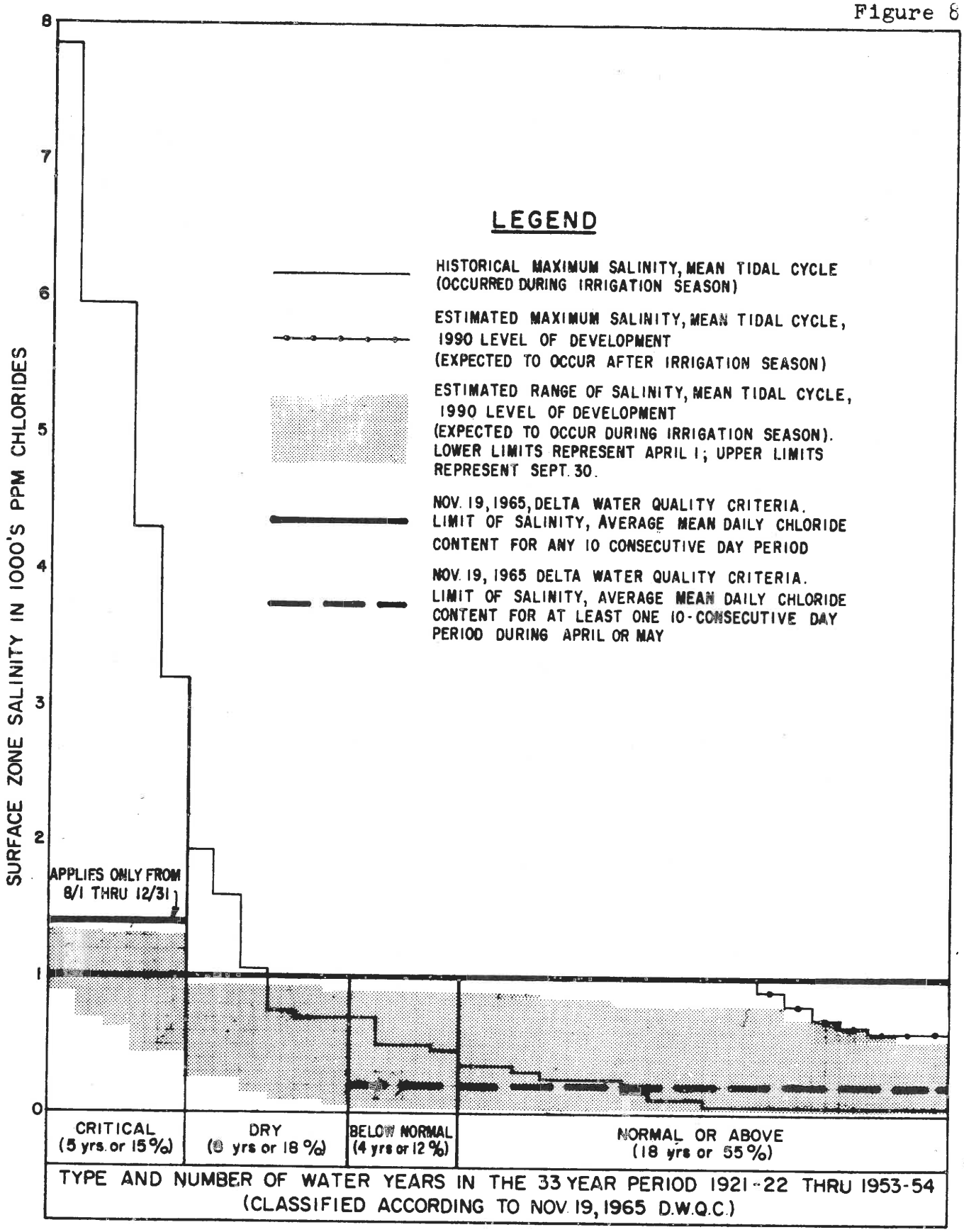
The magnitude of salinity intrusion in the Delta relates to natural hydrologic conditions in the Central Valley Basin tributary to the Delta and to regulated salinity control releases from upstream storage reservoirs. Figure 8 illustrates the relationship between historic salinity intrusion in the Sacramento River at Emmaton and estimated future salinity conditions with the federal and state water projects operated under the provision of the November 19 Criteria at that location.

In all years, the releases to meet these criteria will fully protect the water quality in the interior Delta and, in dry and critical years, will improve the water quality in the western Delta. In normal and below normal water years, the chloride content of inchannel water in the western Delta will exceed the historic value, but the maximum can be expected to occur after the irrigation season is ended. Except for critical years, inchannel water quality is expected to average about 500 ppm chlorides during the irrigation season at Emmaton. Upstream, the quality would be better.

Under provisions of Section 12202 of the California Water Code, the Department of Water Resources plans to provide for a firm high-quality water supply through overland conveyance facilities to the western Delta agricultural areas where salinity control releases do not now provide, or will not provide, acceptable water quality in the adjacent channels.

Water released from the Peripheral Canal into the Delta channels to supply local needs and to control water quality and salinity intrusion will play the dual role of protecting and enhancing the Delta environment. . .

Findings from the "Delta Fish and Wildlife Protection Study" by the Departments of Fish and Game and Water Resources, indicate that when operated pursuant to the November 19 Criteria, the Peripheral Canal will have substantial operational flexibility for meeting the environmental needs of fish and other aquatic life.



HISTORIC AND FUTURE
IN-CHANNEL WATER QUALITY AT EMMATON

This study is being continued to develop specific design and operating criteria for the project. From 1961 to 1971, over $3.4 million of State Water Project funds will be invested in the study. Of this, about $2.4 million will be for biological investigations and analyses by the Department of Fish and Game, and about $1 million for the engineering aspects of the studies by the Department of Water Resources.

Interim measures have been adopted for protection of the fishery resources of the Delta for the period prior to construction of the Peripheral Canal. These measures are outlined in a 4-agency memorandum of understanding (contained in full in Appendix I) by the Departments of Fish and Game and Water Resources, and the Federal Bureaus of Reclamation and Sport Fisheries and Wildlife.

In general, the concept for operation of the Peripheral Canal is to distribute the total amount of water needed for Delta agricultural use and controlled freshwater outflow for salinity control, plus any uncontrolled surplus flows not needed for export, in the best way to achieve a balance among all of the beneficial uses of Delta waters. This concept is best illustrated by examining the various seasons of the year.

For example, during the winter months when surplus flows in the Sacramento River are normally high and requirements for zooplankton as fish food are small, leaching of salts from agricultural lands constitutes the primary use of water and would govern the operation of the Peripheral Canal. Even though water is not required for consumptive use, good-quality (less than 100 ppm TDS) Sacramento River water would be conveyed through the Canal to upgrade the quality of San Joaquin River water under this concept. The blended water could be expected to range between 100 and 250 ppm TDS [12/] in most southern and eastern Delta channels under normal conditions.

During the early spring months striped bass migrate from the ocean and bay into fresh water to spawn. By conveying a portion of the Sacramento River water in the Canal that is required to meet irrigation and salinity control requirements, water could be blended to provide less than 350 ppm TDS in Old, Middle, and Mokelumne Rivers to encourage striped bass to move into these areas. Releases into the main San Joaquin River would be kept to a minimum to encourage good production of zooplankton.

During about a 30-day period in midspring when the water reaches the spawning temperature between 60 and 65°F, the Peripheral Canal would be operated for striped bass spawning in the Delta by providing sufficient areas of water with less than 180 ppm TDS [12/].

[12/] Delta Fish and Wildlife Protection Study, Report No. 7, "Water Development and the Delta Environment", December 1967.

A balance would be maintained between spawning areas and fish food-producing areas. This is compatible with the springtime flushing flows required under the November 19 Criteria.

In all but dry and critical years, diversions for export would be kept at a minimum for a 30-day period during the peak of striped bass spawning in the Sacramento River. This would allow many of the free-floating eggs and larvae to drift past the Peripheral Canal intake into the central and western Delta and would enable them to hatch and grow in a locality away from the influence of the export facilities. If the historical spawning pattern prevails under future conditions, a larger proportion of striped bass would spawn below the Peripheral Canal intake in dry years; hence fewer eggs and larvae would be subjected to the pumps.

Beginning in summer as soon as spawning is completed, canal releases would be adjusted to increase residence time and concentration of dissolved minerals and nutrients in Delta channels to improve the supply of fish food for the newly hatched bass.

Beginning in mid-July, young striped bass usually shift from zooplankton to Neomysis for food. Because of this shift in food preference, a large portion of Sacramento River water needed to meet the high consumptive use and salinity outflow requirements in the eastern and southern Delta could be released from the Peripheral Canal without harm to the fishery. These large releases would assure positive downstream flows in most Delta channels to prevent the buildup of salts and pollutants, and would provide good-quality water throughout the remainder of the summer for irrigation and recreation.

As the season moves into fall and king salmon spawning migration begins, releases of Sacramento River water from the Canal would be reduced, consistent with maintenance of adequate quality, to assure a high proportion of homestream water in migration channels. This would aid salmon in returning to their spawning streams of origin. It would minimize the attraction of Sacramento River salmon into the southern Delta and deadend sloughs where releases are made.

Accomplishments

Properly operated in conjunction with upstream reservoirs of the Federal Central Valley Project and State Water Project, the Kellogg Project, and the Western Delta Agricultural Water Facilities (discussed later), the Peripheral Canal promises a number of important accomplishments. It is the only plan that can distribute a freshwater supply to all parts of the interior Delta, and at the same time provide a positive downstream flow through Delta channels toward the San Francisco Bay. The Canal will:

(1) Provide salinity control in the Delta in fulfillment of the November 19, 1965 Delta Water Quality Criteria and ensure good-quality water for the Delta by transporting fresh water for release and redistribution within Delta channels to meet up to 1.7 million acre-feet annually of the total Delta requirement (including outflow). This would provide a positive downstream net flow through Delta channels toward the San Francisco Bay. The remaining Delta requirement would continue to be met from precipitation and water entering and flowing in natural channels.

(2) Reduce channel scour and lessen strain on Delta levees.

(3) Deliver high-quality water from the Sacramento River directly to the pumps for the Kellogg Unit, or some similar project, assuring a year-round supply from the Contra Costa County Water District that could be kept below 20 ppm chlorides and 60 ppm hardness. This would insure an improvement in water quality over historic conditions where mineral constituents have exceeded 360 ppm chlorides and 300 ppm hardness.

(4) Fulfill the water transfer and water quality requirements of the State Water Project and the Federal Central Valley Project by transporting up to 8.5 million acre-feet of high-quality water annually from the Sacramento River to aqueducts serving federal and state service areas, while avoiding water quality problems from pumping directly from the Sacramento-San Joaquin Delta. This will:

(a) Eliminate up to 490 thousand tons[13/] of salt annually from irrigation water supplied by federal and state projects in the San Joaquin Valley. Such improved water quality would result in cost savings to agriculture from reduced application of water for leaching, and a decreased requirement for drainage disposal at the Delta.

(b) Assure the delivery of water to Southern California only 1/5 as hard and with only 1/5 the total salts as water from the Colorado River -- the southland's major source of supply at present [14/].

[13/] Informal advance copy of USBR Feasibility Report on Peripheral Canal, September 1968.

[14/] Metropolitan Water District, 27th Annual Report.

(c) Prevent waste of up to about 2 million acre-feet of water per year 15/. This is the estimated amount of additional water that would have to be developed and released from storage reservoirs into the Delta for extra salinity control in order to meet water quality objectives at the export pumps, without the Peripheral Canal -- water that cannot be guaranteed after 1976 from present facilities should a dry or critical year or series of such years occur. The current estimated cost of providing an additional 2 million acre-feet of water in the Delta from future north coastal storage projects is about $1 billion -- about 5 times the cost of the Peripheral Canal.

(5) Prevent great damage to the commercial and sport fisheries and other aquatic life that are dependent on the Delta, and substantially enhance these important resources by eliminating the impact of water transfer and pumping from southern Delta channels and providing better flow distribution throughout the Delta 16/. Operated as described, it will:

(a) Maintain a long (about 50 miles) gradual salinity gradient for migratory game fish.

(b) Prevent flow reversal in all of the main fish migration channels (50 to 100 miles reverse under present conditions) and provide a positive downstream flow in almost all Delta channels.

(c) Reduce to less than 10 percent the removal of striped bass eggs and larvae by the export pumps.

(d) Provide an environment conducive to good production of fish food organisms.

(e) Provide sufficient and well-dispersed areas with TDS levels below 180 ppm during the late spring for striped bass spawning.

(f) In conjunction with appropriate waste discharge controls, keep dissolved oxygen at a satisfactory level.

(g) Help regulate the intermixing of Sacramento, Mokelumne, and San Joaquin River water during the peak of the salmon run to aid the homing ability of these fish.

15/ Interagency Delta Committee Task Force Report, "Coordinated Plan", September 1964.

16/ Delta Fish and Wildlife Protection Study, Report No. 7, "Water Development and the Delta Environment", December 1967.

Scheduling

The Peripheral Canal must be built soon -- by 1976 if possible. If the Canal is not operational by 1976, there is a 17 percent risk of either not meeting water quality objectives or having to take deficiencies in water deliveries, unless remedial work is performed in the Delta. The risk of not meeting these objectives, and the extent that the water quality objectives would be exceeded or deficiencies suffered, increases each year that the completion of the Canal is delayed.

Within the Delta, the quality in the lower San Joaquin and Old River systems would be affected similarly, since they carry the water for export. Also, further damage to the Delta fishery that is caused by the increased export pumping directly from the Delta must be halted.

Local interests in San Joaquin County have strongly urged that construction of the Canal and the Westside Freeway (Interstate 5) be coordinated to minimize hardships on local landowners and disruption to the local economy.

On January 18, 1968, the Department of Water Resources and the Division of Highways entered into an agreement whereby Highways will advance funds interest-free to Water Resources for the acquisition of borrow sites in San Joaquin County. On September 11, 1968, the Department entered into a similar agreement for the area between Mokelumne River and Lambert Road in Sacramento County. The money will be repaid when Water Resources and the U. S. Bureau of Reclamation need the right-of-way for canal construction, but not later than January 1, 1976. Through joint construction of the two projects, material can be excavated from within the proposed canal prism by the Division of Highways and used as fill for the proposed freeway. This action will result in significant cost savings to both projects, as well as reducing the impact of the projects on the local economy. The borrow areas are shown on Figure 7, page 23.

Congressional authorization for federal participation in the joint-use canal is urgently needed to allow the Department and the Bureau to complete this joint venture in an orderly manner by the 1976 completion date. The Bureau has given assurances that expenditures by the State for acquisition of this portion of the Canal will be credited to the State's share of the Canal when congressional authorization for the federal share is received.

DELTA WATER ENTITLEMENT NEGOTIATIONS

Water entitlements in the Delta have been the subject of intense study and discussion for several years. Considerable progress has been made toward agreements to protect these entitlements.

With construction and operation of the State Water Project under way, and with works being proposed for the Delta Water Facilities, considerable concern is being expressed by some Delta interests over the effects of this development on Delta water rights, water supplies, and environment.

The Delta and Delta water users are protected by law. Provisions in the California Water Code governing the construction and operation of the State Water Project are quite explicit. Protection is based upon the fundamental law of riparian and appropriative water rights, the County of Origin Act, the Area of Origin Law (sometimes referred to as the Watershed Protection Act), the Delta Protection Act, and the Burns-Porter Act. Such protection, however, is limited to the reasonable and beneficial use of water.

Purpose and History of Negotiations

The Department is negotiating with Delta interests for two basic reasons:

(1) To meet department responsilities pursuant to the California Constitution and various laws protecting the Delta; and

(2) To avoid a complete, costly, and time-consuming adjudication of water rights of the entire Central Valley.

During the 1950's the Department of Water Resources cooperated with the Bureau of Reclamation and the local Delta water users in studies to identify individual entitlements to the waters of the Sacramento River and the Delta. These studies, using the classical approach to solution of water rights problems, considered priority of rights to quantity of water rather than quality. No resolution was reached in the Delta using this approach. Actually, in the Delta, the question of quantity is of little concern, since the Delta is never short of water. If flow from the tributary streams were insufficient to meet Delta use, water from the Pacific Ocean would flow through the San Francisco Bay system and fill the Delta channels.

Beginning in 1963, the Department of Water Resources, the Bureau of Reclamation, and representatives of two local Delta water users' organizations began negotiations specifically to resolve the Delta water entitlement problem. The local organizations are:

(1) The Sacramento River and Delta Water Association (SRDWA), representing Delta water users in Sacramento, Yolo, and Solano Counties, and parts of Contra Costa and San Joaquin Counties.

(2) The Delta Water Users Association (DWUA), acting as the San Joaquin Water Rights Committee (SJWRC) and representing water users in San Joaquin County and part of Contra Costa County.

Together, these 2 Associations represent about 90 percent of the Delta agricultural area, including about 40 percent of the agricultural lands in Contra Costa County.

In 1964, separate negotiations among the Bureau of Reclamation, the Department of Water Resources, and the Negotiating Committee for Contra Costa County's Water Requirements (NCCCCWR) were initiated. This Committee attempted to include representation of all water users in Contra Costa County interested in offshore quality -- municipal, industrial, agricultural, recreational, fish and wildlife, esthetics, etc. In the many months of discussions that followed, little progress was made with this Committee due primarily to its large size (about 50 people), and to the complex and diverse requirements and problems of the many interests involved. Consequently, at the request of individual interests within the group and with committee concurrence, some of those represented on the Committee began independent negotiations with the Department.

In essence, negotiations fall into two areas -- the main Delta, that area that will be protected by the November 19, 1965 Delta Water Quality Criteria and thereby provide irrigators an inchannel water supply of acceptable quality through such protection; and the western Delta, that area where overland water conveyance facilities or other alternative solutions will be required to provide an adequate water supply.

Main Delta Negotiations

Since water shortage in the Delta is not a problem, it was necessary to develop a quality "yardstick" to guide project operation in the Delta. This "yardstick" was established on November 19, 1965, when negotiations among the Sacramento River and Delta Water Association, the Delta Water Users Association, the Bureau of Reclamation, and the Department of Water Resources reached the first concrete achievement with agreement to the "Delta Water Quality Criteria". These criteria, summarized earlier and contained in full in Appendix A, set forth quality limits for inchannel Delta waters and specify the locations of stations to monitor conformance. Under provisions of the criteria, saltwater intrusion will continue to be repelled to approximately the same point as it has been in the summertime by the Federal Central Valley Project.

Representatives of the two Delta groups (Sacramento River and Delta Water Association and Delta Water Users Association) agree that the criteria will assure that water of adequate quality will be available throughout the main Delta to protect water entitlements and to meet present and future needs. The criteria can be met without wasting California's limited and valuable water supply.

It is planned that these criteria will be included in a contract among the Bureau of Reclamation, the Department of Water Resources, and the recently formed Delta Water Agency. Under this contract, sufficient inflow to the Delta will be guaranteed by the projects to meet the consumptive demands, to provide dilution water for the maintenance of a high-quality inchannel water supply throughout the main Delta, and to provide an outflow to limit salinity intrusion in the western Delta in accordance with the criteria.

The responsibility (between the Bureau and the State) for performance under the contract will be settled in the operating agreement being negotiated between the operators of the Federal Central Valley Project and the State Water Project. The inflow distribution capability of the Peripheral Canal is required to assure that this high-quality water will be available throughout the Delta, particularly in the southeastern portion.

Western Delta Negotiations - General

The Department recognizes that the provisions of the November 19 criteria do not guarantee an all-year inchannel supply of usable water to water users in the extreme western Delta area. This area has not had a dependable all-year inchannel supply of fresh water. The parties to the agreement also recognize that it would be impractical and wasteful to provide a salinity control outflow from the Delta of sufficient magnitude to guarantee such an inchannel supply in this area. As discussed later, it is far less costly, in terms of both money and water, to supply good-quality water in this area through overland water transportation facilities.

Overland water facilities, in conjunction with continued salinity control, are an inseparable part of the Peripheral Canal Plan. They will play an increasingly important part as uncontrolled winter flows and conserved but unmarketed supplies are further depleted by authorized exports and new upstream developments. While joint project operation (CVP and SWP) pursuant to the November 19 Criteria will limit the extent and magnitude of saline intrusion in the western Delta, export and upstream use of that portion of the Delta inflow not required to meet these criteria, will cause the duration of salinity intrusion in the extreme western Delta to increase. This will reduce the period of time that good-quality water will be available as compared to that which has been enjoyed in recent years largely as a result of releases of conserved but unmarketed water supplies from the CVP reservoirs.

The concept of an overland water supply system in the western Delta is not new. It was because water of suitable quality was not available directly offshore to Contra Costa County on a year-round basis that the Contra Costa Canal was constructed. Completed in 1940, this Canal provides overland conveyance of protected quality water from Rock Slough, an interior Delta channel, to westerly service areas of Contra Costa County adjacent to the offshore salinity-intruded tidal channels of the western Delta and Suisun Bay.

The concept was extended in Department of Water Resources Bulletin No. 76, "Delta Water Facilities", and in the Interagency Delta Committee report, "Plan of Development, Sacramento-San Joaquin Delta". Both of these plans provided for a Delta outflow to protect the majority of the Delta from salinity intrusion and substitute overland water supply facilities in those areas where an all-year high-quality water supply has not been and will not be available in adjacent channels.

Western Delta Agricultural Negotiations

The extreme western Delta agricultural area (see Fig. 10, p. 56) includes those lands adjacent to: (1) the Sacramento River shore of Sherman Island below Threemile Slough; (2) the San Joaquin River shore of Sherman and Jersey Islands below False River; and (3) the Dutch Slough shore of Jersey Island and Hotchkiss Tract below Taylor Slough.

General concurrence has been obtained from landowners on Sherman Island as to the overland water conveyance facility to be provided. Plans for these facilities are now being studied in more detail for cost determination preparatory to engaging in the second round of discussions concerning the allocation of costs among participants in the negotiations.

Several possible overland water conveyance systems have been considered for the Hotchkiss Tract and Jersey Island areas. It is contemplated that water will be obtained for Hotchkiss Tract from the intake channel to the Contra Costa Canal. As a result, direct participation in the negotiations by the Bureau of Reclamation will be required. Water to serve Jersey Island would be diverted from Taylor Slough.

After the participants reach final agreement on a system of overland water conveyance facilities that will provide an all-year, good-quality water supply to the areas referred to, the capital, operation, and maintenance costs will be estimated. After mutual agreement as to the costs of the facilities, the costs will be allocated as follows: (1) that portion of the cost of the facilities attributable to betterment will be allocated to the local water users; and (2) the remaining cost will be allocated to upstream diverters. The responsibility of sharing this latter portion will be decided in further negotiations.

Western Delta Municipal Negotiations

There are two municipal users of offshore water in the area, the Contra Costa County Water District and the City of Antioch. Both of these users presently depend upon the Contra Costa Canal supply when the offshore quality degrades beyond acceptable limits for their purposes.

The Contra Costa County Water District diverts a portion of its water supply at Mallard Slough, opposite Chipps Island, when the chloride ion content of the water (mean tidal cycle surface zone) is 100 parts per million or less. The City of Antioch diverts its total requirements from offshore adjacent to the City when the chloride ion content of the water (high high tide) is 250 parts per million or less.

On April 21, 1967, negotiations with the District resulted in an agreement which calls for compensation by the State for offshore water lost because of any reduced availability of high-quality water due to the operation of the State Water Project. Historic availability of 100 ppm Cl^- water (MTC) at Mallard Slough has varied from a low of 25 days (1930-1931 water year) to a high of 240 days (1937-1938 water year) and has averaged 142 days for the period 1926 through 1959).

The actual loss of availability in days will be determined each year as the difference between the annual measured availability and the average annual historic availability. Credit will accrue for annual availabilities in excess of the historic average to offset future years' losses. The daily quantity of water lost is measured as the actual demand on the system capable of service from the point of diversion. The value of this loss will be determined as the difference in the cost of diverting offshore water and the average cost of water delivered from the Contra Costa Canal as augmented by other facilities, such as the Kellogg Project.

The extent of State Water Project responsibility has been negotiated at one-third of the total loss of availability sustained by the District due to all water development in the Central Valley.

On April 11, 1968, negotiations with the City of Antioch resulted in an agreement similar to that with the District. Historic availability of 250 ppm Cl^- water (HHT) at Antioch has varied from a low of 97 days (1930-1931) to a high of 285 days (1937-1938) and has average 208 days for the period 1925 through 1943. The compensation realized under this agreement will be used to purchase water from the Contra Costa County Water District.

The agreements with the Contra Costa County Water District and the City of Antioch are included in Appendix B to this report.

Western Delta Industrial Negotiations

There are many industries in the Antioch-Pittsburgh area of the western Delta that use offshore water. These are shown on Figure 4 (page 8).

Seven of these industries, plus two outside the Delta, protested the State's applications to appropriate water for the State Water Project. In essence, they alleged that there would be damage caused by loss of availability of a freshwater supply due to operation of the State Water Project. During the hearings held before the State Water Rights Board in 1966 concerning the Department's applications, these industries withdrew their protests and stipulated that they believed a settlement could be achieved through negotiation without requiring excessive Delta outflow.

Water quality problems vary with each industry as does the type of water use. These nine industries and the uses of offshore water with which problems may develop are shown in the following tabulation:

Name of Industry	Process Water	Cooling Water
Allied Chemical Corporation[1/]	X	X
Crown-Zellerbach Corporation	X	
Dow Chemical Corporation	X	X
E. I. duPont de Nemours & Co.	X[2/]	
Fibreboard Paper Products Corp.		
Antioch Division	X	
San Joaquin Division	X	X
Johns-Manville Products Corp.	X	
Phillips Petroleum Company[1/]		X
U. S. Steel Corporation	X	X
Western California Canners, Inc.		X

[1/] Located outside statutory Delta.
[2/] For irrigation use.

Process Water. Industries divert process water from offshore when the water is of acceptable quality for their needs and depend on the Contra Costa Canal supplies when the offshore water degrades during the summer.

There are three basic alternatives for solving the problems contemplated in obtaining process water supplies from offshore: (1) Modify existing plant operations and facilities to enable the continued use of future higher saline offshore waters; (2) Replace

the offshore water with water from the Contra Costa Canal system during that period of time when the offshore water is unacceptable; or (3) Continue to use offshore water and accept the higher operation and maintenance costs and product quality degradation resulting from such use. In negotiations to date, all industries have elected the second alternative -- replacement of offshore water with water from overland facilities.

The Department is attempting to reach agreements similar to the agreement with Contra Costa County Water District in that compensation would be based on the loss of high-quality water each year when measured against a historic average. Compensation for reduced availability due to operation of the State Water Project would be in the form of annual payments, enabling the industry to purchase a substitute supply and transport the supply to its location.

Cooling Water. Increased chloride content (resulting from upstream development of Central Valley water) in offshore water supplies used for cooling purposes can cause increased operation and maintenance costs. Replacement of offshore water for cooling purposes from an overland supply is not feasible because of the large volume required by each industry. The industries involved with cooling water problems have four basic alternatives from which to choose: (1) Continue use of the offshore supply, preventing corrosion in the cooling system through deaeration or by installation of corrosion-resistant material; (2) Continue use of the offshore supply regardless of the salinity and accept more frequent replacement and increased maintenance costs; (3) Install cooling towers to supply a coolant directly to the existing heat exchange equipment; or (4) Install a modification of the cooling tower alternative by providing a closed cooling loop. In any event, any added cost incurred as a result of State Water Project operation would be the basis for compensation.

Although special design and selection of materials offer a means of operating cooling equipment in an environment of high salinity, it is difficult to identify all the factors contributing to the increased cost resulting from corrosion and equipment degradation. A major and expensive plant modification might be necessary to adjust to new salinity conditions. Because of the magnitude and complications of this problem, the Department has retained the consulting firm of Sheppard T. Powell and Associates of Baltimore, Maryland, to assist in its evaluation.

The form of settlement may vary with the unique situation of the industry. One alternative would be that the basis of compensation would be the capital expenditure required to make the cooling system virtually independent of the effects of salinity. After reducing the capital expenditure by a sum which represents the "betterment" of the industry's facilities, a portion of the resulting expenditure would be paid to the industry each year, dependent upon the average annual chloride content of the river during the year when measured against a historic average. The total amount payable to the industry during the term of the agreement would not exceed a negotiated share of the total capital expenditure.

Another alternative is based on the quantity of high-quality water required to blend the offshore water to a specified concentration. Although water would not actually be purchased, the computed volume required for the blend would provide a fluctuating parameter that would vary directly with the offshore salinity. This parameter would be used to compute the required compensation to offset the increased operations and maintenance costs resulting from variations in offshore salinity.

Other Problems

In addition to the direct problems of agricultural, municipal, and industrial "offshore" water uses which are relatively easy to assess, the Negotiating Committee for Contra Costa County Water Requirements has asserted several other adverse effects on inchannel water uses due to the planned operation of Central Valley Project and State Water Project. These include increased damage by marine borers, harm to fish, wildlife, and recreation, and lowered waste assimilation capacity.

Specifically, they asked if the Department and the Bureau would recompense for "losses" to Contra Costa's economy due to:

> (1) "Damage to wharfage resulting from increased teredo invasion and to boat hulls and appurtenant boating facilities resulting from greater exposure to saltwater environment?"; and
>
> (2) Damage to the Delta's fishery, esthetic environment, affect the recreational economy, and the diminution of assimilative capacity?" 17/

There is no evidence that operation of the Federal Central Valley Project and the State Water Project will result in any of the problems cited by the Negotiating Committee for Contra Costa County's Water Requirements. Alleged detriments, such as damage from increased activity of marine borers (Teredo Navalis), damage to the esthetic environment, and lowering of the recreation economy are of such a nature that they could only be evaluated under actual operating conditions. The Department has proposed that a study group composed of local, state, and federal interests be formed to monitor actual conditions and to suggest corrective measures if such problems develop.

In regard to damage to the Delta fishery, the Department's cooperative study with the Department of Fish and Game (discussed earlier) has shown that the Peripheral Canal provides the greatest opportunity of all Delta plans studied to protect and enhance environmental conditions for fish.

17/ Letter of June 29, 1966 from Mr. Harvey O. Banks, Chairman, and Mr. John A. Nejedly, Vice Chairman, Negotiating Committee for Contra Costa County Water Requirements; to Mr. Robert J. Pafford, Regional Director, USBR; and Mr. William E. Warne, Director, DWR.

In regard to lowering of waste assimilation capacity, there is no right to pollute. To the extent that any facility of the State Water Project adds to pollution of any waters, the State will participate with other contributors to assess and correct or prevent the problem. Moreover, waste assimilative capacity in the western Delta results from a complex relationship of many factors, including aeration, tidal diffusion, photosynthesis, etc. Tidal action overshadows Delta outflow as a source of dissolved oxygen in the western Delta during the critical summer months. Only during large floods does the outflow contribute a substantial amount of dissolved oxygen to the waters of the western Delta, and the intermittent and unpredictable nature of these flows renders the accompanying increase in assimilative capacity unreliable and therefore unusable by any municipality or industry. Consequently, the effect, if any, of the Federal Central Valley Project and State Water Project operations on usable assimilative capacity will be negligible, since project facilities will not be capable of substantially reducing the total outflow during flood periods.

EVALUATION OF INCREASED SALINITY CONTROL

Several proposals have been made for Delta salinity control standards more stringent than those set forth in the November 19, 1965 Delta Water Quality Criteria. The effects of each of these proposals on required storage and cost of water, and the local benefits derived are considered in the following sections. In addition, affected Delta water requirements, alternative measures and costs, and the reasonable and beneficial use of water are discussed.

Proposals to Upgrade Salinity Control Standards

The Water Quality Act of 1965 (P.L. 89-234, 79 Stat. 903) (1965) provides that the Federal Government would establish water quality standards for interstate and coastal waters if the states involved did not themselves set the standards. The principal purpose of the federal act is to abate waste discharges that pollute water and lower its quality.

In the Delta, however, various interests have also proposed the establishment of standards for limiting the degree of natural salinity intrusion. Such proposals seek to increase the freshwater flow into the Delta in order to push back the natural salt waters of San Francisco Bay. This can only be accomplished through releases of water stored in conservation projects upstream. A summary of the more significant proposals can be found in Appendix E.

The Department of Water Resources has adopted the November 19, 1965 Delta Water Quality Criteria but has opposed several of the other proposals because of excessive costs, more practical alternatives, and waste of water.

Amount and Cost of Water to Increase Salinity Control

The degree of salinity control in the Delta is directly dependent upon the amount and duration of net outflow from the Delta. Increased salinity control above the November 19 Criteria would require additional supplies of stored or imported water which could come from a number of sources. The additional water for the Delta was assumed to be imported from the north coastal area of the State. Development of north coastal supplies will require a series of extensive and expensive projects such as outlined in Bulletin No. 136, "North Coastal Area Investigation", September 1964. The amount and cost of additional water, however, depend on the desired degree of increased salinity control.

Planning for these import projects is generally in the reconnaissance stage, with the exception of the Middle Fork Eel River Development (Dos Rios Reservoir) which has been authorized as the next source of water for the State Water Project.

The individual projects necessary to supply large volumes of water to the Delta have been integrated into a staged plan for use in this report. The staging sequence of projects represents only a single solution to a complex problem. It is preliminary in nature and applicable to this report only.

The details of each stage and the staging sequence chosen are presented in Appendix G.

The total amount of critical period or firm water yield that could be supplied by these projects is 7,350,000 acre-feet/yr. In many normal or wet years, Central Valley basin reservoirs could release more water (than assumed in existing studies) to provide potentially larger yields at the Delta while meeting other project commitments. These increased "normal" or "wet" year yields could be applied to increase Delta outflow, thereby reducing the required imports from the north coastal area in such years. However, large reservoir drawdowns introduce a risk factor, if the next year should be dry, which the operating agencies probably would be unwilling to take unless they had adequate reserves in carryover storage. Moreover, such releases would not reduce the required import to guarantee a supply during a critical period and therefore would have little effect on reducing the cost of water for increased salinity control.

The estimated unit cost of future increments of north coastal import varies from $16 to $40 per acre-foot. Neither the most nor least expensive increment of water should be assigned to increased salinity control. As presented in Appendix G, a value of $30 per acre-foot is considered an appropriate value to use at this time, in estimating the cost of a long-term, future commitment of water for increased salinity control on a firm, no-deficiency basis. Of this amount, $25 per acre-foot represents the average capital cost component, with interest, and $5 per acre-foot represents the average annual operation , maintenance, replacement, and energy cost component. Of the $5 per acre-foot, approximately $3 represents fixed annual cost, with the remaining $2 variable, depending on the amount of water imported in a particular year. No distinction was made in the cost estimates between possible state or federal projects and expenditures. The estimates indicate how much water is available from these sources and how much it will cost the developing agency.

The estimates of outflow required to meet the various proposals for increased salinity control are depicted as incremental amounts of water in excess of those necessary to operate within the provisions of the November 19 Criteria. These amounts were determined from results of a theoretical mathematical simulation of salinity intrusion, which is a function of Delta outflow, tidal diffusion, and time.

Evaluations of the various proposals were made assuming a 1990 level of development, and operation in the Delta within the provisions of the November 19 Criteria. Delta outflows, based on

the 33-year hydrologic cycle (1921-22 through 1953-54), were used in the mathematical simulation to predict what patterns of salinity intrusion would occur in 1990 for conditions represented by each of the 33 years. Salinity predictions were also made for the 7-year critical period (1927-28 through 1933-34).

The salinity gradients developed from the mathematical simulation represented conditions that would exist if the outflows were held constant long enough that intrusion no longer increased with time. From these gradients, interpolations were made to determine any given concentration of chlorides at specific locations on the gradient.

Table 3 presents the estimated additional amounts and costs of water required to meet selected proposals for increased salinity control, and also the number of days per year that the objectives of the proposals could not be met. The annual costs for additional water presented in this table are based on the cost of developing sufficient upstream storage to meet the proposed salinity control during the critical period. Therefore, even in a wet year, when additional storage releases are not required, there is a sizable annual cost for repayment of the capital investment, with interest, and fixed annual costs. The only difference between the annual cost in wet, critical, and average years would be the difference in variable annual costs that depend on amount of water imported, such as cost of power for pumping.

As stated earlier, the provisions of the November 19 Criteria limit the quality of inchannel water from exceeding 1,000 ppm chlorides at control points located in the Sacramento River at Emmaton and the San Joaquin River at Jersey Point. Evaluations were made to determine the additional amounts and costs of water that would be required (over and above that necessary to meet the November 19 Criteria) to move the control points further downstream to various westerly points. For this purpose, refinements to reflect relaxed criteria in critical years and springtime flushing flows in normal and below normal years were not made. These evaluations are presented in Figure 9, page 49.

The Figure shows, for example, that it would require an additional outflow of 1,900 cfs just to move the control points 6 miles downstream to Antioch. To supply this water during a critical period, approximately .9 million acre-feet of water would have to be wasted to the ocean annually. The capital cost of building new upstream storage projects to furnish this water would be about $500 million. The average annual cost would be about $25 million.

TABLE 3

ESTIMATED ADDITIONAL QUANTITIES AND COSTS
TO MEET SELECTED PROPOSALS FOR INCREASED SALINITY CONTROL

AGENCY	NUMBER	Proposal	Additional Outflow Required[1] (cfs)	Additional Capital Cost Required[2] (Billions of $)	Condition	Estimated Additional Amount and Cost of Water from Storage, 1990 Level of Development				Number of Days per Year Proposal Not Met	
						Water in Millions of AF[3]	Annual Capital Cost, in Millions of $	Annual Operations Cost, in Millions of $	Total Annual Cost, in Millions of $	Hist[4]	1990[5]
CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD	1	San Joaquin River at the City of Antioch water intake, 100 ppm Cl^-, 1-1/2 hrs. after HHT, 50% of any year.	8,500	1.0	Wet Year (1938)	0	49.3	5.8	55.1	0	0
					Critical Year (1931)	3.12	49.3	12.0	61.3	122	182
					Critical Period (1928-34)	13.80	49.3	9.8	59.1	46	162
					Average Annual	0.80	49.3	7.4	56.7	23	96
	2	San Joaquin River at the City of Antioch water intake, 250 ppm Cl^-, 1-1/2 hrs. after HHT, 60% of any year.	5,700	0.9	Wet Year (1938)	0	41.5	5.0	46.5	9	21
					Critical Year (1931)	2.45	41.5	9.9	51.4	120	219
					Critical Period (1928-34)	11.62	41.5	8.3	49.8	51	197
					Average Annual	0.85	41.5	6.7	48.2	19	116
	3	San Joaquin River at Jersey Point, 250 ppm Cl^-, 1-1/2 hrs. after HHT, 79% of any year.	1,700	0.3	Wet Year (1938)	0	14.2	1.7	15.9	0	0
					Critical Year (1931)	0.94	14.2	3.6	17.8	152	270
					Critical Period (1928-34)	3.99	14.2	2.8	17.0	71	211
					Average Annual	0.34	14.2	2.4	16.6	26	119
	4	Combining (1) and (3), above.	-	1.2	Wet Year (1938)	0	57.5	7.0	64.5	-	-
					Critical Year (1931)	3.48	57.5	14.0	71.5	-	-
					Critical Period (1928-34)	16.10	57.5	11.6	69.1	-	-
					Average Annual	1.12	57.5	9.2	66.7	-	-
CONTRA COSTA COUNTY WATER AGENCY	5	At Jersey Point, 100 ppm Cl^- at MTC, 100% of any year.	1,900	0.5	Wet Year (1938)	.08	21.2	2.7	23.9	0	58
					Critical Year (1931)	1.36	21.2	5.2	26.4	232	350
					Critical Period (1928-34)	5.95	21.2	4.2	25.4	151	300
					Average Annual	0.74	21.2	4.0	25.2	89	203
	6	Mallard Slough, 100 ppm Cl^- for 142 days between Nov. 1 and June 30[6].	27,300	2.9	Wet Year (1938)	0	134.6	15.9	150.5	0	1
					Critical Year (1931)	7.54	134.6	31.0	165.6	117	142
					Critical Period (1928-34)	37.66	134.6	27.0	161.6	31	133
					Average Annual	1.60	134.6	19.1	153.7	0	94
	7	Blind Point, 250 ppm Cl^- at HHT. (Critical year, 500 ppm Cl^- from Aug. 31-Dec. 31)	3,500 (1,900)	0.8	Wet Year (1938)	0.31	36.0	4.9	40.9	0	76
					Critical Year (1931)	1.99	36.0	8.3	44.3	219	365
					Critical Period (1928-34)	10.11	36.0	7.2	43.2	114	326
					Average Annual	1.06	36.0	6.4	42.4	40	248
N/A	8	Combining (1) and (5), above.	-	1.4	Wet Year (1938)	0.10	66.5	8.2	74.7	-	-
					Critical Year (1931)	3.60	66.5	15.2	81.7	-	-
					Critical Period (1928-34)	18.60	66.5	13.3	79.8	-	-
					Average Annual	1.50	66.5	11.0	77.5	-	-

[1] Additional outflow required over that necessary to meet the provisions of the Nov. 19, 1965 Delta Water Quality Criteria.

[2] Approximate capital cost of additional storage facilities necessary to provide the additional outflow.

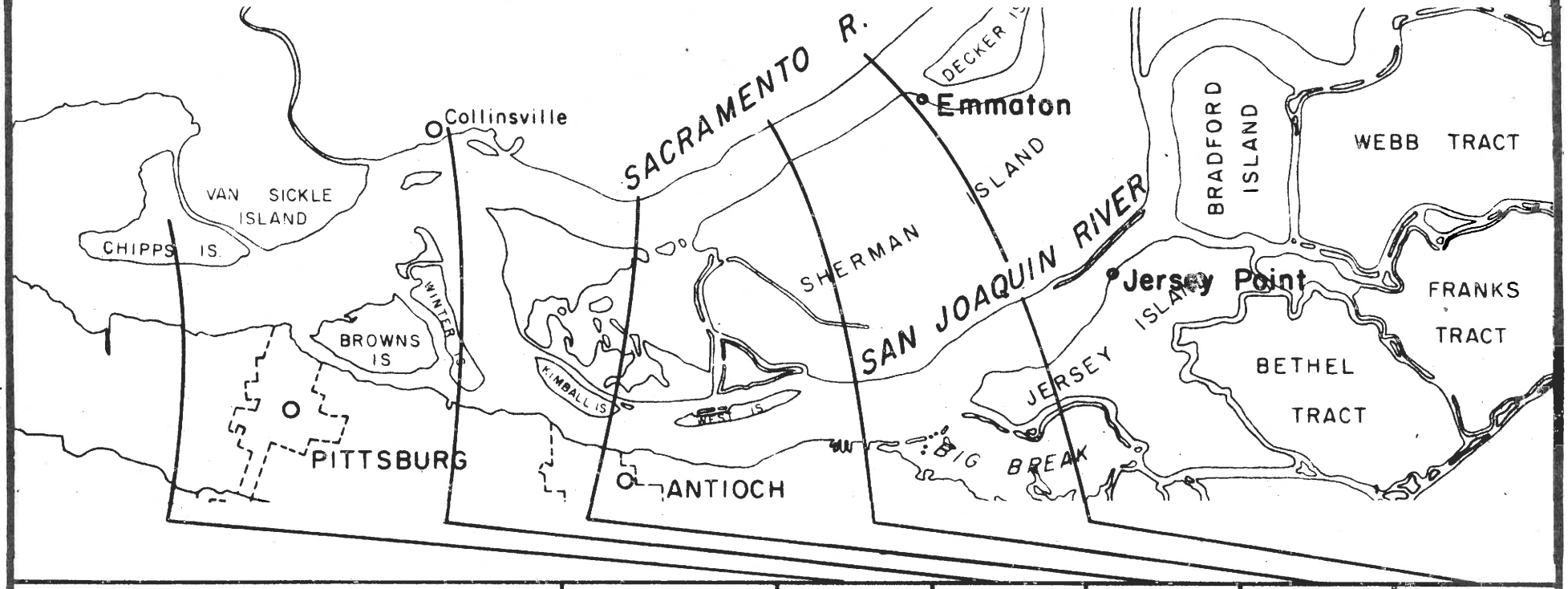
[3] Based on water year (Oct. 1 to Sept. 30).

[4] Historic conditions based on the period 1926-64 (calendar years).

[5] 1990 level of development based on the period 1922-54 (calendar years) and assuming project operated to meet provisions of Nov. 19 criteria.

[6] This proposal is to limit diversion for storage and direct use. Values assume export is continued.

ESTIMATED ADDITIONAL AMOUNT & COST OF WATER TO MOVE 1000 ppm Cl^- MTCSZ,* BELOW EMMATON (1990 Level of Development)



ESTIMATED ADDITIONAL OUTFLOW REQUIRED (Steady State)	cfs	7500	3700	1900	500	0
ADDITIONAL AMOUNT OF WATER REQUIRED FROM STORAGE	MAF/YR (Avg. for critical period 1927-28 thru 1933-34)	4.4	2.1	.9	.24	0
CAPITAL COST OF ADDITIONAL STORAGE FACILITIES	BILLIONS OF DOLLARS	2.4	1.1	0.5	0.1	0
AVERAGE ANNUAL COST OF ADDITIONAL WATER FROM STORAGE	MILLIONS OF DOLLARS	132	63	25	7	0

*MEAN TIDAL CYCLE SURFACE ZONE

Figure 9

This amount of water, enough to supply a city of 4 million people for 1 year, would be unavailable for other beneficial uses during these critical periods when it is most needed. Water supply can be provided to the affected area at reasonable cost through overland conveyance facilities without this waste. Also, the inchannel needs of fish and other aquatic life can be met when the proposed Peripheral Canal is operated in compliance with the provisions of the November 19 Criteria.

Accomplishments of Increased Salinity Control

Economics of inchannel water quality include the examination and evaluation of benefits, detriments, and costs as a result of changing water quality. Theoretically, the objective should be to maximize the net benefits so that the last incremental benefit added to the system under study is equal to the incremental cost. Several reports on the Delta have included sections on the economics of water quality, but none have covered all the parameters of the standard "with and without" evaluation for any of the specific proposals for increased salinity control above the November 19 Criteria. A brief discussion of the water quality economics presented in the more significant reports is included in Appendix F.

There is sufficient information available in the reports to give an indication of the magnitude of such benefits as compared to the cost of the additional Delta outflow required to produce them.

General. The Metcalf-Eddy Report ("An Economic Evaluation of the Water Quality Aspects of Contra Costa County's Offshore Water Supply", November 1965) presents estimates which indicate a difference of $6.7 million annually in the economic value between an all-year inchannel quality of 10 ppm chlorides and 10,000 ppm chlorides at Antioch. The uses evaluated included industry, recreation, agriculture, municipal, and waste assimilation. Overland water supplies in the western Delta were not considered.

As explained in Appendix F, this estimated value was reduced to $5.7 million annually for use in this report as an approximation of the upper limit of possible annual benefits from increasing salinity control in the western Delta beyond that of the November 19 Criteria (approximately 2,000 to 2,500 ppm Cl^- at Antioch), again without considering overland water facilities to serve the western Delta. (If the western Delta facilities were considered, the benefit of increasing salinity control would be reduced even further.)

The cost of providing water for this increased salinity control was not included in the Metcalf and Eddy report. In Figure 9, however, the average annual cost of additional outflow to provide 1,000 ppm chlorides at Chipps Island (approximately 100 ppm at Antioch) was estimated as $132 million. By projection, the annual cost of additional water to provide 10 ppm chlorides at

Antioch would probable be in excess of $200 million -- which is more than 35 times the benefits. Even if a more thorough analysis should show benefits to be larger, such benefits would be limited by the alternative cost. Water needs in the western Delta can be met at far less cost through overland water facilities.

Specific. The various proposals for increased salinity control would provide varying degrees of protection to the inchannel water quality in the western portion of the Delta. This area represents about 10 percent of the total Delta, however, and only a small portion of the total Delta water requirements (presented in Appendix C) would be affected.

For example, control that provided 250 ppm Cl^- 1-1/2 hours after H.H.T., 79 percent of any year at Jersey Point (proposal No. 3, Table 3), would insure inchannel water of good quality for an additional 13,200 acres of agricultural lands not provided an adequate supply by the November 19 Criteria. This area has a net water requirement of about 35,000 acre-feet annually as compared to the total Delta agricultural water requirement of about 1,600,000 acre-feet a year (net channel depletion). Gross annual income from crops grown probably would not exceed $3.4 million -- assuming $254/acre, the average gross farm income in the Delta (Appendix H, Table H-2). This increased protection, however, would require development of an additional annual yield of 570,000 acre-feet during the critical period at a cost of $16.6 million per year. This additional yield is more than 16 times the amount of water required to serve these lands through overland conveyance facilities.

Municipal and industrial high-quality water users in Contra Costa County are presently supplied by both offshore diversion and, to a much greater extent, by a substitute overland supply -- the Contra Costa Canal. None of the proposals would fully protect the offshore water enough to supply all of these users. Among the regional boards' proposals, the one that would provide the greatest benefit to these users would insure 100 ppm Cl^- 1-1/2 hours after H.H.T. for only 1/2 the time at Antioch (proposal No. 1, Table 3). It is estimated that less than 60,000 acre-feet annually of the area's supply (excluding cooling water) under a 2020 level of development could be protected under this proposal. The remainder of the time, high-quality water would still have to be supplied from the Contra Costa Canal, supplemented by the proposed Kellogg Project in the future. The increased protection has an annual price tag of $56.7 million, and would require about 2 million acre-feet of water per year during a critical period. These uses can be served through substitute facilities at far more reasonable cost in terms of both water and money.

None of the proposals for increased salinity protection would have a measurable effect on the water requirements for recreation, esthetics, and fishlife.

First, recreation would not be affected by the salinity content of Delta waters. People can recreate on slightly saline water as well as on fresh.

Second, there will be only a relatively small change of salinity (from present), insufficient to materially alter the esthetics. There will be the same amount of water surface in the Delta and no change in the "view from the shore".

Third, most fish and wildlife in the Delta would not be appreciably benefited by the proposals for increased salinity control. The November 19 Criteria and the Peripheral Canal will provide the operational flexibility for meeting the environmental needs for fish and other aquatic life in the Delta. A trial period of operation of the Peripheral Canal will be carried out to assure desired results before final operating criteria are adopted. The establishment of additional water quality criteria before studies and a meaningful period of trial operation are completed could restrict the flexibility of this approach.

Benefits Foregone

Assuming that there are beneficial uses in the Delta other than those protected by the November 19 Criteria and overland water facilities, the question which next must be answered is whether their protection is justified when large and costly freshwater releases would be required. The mere fact that a use may be beneficial is not sufficient reason for protection if the use is not also reasonable.

The California Water Code (Section 100) declares that water resources of the State be put to the fullest beneficial use possible; that waste or unreasonable use be prevented; and that conservation be exercised. The Legislature has also declared that the use of water for domestic purposes is the highest use of water, and the next highest use is for irrigation (Water Code Sections 106 and 1254). Delta exports by the State Water Resources Development System will meet both domestic and agricultural needs. These needs must be weighed against any possible benefits the Delta could derive from additional freshwater releases which could otherwise be exported.

In evaluating the economic cost of using stored or imported water for salinity repulsion in the Delta, it must first be recognized that such water is a limited resource in California and that a long-term commitment of a significant portion of this resource to one purpose will preclude its use for some alternative purpose.

Second, it must be recognized that to maximize the net benefits from the use of this limited resource, water must be put to the highest use within the framework of existing and potential demands, including those for municipal, industrial, and agricultural purposes.

Within this context, the benefits that could be realized from alternatives of "higher use" in the economic sense must be considered as foregone and therefore charged against the function of salinity repulsion. Such benefits foregone have not been estimated for this report, but would be at least as great as the development costs of stored or imported water.

Alternative Measures and Costs

As an alternative to providing additional outflow for increased salinity control in the western Delta, Section 12202 of the Water Code specifies that adequate substitute water supplies may be provided (in lieu of salinity control) if it is in the public interest to do so and if no added financial burden is placed on the water users in the Delta. The alternative measures discussed herein include substitute water supplies from the Western Delta Overland Agricultural Water Facilities and the Contra Costa Canal-Kellogg Project system. Also discussed are possible plant equipment changes and incremental operation and maintenance costs for western Delta industries.

Western Delta Overland Agricultural Water Facilities. Agricultural water demands in the western Delta can most economically and efficiently be met from an overland water conveyance system bringing water from interior Delta channels 18/. Initial overland facilities would be placed in operation for a trial period and remaining works constructed as needed. Such initial overland works would function in conjunction with salinity repulsion outflows required to meet the November 19 Criteria.

These initial works would not increase the net water requirements of the western Delta agricultural area and would not detract from the net outflows provided for salinity repulsion. Rather, the extractions by the overland works from the interior channels would be offset by the decrease in the present level of diversions from the channels adjacent to the agricultural use areas.

The purpose of the overland agricultural water facilities is to provide a good-quality irrigation water at times when water of acceptable quality is not available from the channels immediately adjacent to the western Delta farmlands. Historically, a portion of the agricultural requirement has been met by seepage coming in from the channels and rising to the root zone of the crops grown on Delta lands below sea level. Such seepage generally progresses very slowly and thus the seepage water arriving in the plant root zone represents the average composite quality of water escaping from the channels for many years. The Department believes that the composite quality of the seepage water, even under future conditions, will be

18/ California Department of Water Resources, Bulletin No. 76, "Delta Water Facilities", December 1960; and Interagency Delta Committee, "Plan of Development, Sacramento-San Joaquin Delta", January 1965.

of acceptable quality when blended with the overland supply. (It has been estimated that, under future conditions, the blended water quality would average about 160 ppm chlorides at the center of the area requiring substitute water supplies 19/.)

The overland facilities will not interfere with the current practices of applying surface water, periodic leaching during the noncropping season, and extensive field drainage collection and disposal through centralized pumping plants.

The original proposals for overland agricultural water facilities included lined, perimeter canals near the toe of the landward side of the levees. The revised water distribution plans, which have been developed in coordination with the Delta landowners, eliminate the perimeter canal concept in favor of unlined ditches located away from the levees. This latter design has met with more landowner approval and has removed the possibility of affecting levee stability.

The November 19 Criteria specifies certain maximum salinity concentrations and durations at Emmaton and Jersey Point which are not to be exceeded by operation of State Water Project and Federal Central Valley Project. These criteria are scheduled to be applicable during the trial operation period extending to 1980.

During this initial period prior to the full buildup of demand for state and federal project water, it is assumed that no overland works would be required. However, to guard against severe loss in the event of water-short years, initial overland facilities are proposed for Sherman Island, Jersey Island, and the Hotchkiss Tract area. The water supply for Sherman Island would be drawn from Threemile Slough, the supply for Jersey Island from Taylor Slough, and the supply for Hotchkiss Tract from the Rock Slough portion of the Contra Costa Canal intake.

The November 19 Criteria also provide that, after 1980, the locations of the control stations at Emmaton and Jersey Point may be moved upstream as far as Threemile Slough, and that substitute water facilities be provided for the area affected by such a move; if the parties agree that operating experience of controlling salinity at Emmaton and Jersey Point will create undue hardship on the state and federal projects. The extended facilities would serve all or parts of Bethel, Webb, Bradford, Twitchell, and Brannan Islands, in addition to the initial works required to serve Sherman Island, Jersey Island, and Hotchkiss Tract.

The maximum probable service area for overland agricultural facilities was estimated to cover 28,900 acres. This area would

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19/ IDC Task Force Report, "Coordinated Plan", September 1964.

obtain acceptable-quality water directly from Delta channels further upstream. The capital cost of the facilities to serve this area was estimated to be $6.8 million by the Interagency Delta Committee in 1965. This cost included $2.8 million to serve 15,000 acres on Sherman Island, Jersey Island, and Hotchkiss Tract. Costs to serve the affected 13,200 acres on these three islands are estimated to be about $2 million. The initial and maximum probable western Delta agricultural water service areas are shown on Figure 10.

The average annual cost of facilities, including return of capital, with interest, is estimated to be less than $200,000 for the 3 affected areas on Sherman Island, Jersey Island, and Hotchkiss Tract that need substitute supplies with salinity controlled at Emmaton and Jersey Point. Assuming the maximum expansion of the overland agricultural water facilities, the average annual cost is estimated to be about $700 thousand. This compares to the $16.6 million per year if this area were protected by increasing salinity control beyond that required for the November 19 Criteria (proposal No. 3, Table 3).

Contra Costa Canal-Kellogg System. The existing Contra Costa Canal serves as the substitute water supply facility for municipal and industrial uses in the western Delta at times when offshore inchannel water quality falls below acceptable limits due to periodic salinity intrusion. The Kellogg Unit of the Central Valley Project, or some similar project, is needed:

(1) To supplement water deliveries from the Contra Costa Canal to meet the expanding municipal, industrial, and agricultural water requirements in Contra Costa County;

(2) To improve reliability of the Contra Costa Canal delivery system; and

(3) To improve the water quality delivered from Contra Costa Canal.

Flood control, recreation, and fish and wildlife enhancement are planned project purposes also.

The proposed Kellogg Project[20/] is located in Contra Costa County. It consists of 3 reservoirs and 22 miles of conveyance works. The estimated capital cost is $73 million. The present service area of the Contra Costa Canal and the future service area of the Contra Costa Canal-Kellogg system are shown on Figure 10.

Kellogg Reservoir (135,000 acre-feet) and Herdlyn Forebay (1,870 acre-feet) would be filled by a new pumping plant located at

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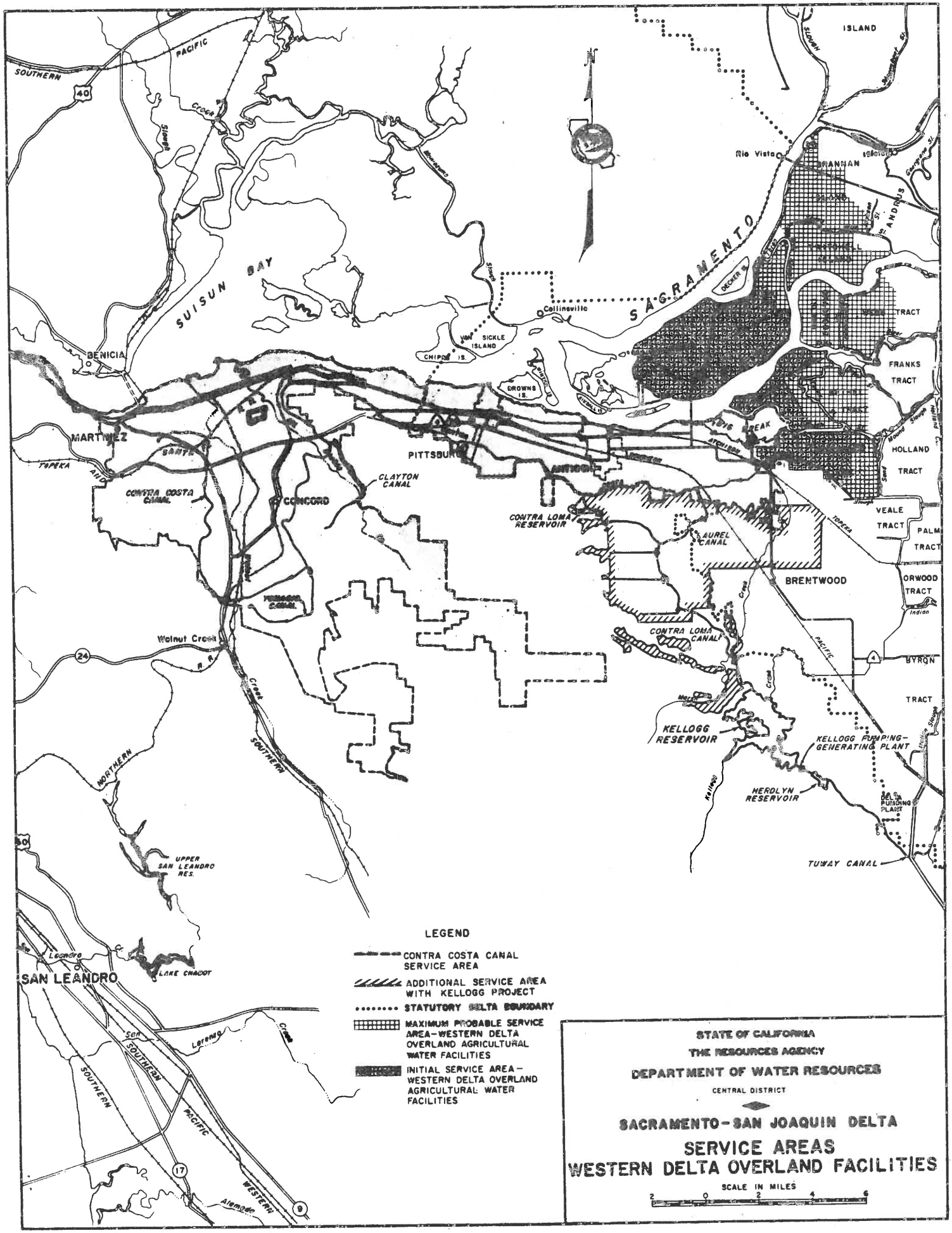
20/ USBR Feasibility Report, "Kellogg Unit", dated January 1968; and Contra Costa County Water District brochure, "Kellogg Water Project", January 1967.

Figure 10


SUISUN BAY
SACRAMENTO
BENICIA
MARTINEZ
PITTSBURG
CONCORD
CLAYTON CANAL
CONTRA COSTA CANAL
CONTRA LOMA RESERVOIR
AUREL CANAL
BRENTWOOD
CONTRA LOMA CANAL
KELLOGG RESERVOIR
KELLOGG PUMPING-GENERATING PLANT
HERDLYN RESERVOIR
TUWAY CANAL
BYRON
TRACT
Walnut Creek
SAN LEANDRO
UPPER SAN LEANDRO RES.
LAKE CHABOT
Rio Vista
COLLINSVILLE
SICKLE ISLAND
CHIPPS IS.
BROWNS IS.
FRANKS TRACT
HOLLAND TRACT
VEALE TRACT
PALM TRACT
ORWOOD TRACT
DELTA PUMPING PLANT
LEGEND
CONTRA COSTA CANAL SERVICE AREA
ADDITIONAL SERVICE AREA WITH KELLOGG PROJECT
STATUTORY DELTA BOUNDARY
MAXIMUM PROBABLE SERVICE AREA-WESTERN DELTA OVERLAND AGRICULTURAL WATER FACILITIES
INITIAL SERVICE AREA-WESTERN DELTA OVERLAND AGRICULTURAL WATER FACILITIES
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
CENTRAL DISTRICT
SACRAMENTO-SAN JOAQUIN DELTA
SERVICE AREAS
WESTERN DELTA OVERLAND FACILITIES
SCALE IN MILES
2 0 2 4 6

the intake channel of the Delta-Mendota Canal near Tracy. This pumping plant would be served from the Peripheral Canal upon its completion. Water would be discharged by gravity flow from Kellogg into the smaller Contra Loma Reservoir (2,457 acre-feet) and thence to the Contra Costa Canal.

The present contract for water service through the Contra Costa Canal is limited to 86,000 acre-feet per year. The Kellogg Project would expand the delivery capability to the Contra Costa Canal Service Area to supply the 195,000 acre-feet per year presently allocated from the Federal Central Valley Project; and when additional conservation features are added to the system, the projected future annual demand of 440,000 acre-feet.

The Kellogg Unit, or some similar project, is needed to allow the District's delivery capability to keep pace with its growing water requirements and to improve system reliability, irrespective of the degree of salinity control provided in the western Delta. With Kellogg and the Peripheral Canal Projects, the District's high-quality water supply would become completely independent of offshore inchannel sources (Mallard and Rock Sloughs) which do not now provide a reliable year-round supply of good-quality water (less than 100 ppm chlorides).

Peak delivery requirements increase as service area demands increase during July and August, not because of the loss of availability of high-quality offshore water that will occur at other times of the year due to operation of the state and federal projects or other upstream water developments in the counties of origin. Diminution of availability of usable quality offshore water, however, will result in an increase in annual delivery requirements from such facilities (Appendix C, Table C5). This means that although the Kellogg Project is proposed primarily to augment supplies to the Contra Costa Canal to meet the increasing high-quality water demands in Contra Costa County, it also has sufficient capacity to deliver substitute supplies to municipal and industrial users in the County who will be faced with decreased periods of availability of good-quality offshore water.

Accordingly, the Contra Costa Canal-Kellogg system will serve as the overland water-conveyance facility for delivering substitute water supplies in lieu of increasing salinity control above that provided for by the November 19 Criteria. The net cost of delivering substitute water supplies through overland facilities is the difference between the cost of pumping directly from offshore sources and the cost of obtaining water from the Contra Costa Canal-Kellogg system.

The actual cost of substitute supplies to the users and the various water developers will be determined by agreements now being negotiated. Based on preliminary estimates, the annual cost of providing high-quality substitute supplies (excluding cooling water) to affected water users is approximately $720 thousand in a critical year and $375 thousand in an average year.

No direct comparison of overland M&I supplies can be made with any of the proposals for increased salinity control, because none of the proposals would provide a dependable year-round supply of high-quality water. The proposal with the highest upgrading of salinity control would have an average annual cost of $154 million (proposal No. 6, Table 3), but would only provide a dependable supply of high-quality water directly offshore for 142 days per year -- a condition where overland facilities would still be needed for the remaining 223 days of the year. Furthermore, the estimated capital cost of this proposal is $2.9 billion, whereas no portion of the capital cost of the Kellogg Unit is directly chargeable to delivery of substitute water, because the expanded overland facilities would still be required.

Industrial Plant Equipment Changes and Incremental O&M Costs. As explained in the negotiations chapter, six of the nine industries that would be adversely affected by operations of federal and state projects have problems with cooling water. The cost of substitute supplies for process water and irrigation water was included in the cost of obtaining high-quality substitute supplies from the Contra Costa Canal-Kellogg system. Replacement of poor-quality offshore water for cooling purposes, however, is not feasible because of the large volume required by each industry.

Many of the industries in Contra Costa County have cooling equipment of which operation and cost of operation is unaffected by water quality. The six plants where water quality presents cooling water problems could be modified to make them independent of water quality.

It is difficult to identify all of the factors contributing to the increased cost resulting from corrosion and equipment degradation in an environment of higher salinity. The actual costs to compensate industries for increased salinity due to future project operation under the November 19 Criteria is the subject of current negotiations. Based on preliminary studies, that portion of the cost of modifying industrial equipment and operation for cooling water due to future increases in salinity concentrations will not exceed $10 million in capital outlay or $465 thousand annually.

Summary

The degree of salinity control obtained by operating within the provisions of the November 19, 1965 Delta Water Quality Criteria, supplemented by substitute water supplies from overland conveyance facilities and modifications of certain industrial cooling systems, can provide the water users in the western Delta with an adequate supply of good-quality water to meet their foreseeable needs. This can be accomplished at a reasonable cost without unreasonable waste of water.

Of the several proposals made to increase the degree of salinity control, all would require development of large additional

quantities of water [from 4 million acre-feet (proposal No. 3) to over 37 million acre-feet (proposal No. 6) during a critical period such as 1928 to 1934] for release from storage to push the salt water back farther. The capital costs of facilities to provide this additional water range from $0.3 billion to $2.9 billion. The average annual costs range from almost $17 million to $154 million over a 50-year repayment period.

The maximum annual benefits that could be obtained by increasing salinity control to a point where water of 10 ppm chlorides could be obtained offshore at Antioch 100 percent of the time are estimated to total $5.7 million 21/. The average annual cost to obtain these benefits would exceed $200 million -- more than 35 times the benefits. None of the various proposals for increased salinity control, however, would provide water of 10 ppm chlorides at Antioch 100 percent of the time. Overland water conveyance facilities would still be needed.

The estimated average annual cost to furnish substitute water supplies through overland conveyance facilities and to modify certain industrial cooling systems is about $1 million -- $200,000 for the initial western Delta agricultural water facilities; $375,000 for increased purchases of water from the Contra Costa Canal-Kellogg system for municipal and industrial purposes; and $465,000 for modifying the industrial cooling systems. Even assuming maximum expansion of the overland agricultural water facilities, the total average annual cost would be increased to only about $1.5 million.

A long-term commitment of water -- a limited and valuable California resource -- for salinity repulsion would preclude its use for some alternative "higher" uses, and the benefits that could be realized for these uses would be foregone. Such benefits foregone are estimated to be at least as great as the cost of the additional water required to provide increased salinity control.

Since the Peripheral Canal Plan includes plans for alternative measures to protect all reasonable and beneficial uses by agreements to provide substitute water supplies and releases of fresh water, it follows that:

1. It would be wasteful in terms of both water and money to require the additional releases of great quantities of conserved water to reduce natural salinity in the extreme western Delta and to ignore the plans to provide all Delta users with good-quality water through a combination of releases and substitute supplies;

2. It would be an unreasonable use of water to meet proposals for increased salinity control and would

21/ Based on data developed by Metcalf and Eddy Engineers as described in Appendix F.

be clearly in violation of the principles set forth in the California Constitution (Article XIV, Section 3), and the general state policy on reasonable and beneficial use of water given in the Water Code (Section 100); and

3. Increased salinity control would require: (a) denial of water users of water supplies they have contracted for and made advanced payments for; or (b) construction of new water conservation and transportation facilities upstream from the Delta; or (c) both.

ANALYSIS OF LEGAL PROBLEMS IN THE DELTA

This section of the Delta report reviews the germane state and federal law as it applies to the Sacramento-San Joaquin Delta and briefly illustrates the means by which the Department of Water Resources is complying with these legal requirements so as to protect vested property rights in the Delta. The laws which are reviewed include California Constitution Article XIV, Section 3, the Delta Protection Act, the Area of Origin Law, the County of Origin Law, the Burns-Porter Act, the Dickey Water Pollution Act, the common law of riparian rights, state laws relating to appropriative water rights, state and federal judicial decisions, and the Federal Water Pollution Control Act (as amended).

Delta Water Rights

Water rights in the Sacramento-San Joaquin Delta have been analyzed in three department reports. 1/ These reports have assumed that all of the Delta lowlands are riparian, that certain parcels of land located in the Delta uplands are riparian, and that 70 percent of the appropriative water rights in the uplands antedate the state water rights applications of 1927.

Protection of Prior Vested Rights in the Delta

Protection of prior vested water rights in the Delta is dictated by the Constitution and statutes alike. Both the constitutions of the United States and California preclude the Department from taking property -- water rights constitute a species of property -- without payment of just compensation. 2/ Existing

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1/ Report on 1956 Cooperative Study Program-Water Use and Water Rights Along Sacramento River and in Sacramento-San Joaquin Delta by U. S. Department of the Interior, Bureau of Reclamation, Department of Water Resources, Division of Resources Planning, Sacramento River and Delta Water Association, March 1957; Assumptions as to Water Rights Supplement to Report on 1956 Cooperative Study Program-Water Use and Water Rights Along Sacramento River and in Sacramento-San Joaquin Delta by U. S. Department of the Interior, Bureau of Reclamation, Department of Water Resources 1966 Joint Water Rights Study - Department of Water Resources, U. S. Bureau of Reclamation, July 1966.

2/ Calif. Const. Art. I, Sec. 14; U. S. Const. Amend. V.

water rights are also recognized and protected in the Burns-Porter Act, 3/ the Delta Protection Act 4/, and other statutory laws.

The overriding law which guides the Department in its protection of rights in the Delta is California Constitution Art. XIV, Sec. 3. This provision requires that California waters be used in a reasonable and beneficial manner and that no water shall be wasted. Article XIV, Sec. 3, was added to the Constitution in 1928 because of the California Supreme Court decision in Herminghaus v. Southern California Edison Co. 5/ which upheld riparian rights against appropriative rights regardless of the reasonableness or wastefulness of the riparian use.

Article XIV, Sec. 3, of the California Constitution, provides that:

> "Sec. 3. It is hereby declared that because of the conditions prevailing in this State the general welfare requires that the water resources of the State be put to beneficial use to the fullest extent of which they are capable, and that the waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such waters is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare. The right to water or to the use of flow of water in or from any natural stream or water course in this State is and shall be limited to such water as shall be reasonably required for the beneficial use to be served, and such right does not and shall not extend to the waste or unreasonable use or unreasonable method of diversion of water. Riparian rights in a stream or water course attach to, but to no more than so much of the flow thereof as may be required or used consistently with this section, for the purposes for which such lands are, or may be made adaptable, in view of such reasonable and beneficial uses; provided, however, that nothing herein contained shall be construed as depriving any

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3/ Water Code Sec. 12931 provides that nothing contained in the Burns-Porter Act shall be "construed as affecting vested water rights".

4/ Sec. 12203 of the Water Code states: "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".

5/ 200 Cal. 81, 252 Pac. 607 (1926).

riparian owner of the reasonable use of water of the stream to which his land is riparian under reasonable methods of diversion and use, or of depriving any appropriator of water to which he is lawfully entitled. This section shall be self-executing, and the Legislature may also enact laws in the furtherance of the policy in this section contained."

The courts are bound by this provision as the definitive expression of state water policy. 6/ It has been held to be a valid exercise of police power limiting existing rights without infringing upon any provision of the Federal Constitution. 7/ This provision applies to all types of water rights, 8/ which means that riparians as well as appropriators or holders of prescriptive rights or other property rights in water are prohibited from wasting water. 9/ Because of the constitutional prohibition on the wasting of water, the California courts have held that a dispute between holders of water rights should be settled, if possible, by the means of a "physical solution". 10/ The doctrine of a "physical solution" is a common-sense means of adjusting conflicting water rights so as to maximize the reasonable and beneficial use of all water and at the same time protect vested water rights. In ordering a physical solution a court attempts to effectuate reasonable use by all parties by changing the place of or method of diversions or use, taking into account priorities of water rights. 11/ However, the

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6/ United States v. Gerlach Live Stock Co., 339 U.S. 725, 751 (1950); Peabody v. Vallejo, 2 Cal. 2d 351, 365-366, 40 P.2d 486 (1935); Gin S. Chow v. Santa Barbara, 217 Cal. 673, 22 P.2d 5 (1933).

7/ Peabody v. Vallejo, 2 Cal. 2d 351, 40 P.2d 486 (1935).

8/ Ibid.

9/ Tulare Irrigation District v. Lindsay - Stratmore Irrigation District, 3 Cal. 2d 489, 525, 45 P.2d 972 (1935); Peabody v. Vallejo, supra; Gin S. Chow v. Santa Barbara, 217 Cal. 673, 700, 22 P.2d 5 (1933).

10/ Allen v. Calif. Water & Tel. Co., 29 Cal. 2d 446, 176 P.2d 8 (1946); Rancho Santa Margarita v. Vail, 11 Cal. 2d 501, 559-560 81 P.2d 533 (1938); Lodi v. East Bay Municipal Utility Dist., 7 Cal. 2d 316, 339-340, 60 P.2d 439 (1936); Calif. Water Code Section 12202.

11/ Allen v. Calif. Water & Tel. Co., supra note 10; Meridan Ltd. v. San Francisco, 13 Cal. 2d 424, 451-452, 90 P.2d 537, 91 P.2d 105 (1939); Reclamation Dist. No. 833 v. Quigley, 8 Cal. 2d 183, 187-188, 64 P.2d 399 (1937); Lodi v. East Bay Municipal Utility Dist., 7 Cal. 2d 316, 344, 60 P.2d 439 (1936); Peabody v. Vallejo, 2 Cal. 2d 351, 378-380, 40 P.2d 486 (1935).

court may not change priorities among the water rights holders nor can the solution be applied so as to eliminate vested rights.

The use of a "physical solution" in the Delta was first hinted at prior to 1928 in Antioch v. Williams Irrigation District, 12/ which held against the right of Delta appropriators to insist that subsequent appropriators allow a sufficient outflow of fresh water to create a hydraulic barrier to repel the salt waters from the ocean.

The Antioch case involved a dispute between the City of Antioch and upstream appropriators on the Sacramento River. The City alleged that the upstream diversions caused the water of the San Joaquin River at the City's place of diversion to be so polluted with salt waters of the ocean forced up from San Francisco Bay and into the lower part of the San Joaquin River by the impulses of the tide that it was unfit for domestic uses; therefore, the water rights of the City were impaired. To protect its rights fully, the City requested the court to order that the flow of the Sacramento River past the City of Sacramento should be at least 3,500 cfs. The court refused, noting that the City of Antioch was requesting a large amount of water to be kept flowing in the river to allow for diversions of less than 1 cubic foot per second at its pumping plant, and said "it would be hard to conceive of a greater waste for so small a benefit" and it "... would be extremely unreasonable and unjust to the inhabitants of the valleys above and highly detrimental to the public interests besides". The court oncluded by holding that:

> "an appropriator of fresh water from one of these streams at a point near its outlet to the sea does not, by such appropriation, acquire the right to insist that subsequent appropriators above shall leave enough water flowing in the stream to hold the salt water of the incoming tides below his point of diversion."

Finally, the court noted that if Antioch desired salt-free water, the City could move its point of diversion several miles upstream.

The application of the doctrine of a "physical solution" hinted at in the Antioch case in 1922 received full support in later cases. The case most firmly supporting this doctrine is Lodi v. East Bay Municipal Utility District, 13/ in which the court held that:

12/ 188 Cal. 451, 205 Pac. 688 (1922).

13/ 7 Cal. 2d 316, 60 P.2d 439 (1936).

"Since the adoption of the 1928 Constitutional Amendment, it is not only within the power but it is also the duty of the trial court to admit evidence relating to possible physical solutions, and if none is satisfactory to it to suggest on its own motion such physical solution....the court possesses the power to enforce such solution regardless of whether the parties agree...." [7 Cal. 2d 316, 341.]

The propriety of using a "physical solution" to resolve the complex problems resulting from conflicting claims to use water was most recently approved in Central Basin Water Dist. v. Fossette. 14/

Two important points should be noted about the doctrine of physical solution. First it is a "procedure authorized by California law whereby existing rights to the use of water are protected and excess waters are put to beneficial use". 15/ Secondly, the substitute method need not preserve the method of supply which it replaces. Rather, the limitations are in terms of avoiding a result which would "unreasonably and adversely affect the prior appropriators vested property right" and of providing that if "a physical solution" is to be worked out which would require the [prior appropriator] to change its method of appropriation, any substantial expense incidental thereto should be borne by the junior appropriator who is seeking the physical solution. 16/ To the same effect see Water Code Section 12202.

Of course, the Lodi case involves the application of a physical solution between a prior appropriator (Lodi) and subsequent appropriators. But the holding of the case should be no different where the prior right was riparian in nature. 17/

In compliance with the constitutional mandate and the preference for a "physical solution", the Department has developed a program, described in detail elsewhere in this report, which fully complies with the requirements of the law and provides a workable solution for protecting the vested rights of the Delta. This program includes (1) the payment of money to diverters in the western Delta to purchase substitute supplies of water when normal inchannel supplies are degraded due to operation of the State Water Project; (2) a plan for the overland transportation of water to western Delta agricultural lands to replace inchannel supplies; and (3) a preliminary agreement between the Department

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14/ 235 Cal. App. 2d 689, 699, 45 Cal. Rptr. 651 (1965).

15/ Dugan v. Rank, 372 U.S. 609, 610, n. 1 (1963).

16/ Lodi v. East Bay MUD, 7 Cal. 2d 316, 339-341, 60 P.2d 439 (1936).

17/ See Meridan, Ltd. v. San Francisco, 13 Cal. 2d 424, 90 P.2d 537 (1939).

of Water Resources, the Bureau of Reclamation, and Delta agricultural interests on the quality of inchannel water to be maintained in the Delta.

The portion of the program which insures substitute supplies and overland transportation of water is the "physical solution" for the Delta (i.e., a physical solution is being accomplished by negotiation and agreement of the parties concerned rather than through adjudication).

Agreement With Contra Costa County Water District. On April 21, 1967, the first agreement providing for payment to diverters in the western Delta to purchase substitute supplies of water was entered into between the Department of Water Resources and the Contra Costa County Water District.

The agreement defined the District's entitlement as the average daily volume of water required by the District to meet the demands for the area capable of service from its pumping plant at Mallard Slough during the period of availability. The period of availability was defined as 142 days from January 15 through June 5. This period was determined from available salinity records for the period 1926 through 1959. The loss of entitlement is determined each year as the difference between the individual years measured availability in days and the period of availability multiplied by a daily quantity of water measured as the average daily demand during the period of availability in that portion of the system capable of service from Mallard Slough. Credit is given to the State for annual availability in excess of the period of availability to offset future years' losses. The economic value of the loss of entitlement is determined as the difference in cost of diverting offshore water and the average cost of water delivered from the Contra Costa Canal. The State's responsibility has been negotiated to be one-third of the total loss sustained by the District.

While the vested rights of diverters in the western Delta are being protected by a "physical solution", the water quality of the main Delta will be protected by an agreement among the Department of Water Resources, Bureau of Reclamation, and Delta residents.

November 19, 1965 Delta Water Quality Criteria. On November 19, 1965, an understanding was reached among the Department of Water Resources, the Bureau of Reclamation, the Sacramento River and Delta Water Association (SRDWA) 18/, and the San Joaquin Water Rights Committee including the Delta Water Users Association (DWUA)19/ on a "Delta Water Quality Criteria". This "Criteria" provides that salinity intrusion into the Delta will be prevented

18/ Representing the water users in Sacramento, Yolo, and Solano Counties.

19/ Acting as the San Joaquin Water Rights Committee (SJWRC) representing water users in San Joaquin County.

from exceeding 1,000 ppm chlorides (10-day running mean daily average) in the Sacramento River at Emmaton and in the San Joaquin River at Jersey Point. This is essentially equal to the level of salinity control presently resulting as a byproduct of transporting and protecting the quality of water pumped at the intakes to the Delta-Mendota and Contra Costa Canals of the Federal Central Valley Project. The Criteria provides for relaxations in critical years; however, this is analogous to a deficiency in water deliveries taken by water contractors in such years. The Criteria limits salinity intrusion from exceeding 200 ppm chlorides for at least 10 consecutive days during April and May in all but dry or critical years. This Criteria also specifies TDS quality limits at specific locations for the interior Delta channels that will provide water users with adequate quality water for irrigation.

Although Sacramento River and Delta Water Association and Delta Water Users Association were not authorized to commit the areas that they represented to a binding contract, they did approve the November 19 Criteria as an appropriate basis for further negotiation which would lead to an agreement. 20/

At the commencement of the hearings before the State Water Rights Board in 1966 on Applications Nos. 5629, et al., of the Department of Water Resources, the Sacramento River and Delta Water Association, the Delta Water Users Association, and the Department stipulated 21/ that the diversions by the Department would be subordinate to flows required to meet the November 19 Criteria.

At the close of the hearing, however, the Water Rights Board indicated that it would probably reserve jurisdiction over the question of water quality in the Delta pending the outcome of studies by the State and Federal Governments. In order to provide for a more orderly disposition of other matters, the Department, Sacramento River and Delta Water Association, Delta Water Users Association, San Joaquin County Flood Control and Water Conservation

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20/ The Sacramento River and Delta Water Users Association sponsored legislation to create a Delta water agency which could execute contracts with the State of California and the United States, for the maintenance of the water quality criteria contained in the November 19, 1965 Delta Water Quality Criteria. A bill creating the Delta Water Agency for this purpose was passed by the Legislature and signed by the Governor in 1968. It is contemplated that the contracts will provide that Delta water users will pay $200,000 annually to the Bureau for water quality control.

21/ Department of Water Resources Exhibit No. 71(e). The stipulation provided for termination on October 1, 1970, unless an agreement has been signed as contemplated in the November 19, 1965 Criteria or unless the Department agrees to an extension of time.

District, and John A. Wilson, agreed to put the contents of the stipulation in effect among themselves by agreement. 22/

During the initial negotiations of the November 19 Criteria, a negotiating committee for Contra Costa County attempted to represent all the water users in Contra Costa County interested in offshore water in the Delta. The committee requested that the location of the control point for the (mean tide) 1,000 ppm salinity line be placed at a point 0.6 miles west of Antioch to insure good-quality water for western interests.

On September 27, 1967, the Contra Costa County Water Agency proposed that salinity intrusion be prevented from exceeding a daily average of 100 parts per million (ppm) chlorides (mean tide) in the San Joaquin River at Jersey Point at all times. 23/ This would require about 1,900 cubic feet per second of additional outflow over and above that required to meet the November 19 Criteria. The 1,900 cfs of additional outflow would also tend to stabilize the 1,000 parts per million chloride line at Antioch, which approximates another objective historically sought by the Contra Costa County Water Agency. To meet these requirements of the Agency under 1990 conditions, would require approximately 1.4 million additional acre-feet in a critical year such as 1931. Three-quarters

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22/ Sacramento River and Delta Water Association Exhibit No. 17. Condition 16(a) of the Water Rights Board Decision D-1275 on Applications Nos. 5629, et al., provided that "until further order of the Board, these permits shall be subject to the water quality criteria included as "Exhibit A" of the agreement entered at the hearing of Applications 5629, etc., as Sacramento River and Delta Water Association Exhibit 17, insofar as those criteria do not conflict with other terms included in these permits. In the hearing on applications of the U. S. Bureau of Reclamation No. 18721, et al., Auburn-Folsom South Unit of the Central Valley Project, the Sacramento River and Delta Water Association filed Exhibit 2, which contained an agreement between Sacramento River Delta Water Association and the Bureau whereby the Bureau agreed that the operation of the American River Division of the Central Valley Project should be subject to an agreement to be entered into between the United States and water users of the Sacramento River and Sacramento-San Joaquin Delta with respect to releases from Folsom and Nimbus reservoirs in coordination with other units of the Central Valley Project for consumptive uses and salinity control in the Sacramento-San Joaquin Delta, provided that such agreement is entered into on or before October 1, 1970, or if no agreement is reached, the permit in question shall be subject to further board action. This agreement was based in part upon the Delta Water Quality Criteria dated November 19, 1965.

23/ Report to the Board of Supervisors, Ex Officio Governing Board, Contra Costa County Water Agency, entitled "A Re-Evaluation of this Agency's Objectives and Positions with Respect to Protecting the County's Offshore Water", June 14, 1966.

million acre-feet additional would be needed in an average year such as 1936, and about 0.1 million acre-feet in a wet year such as 1938. The total additional volume of outflow required during a 7-year critical period such as occurred from 1928-1934 would be about 6 million acre-feet.

The Central Valley Regional Water Quality Control Board proposed that salinity intrusion should be prevented from exceeding a maximum of 100 ppm chlorides (high high tide) in the San Joaquin River at the City of Antioch for at least 50 percent of every year. 24/ This would require about 8,500 cfs over and above the outflow required to meet the November 19 Criteria. The total annual additional outflow required would be about 3.1 million acre-feet in a critical year and about 0.8 million acre-feet in an average year. The total additional volume of outflow required during a 7-year critical period such as occurred from 1928-1934, would be about 14 million acre-feet.

To meet both the foregoing demands would require total annual additional outflows in the magnitude of 3.6 million acre-feet for a critical year, 1.5 million acre-feet in an average year, and 0.1 million acre-feet in a wet year. The total additional volume of outflow required during a 7-year critical period would be about 18.6 million acre-feet. This volume of water could only be supplied through abandonment of contractual deliveries of the existing Federal Central Valley and State Water Projects; or local projects such as San Francisco's Hetch-Hetchy development on the Tuolumne River, East Bay MUD's development on the Mokelumne River, New Hogan Reservoir on the Calaveras River; or further development of imported water for the Central Valley. Also, the capital cost to meet these demands would be about $1.4 billion and would certainly entail a vast waste of water to the ocean. The true economic cost, considering the economic value that this water could develop if devoted to other uses, would be substantially greater.

The major benefit to be derived from meeting the Contra Costa County Water Agency's request for 100 ppm chloride water at Jersey Point would be to insure suitable inchannel irrigation water for about 13,200 acres of agricultural lands in the western Delta. However, as earlier indicated, these lands will be furnished a substitute water supply of adequate quality as a part of the "physical solution" for the entire Delta, for about $2 million.

The benefit derived from providing for 100 ppm chlorides at Antioch for 50 percent of the year would be to insure adequate inchannel water for the City of Antioch and the industrial water users upstream therefrom for 50 percent of the year. However, since the City of Antioch and the industries have access to a substitute water supply (Contra Costa Canal) that does not necessitate waste, the maintenance of water at 100 ppm chlorides at Antioch is not necessary.

24/ Water Quality Control Policy for the Sacramento-San Joaquin Delta, April 28, 1967, pg. G-3.

While operation of the State Water Resources Development System pursuant to the November 19 Criteria will not adversely affect the environment of the Delta, some parties in the Delta area have claimed that adherence to this Criteria will lower the waste assimilative capacity of the waters, permit the intrusion of the marine borer, and result in harm to fish, wildlife, and recreation. Some of these inchannel uses of water are unreasonable uses under Article XIV, Section 3, of the California Constitution because of the large amount of water required and the cost involved.

Some insight into the scope of reasonable use, in the light of the present-day California expanding needs, is illustrated in the recent California Supreme Court case of Joslin v. Marin Municipal Water District. 25/ The case involved a dispute between an upstream appropriator of water for domestic uses (water district) and a downstream riparian user for inchannel purposes (Joslin). The dispute arose when the water district constructed a dam upstream on a stream which supplied gravel deposits to Joslin's land; the dam curtailed the flow of gravel and Joslin sued for damages on the basis of inverse condemnation.

The court first outlined the events leading to California Constitution, Art. XIV, Sec. 3, and its applicability to disputes between riparians and appropriators stating (1) that neither riparians nor appropriators had the right to waste water; (2) that "what is a reasonable use or method of use of water" is a question of fact to be determined according to the circumstances of the case; and (3) that reasonableness cannot be isolated from statewide consideration of transcendent importance and that paramount among these considerations is the ever-increasing need for the conservation of water in this State.

The court found as a fact that there was no great need in California to conserve sources of gravel and, therefore, when compared to the need of the district to conserve water, the former use palled. The opinion asks the question: "Is it 'reasonable', then, that the riches of our streams which we are charged with conserving in the great public interest are to be dissipated in the amassing of mere sand and gravel which for ought that appears subserves no public policy?" The same question can be asked with respect to the use of large freshwater releases to repel salinity in the Delta beyond that provided for under the November 19 Criteria.

The court then found that as a matter of law it was unreasonable to use the stream to accumulate gravel. The court stated:

25/ 67 Cal. 2d, 132, 429 P.2d 889 (1967).

"We cannot deem such a use to be in accord with the constitutional mandate that our limited water resources be put only to those beneficial uses 'to the fullest extent which they are capable,' that 'waste or unreasonable use' be prevented, and that conservation be exercised 'in the interest of the people and for the public welfare.' (Cal. Const. Art. XIV, Sec. 3). We are satisfied that in the instant case the use of such waters as an agent to expose or to carry and deposit sand, gravel and rock, is as a matter of law unreasonable within the meaning of the constitutional amendment."

In footnote 6, the court cited the prophetic statement made in Gin S. Chow v. City of Santa Barbara, 217 Cal. 673, 701, 702 (1932) to the effect that:

"It requires no extraordinary foresight to envision the great and increasing population of the state and its further agricultural and industrial enterprises dependent upon stored water--water that is now wasted into the sea and lost to any beneficial use. The conservation of other natural resources is of importance, but the conservation of the waters of the state is of transcendent importance. Its waters are the very lifeblood of its existence."

The value of the Joslin case to the Department's position in the Delta is threefold. First, the court makes the observation that there is a great need in California to conserve and use to the best advantage the waters of the State. This statement while not adding substantively to the law does update the expressions of concern of the Supreme Court with respect to the problems of supplying water to the populace.

Secondly, and most important, is the court's analysis of California Constitution Article XIV, Section 3, which is the phalanx of the Department's position that there should be no freshwater releases out of storage to the Delta in addition to those required by the November 19, 1965 Criteria. The court reemphasized that Article XIV, Section 3, not only states that the right to water shall be limited to such use as shall be required for the beneficial use to be served, but state unequivocally "that such right does not and shall not extend to the...unreasonable use...of water". This quoted portion of the Constitution is the one which is most consistently ignored by Delta interests seeking the maintenance of a hydraulic barrier through large outflows. They are content to equate beneficial use with reasonable use or merely ignore the issue of the latter. The question of whether a riparian owner in the Delta has a right to use the natural stream flow does not simply start with the determination that his use is "beneficial" and end with a finding that the quantity used or method of use is reasonable. Resolution of the question involves a determination of whether the use of water itself is reasonable and this was emphasized by the Joslin case more clearly than in preceding cases.

The court did not make a determination that the use to which the water district put the water was more desirable than the use made by Joslin. It tested the use made by Joslin against the public policy manifested by the Constitution, that is, that California's limited water resources be put only to those beneficial uses "to the fullest extent of which they are capable, that a waste or unreasonable" use be prevented and that conservation be exercised "in the ineterests of the people and for the public welfare". This is the test which would be applied to the uses of Delta waters. Particularly relevant to the Delta is the Court's statement that "...what is a reasonable use of water depends on the circumstances of each case, such an inquiry cannot be resolved in vacuo isolated from statewide considerations of transcendent importance...." 26/

Lastly, the court makes it abundantly clear that if there is an unreasonable use of water, there is no compensable property right. This is clearly of benefit to the Department since it clarifies a heretofore (before 1967) hazy area of the law.

When reviewed against the background of the Joslin case and other Supreme Court cases it is quite clear that it is unreasonable to use large freshwater releases for esthetics, waste assimilative capacity and recreation uses in the Delta in excess of those required to meet the November 19 Criteria.

Esthetics and Environment. The trend of California decisions over a long span of years has been to recognize the use of water for material purposes only as a part of a riparian landowner's rights. Esthetic considerations on the whole have not influenced judicial decisions if such considerations would inhibit the utilitarian use of water. However, the maintenance of the level of several lakes in their natural condition, with all of their attractive surroundings, has been held to be a reasonable beneficial use of water under the constitutional amendment of 1928. 27/ In each case, however, the community interest was considerable, the court finding that the existence of the lakes was vital and that it furnished to the marginal land almost its entire value. The facts in these cases are readily distinguishable from the situation in the Delta where there will be only a slight change of water quality insufficient to materially alter the esthetics; there will be no drying up of the Delta and the "view from the shore" will remain the same. Where water is so precious, it should not be used for mere matters of taste or fancy while those who need it go without. 28/

26/ Id. at 140, 429 P. 2d at 894-95.

27/ Elsinore v. Temescal Water Co., 36 Cal. App. 2d 116, 97 P.2d 274 (1937); Los Angeles v. Aitken, 10 Cal. App. 2d 460, 52 P.2d 585 (1935).

28/ Los Angeles v. Pomeroy, 124 Cal. 597, 650 (1899).

Protection of Fish and Wildlife and Recreation. The use of water for recreation and fish and wildlife purposes may be classified as a beneficial use of water in California. 29/

Water for recreation must generally have a biochemical oxygen demand of 2.5 mg/l or less, and a population of coliforms resulting in a most probable number of 1,000 per 100 ml. or less, and be free from obnoxious floating or suspended substances, objectionable color, odor, and substance which are toxic upon ingestion or irritating to the skin. As noted elsewhere in this report, the operation of the State Water Project will not inhibit Delta recreation.

Delta fisheries will be protected by operation agreements among the Department, Bureau of Reclamation, and the Department of Fish and Game both before and after the construction of the Peripheral Canal. Following construction of the Peripheral Canal, a striped bass spawning area will be provided in the interior Delta that will not be subject to periodic salinity intrusion.

Repulsion of the Marine Borer. The use of freshwater releases for the repulsion of the marine borer which attacks piers in areas of high saltwater concentration is a singularly unreasonable use. This situation finds its analogy in Tulare Irrigation Dist. v. Lindsay-Strathmore Irrigation Dist. 30/, wherein the court held that killing gophers by flooding the land was not a reasonable beneficial use of water. The same would probably hold true with respect to the use of water to repel the marine borer. Also, evidence introduced at the water rights hearing on the Department's applications for the State Water Project raised considerable question as to whether the marine borer problem would be increased if outflows were decreased.

Waste Assimilative Capacity. Another way of looking at water rights in the Delta is from the standpoint of water quality and pollution. Some Delta interests have asserted that any decrease in future outflows from the Delta will lower the waste assimilative capacity of the waters. First, department engineers do not believe that the year-round, dependable assimilative capacity will be lowered. Second, no one has a property right to the waste assimilative capacity of water. 31/ Both riparians and

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29/ Water Code Secs. 233, 345, 346, 11900-11912, 12201, 2581; Elsinore v. Temescal Water Company, 36 Cal. App. 2d 116, 97 P.2d 274 (1939); Los Angeles v. Aitken, 10 Cal. App. 2d 460, 52 P.2d 585 (1935), but see: ex parte Elam, 6 Cal. App. 233, 91 Pac. 811 (1907); In re Maas 219 Cal. 422, 27 P.2d 373 (1934).

30/ 3 Cal. 2d 489, 569, 45 P.2d 972 (1935).

31/ While persons may discharge waste products into streams pursuant to conditions prescribed by the regional water quality control boards (Water Code Secs. 13053-13054.3), no property right to continue the discharges results from the boards' action.

appropriators have a right to insist that waters not be polluted to their injury. 32/ The law is well settled that there is no property right in the waste assimilative capacity of a stream and that any use of a stream which materially fouls and adulterates the water, or the deposit or discharge in a stream of any filthy or noxious substances that impair the quality of water will be enjoined. 33/ This policy is also enunciated in Water Code Sec. 13000.2 which provides that:

> "...the disposal of wastes into the waters of the State shall be so regulated as to achieve highest water quality consistent with maximum benefit to the people of the State and shall be controlled so as to promote the peace, health, safety, and welfare of the people of the State."

The same policy pronouncements are contained on page 4 of the Resolution 67-7 of the State Water Quality Control Board and in the Federal Water Pollution Control Act (as amended). 34/

As indicated above, the Department must construct and operate the State Water Project within the framework of California Constitution Article XIV and other laws. These laws include the Burns-Porter Act, the County of Origin Law, the Area of Origin Law, and the Delta Protection Act. The latter has been, in part, discussed with reference to the desirability of a "physical solution" but is again discussed at this point in more detail.

Burns-Porter Act. This act provides in Water Code Section 12931, that the Delta is, for the purposes of that act, within the watershed of the Sacramento River and that works financed under the Burns-Porter Act shall be constructed, operated, and maintained pursuant to the State Central Valley Project Act. By doing so, the Legislature has made these works subject to the Area of Origin Law, and since the Delta is within the watershed of the Sacramento River, it is among the protected areas.

The County of Origin and Area of Origin Laws were enacted at different times and appear in difference parts of the Water Code.

32/ Mentone Irrigation Co. v. Redlands Electric Light & Power Co., 155 Cal. 323, 327, 100 Pac. 1082 (1909); Joerger v. Pacific Gas & Electric Co., 207 Cal. 8, 25-26, 276 Pac. 1017 (1929). It should be noted that while the court in Antioch v. Williams Irrigation Dist., 180 Cal. 451, 205 Pac. 688 (1922) agreed with this rule of law, in view of the circumstances then existing, the court held that there was no right to require upstream appropriators to allow large amounts of fresh water to flow into the Delta to repel the ocean waters.

33/ Joerger v. Pacific Gas & Electric Co., 207 Cal. 8, 25-26, 276 Pac. 1017 (1929).

34/ P.L. 84-660, 70 Stat. 498 (1956); P.L. 87-88, 75 Stat. 204 (1961); P.L. 89-234, 79 Stat. 903 (1965); P.L. 89-753, 80 Stat. 1246 (1966).

However, they have the common purpose of reserving to the area or county where water originates certain rights to such water for future needs which is preferential to the right of outside areas.

County of Origin Act. The County of Origin Law, Water Code Sec. 10505, requires that reservations be made to protect counties in which water originates when state applications involving downstream use or export of water are assigned or released from priority. Reservations under this section are, however, of negligible benefit to those in the Delta. First, the reservations apply only to state applications, and no similar protection is required by law with respect to others. Second, the protection is limited to water which originates within the county. Because of the county boundary lines, little usable water originates in the Delta counties. The vast majority of the water which reaches the Delta originates in mountain counties upstream on the Sacramento and San Joaquin Rivers.

Area of Origin Law. The Area of Origin Law is contained in Water Code Sections 11460-11463, and 11128. The principal operative provision of the law is contained in Water Code Sec. 11460 which provides that:

> "In the construction and operation by the department of any project under the provisions of this part a watershed or area wherein water originates, or an area immediately adjacent thereto which can conveniently be supplied with water therefrom, shall not be deprived by the department directly or indirectly of the prior right to all of the water reasonably required to adequately supply the beneficial needs of the watershed, or any of the inhabitants or property owners therein."

The Area of Origin Law is beneficial to the Delta in two ways. First, it grants to the Delta, and all other areas of origin, certain preferential rights to contract for project water within the general framework established in the state water supply contracts. Of course, the Area of Origin Laws do not provide a price preference to water users in such areas. Water Code Section 11462 specifically provides that the Area of Origin Law "shall not be construed...to require the department to furnish to any person without adequate compensation therefor any water made available by the construction of any works by the department". Coupled with the Department's requirements for uniform contracts, this means that those in areas of origin must pay the cost of project water on the same basis as any other contractor (e.g., payment must include the Delta water charge). Secondly, it grants certain rights to construct projects or make diversions without being subject to the prior rights acquired under state applications for the State Water Project.

The quantity of water to which the prior right for use applies is limited to the water which is required for reasonable and beneficial use. 35/

It is also important to note that the priority established by the Area of Origin Law cannot be circumvented by the power of

35/ Water Code Secs. 100, 11460; Cal. Const. Art. XIV, Sec. 3.

condemnation. Neither does the priority violate California Constitution Article XIV, Section 3. While this constitutional provision prohibits the waste of water, it does not forbid the maintenance of preference for prospective uses, so long as the water is made available for interim use by others who have a present need for it. 36/

Delta Protection Act. The Delta Protection Act has made certain obligations of the Department with respect to the Delta very explicit. The Act requires that the State, in cooperation with the United States, provide salinity control and an adequate water supply for users of water in the Delta. However, if inchannel salinity control is not in the public interest, a substitute water supply can be used to provide water to users in the Delta in lieu of that which would be provided as a result of salinity control. If a substitute supply is provided in lieu of salinity control, no additional expense is to be charged to Delta users solely by reason of the substitution.

The Delta Protection Act was passed by the Legislature in 1959 and thereby prevails over Water Code Section 11271 passed in 1957, which provides for salinity control without reference to substitute facilities. When two laws on the same subject are passed at different points in time and are inconsistent, the last expression of the Legislature prevails. 37/

While the Delta Protection Act allows the State to fulfill its obligations to the Delta by a substitute supply with no added financial burden to the users, the State is not required to supply any betterment. If the substitute supply should provide a betterment to the user, either in the form of decreased operating costs, or better crops, etc., the State should adjust the price of the substitute supply. 38/

Decisions of the State Water Rights Board Affecting the Delta

Compliance with the laws that have been discussed is illustrated by decisions of the former State Water Rights Board, whose duties and functions are now vested with the State Water Resources Control Board. This body is vested with jurisdiction over the granting of appropriative water rights in California. It is the forum before which individuals and government alike must appear to obtain permits on applications to appropriate water. Its permits to appropriate water are issued subject to vested water rights. By conditioning the applications of users upstream from the Delta, Delta interests have received protection for their vested rights.

36/ 25 Op. Cal. Atty. Gen. 8, 21, 26 (1955).

37/ Spreckels v. Graham, 194 Cal. 516, 228 Pac. 1040 (1924).

38/ See State Water Rights Board Decision D-990, pg. 52 (1961).

The decisions of the Board granting the Bureau of Reclamation and the State of California permission to appropriate and store water which normally flows to the Delta are particularly significant since they require that the permittees observe vested water rights in the Delta.

Water Rights Decision D-990. By Decision D-990 adopted February 9, 1961, the Water Rights Board issued permits to appropriate water for the Federal Central Valley Project subjected to vested rights and conditioned so as to protect Delta interests. Condition 22 provides that:

> "Direct diversion and storage of water under permits issued pursuant to applications...for use beyond the Sacramento-San Joaquin Delta or outside the watershed of the Sacramento River Basin shall be subject to rights initiated by application for use within said watershed and delta regardless of the date of filing said applications."

Condition 25 provides that the State Water Rights Board will reserve jurisdiction over the permits for the purpose of formulating terms and conditions relative to salinity control in the Delta. The permits were also conditioned to include the May 16, 1960, operating agreement between the Department of Water Resources and the Bureau. The Board stated on page 40 of the decision that these conditions assured that there would be no prejudice to Delta interests.

In discussing the disposition of the salinity problem, the Board also noted the desirability of providing a substitute water supply in lieu of controlling inchannel salinity. The Board stated on page 56:

> "Provided the western portion of the delta will be supplied by an alternate method and thereby conserve water to be beneficially used in the future through the State water facilities or the Central Valley Project, the Board concludes that it would be unreasonable to dedicate for salinity repulsion purposes the large quantities of water that would be required to flow out to the sea." (Emphasis added.)

> "The Board is particularly persuaded to this view in the light of Article XIV, Section 3, of the State Constitution."

The Board also recognized that Delta users should be responsible for the cost of any betterment resulting from a substitute water facility.

The Board stated that it was:

"...cognizant of the responsibility of the water users, present and future, in the Delta and in the northern portion of Contra Costa County to assume their share of the costs of the federal and/or state project, commensurate with the benefits received, over and above those they would have enjoyed in the absence of a project."

Water Rights Decision D-1275. On May 31, 1967, the State Water Rights Board issued Decision D-1275 on the applications for permits by the Department of Water Resources. The permits were granted but conditioned so as to protect the Delta.

At the commencement of the hearings the Department introduced a stipulation between the Department and the Sacramento River and Delta Water Association (SRDWA) whereby it agreed that the Department would abide by the November 19 Criteria. This stipulation later ripened into an agreement between the Sacramento River and Delta Water Association and the Department at the end of the hearing (see discussion in an earlier section of this chapter).

During the hearing, the Board indicated that any permits issued would specify the minimum water quality to be maintained in the Delta and that this quality would be equal to or better than that agreed upon in the November 19 Criteria.

The Board found that from April 1 through June 30, the needs of the agricultural interests in the western Delta would be satisfactorily met for the next 3 years, or until a final determination, by maintaining a chloride ion content not to exceed 250 ppm measured at Blind Point on the San Joaquin River, and that from July 1 to November 30, the quality of water insured by the November 19 Criteria would provide water of higher quality than would result at most times under natural conditions.

However, the Board found that there was insufficient information available to finally determine the terms and conditions regarding water quality in the Delta which would protect vested rights without resulting in waste of water and therefore reserved jurisdiction over the permits of the Department for the purpose of formulating terms and conditions relative to water quality control in the Delta. 39/

39/ Jurisdiction was reserved for three years or for such additional time as the Board requires. Jurisdiction was continued in part because of the lack of information on water quality problems in the Delta and because both federal and state agencies are conducting extensive studies regarding the problem of water quality in San Francisco Bay and the Delta for the purposes of determining what standards of water quality should be maintained and by what means this should be accomplished. The Water Pollution Control Law of 1965 (Stats. 1965, Ch. 1351) requires that a report of these studies be made to the State Legislature by 1969.

Based upon the testimony and exhibits introduced at the hearing, the Board issued permits which contained various conditions for the protection of prior vested property rights.

Condition 15 provided that the Department shall make no diversions (except under permits issued pursuant to Applications 5629 and 14444) and shall not collect water to storage during the period from April 1 through June 30 at any time the maximum surface zone chloride ion content of the San Joaquin River at Blind Point exceeds 250 parts per million.

However, it should be emphasized that Condition 15 is only temporary in nature and is subject to change not later than mid-1970 when the results of the state and federal water quality studies are known. Also, Condition 15 is only an inhibition on exports from the Delta and does not require releases from storage.

Subsequent to the adoption of Decision D-1275 by the Board on May 31, 1967, the Department petitioned for reconsideration of portions of the decision, including Condition 15. 40/ However, reconsideration of Condition 15 was denied by the Board. 41/

Other pertinent conditions contained in Decision D-1275 are as follows:

Condition 6 requires releases from Oroville to the extent necessary to satisfy downstream prior rights; Condition 16 requires the Department to abide by the November 19, 1965 Criteria agreed to with the Bureau and Delta water users; Condition 18 requires the State to respect vested rights of Delta lands by avoiding severance of such lands from their sources of water supply by the construction of the Peripheral Canal except through purchase or condemnation; Condition 19 provides that the State Water Rights Board reserves continuing jurisdiction over these permits for the purpose of formulating or revising terms and conditions relative to salinity control in the Delta; and in Condition 27 the Board reserves continuing jurisdiction over permits for the purpose of formulating terms and conditions relative to flows to be maintained in the Delta for the protection of fish and wildlife.

Riparian Rights in the Delta. The Department has always assumed that all of the Delta lowlands are riparian to channels of

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40/ It was estimated by department engineers that an outflow of 6,000 cfs would be required to meet Condition 15 (i.e., the 250 ppm at Blind Point during the period).

41/ A hearing was held on other portions of the decision on August 22, 1967. On November 30, 1967, Decision D-1291 was issued.

the Delta and in some studies it has been assumed that such lands are riparian with respect to waters of the Sacramento River and to other tributary streams of the Delta. 42/ This section of the Delta report so far has made the assumption that there are riparian and appropriative rights in the Delta superior to those of the Department. This superiority results either because of statutory protection or because of the common law of riparian rights. However, the extent of some of these rights is unclear. First, no investigation has apparently been made of the chain-of-title of each assumped parcel of riparian land to determine if the parcel is the "smallest tract held under one title in the chain of title leading to the present owner". 43/

Second, riparian rights of Delta lands are somewhat circumscribed because Delta land does not abut upon the water at all times. This anomaly results because the State is the owner of all land below ordinary high water mark bordering upon tidewaters within the State, 44/ and the owner of lands bordering upon tidewater, takes only to the ordinary high water mark. 45/

At any time other than high tide, the state-owned land separates Delta land from abuting on the water. "Abutting upon the water" has been said to be a prerequisite to riparian status and the riparian right is held in suspense until the water next reaches the high tide mark. 46/

It is also possible that some Delta riparians have lost a portion of their riparian rights due to adverse use by upstream users. This condition occurred during the early 1930's when salt water intruded into the interior Delta thus rendering inchannel water unfit for agricultural use for an extended period of time. This intrusion resulted in part from the upstream use of water by persons who were lower in priority than Delta riparians and continued for a time sufficient to ripen into prescriptive rights. However, department reports have not taken possible prescriptive

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42/ Report on 1956 Cooperative Study Program -- Water Use and Water Rights Along the Sacramento River and in the Sacramento-San Joaquin Delta, U. S. Bureau of Reclamation, California Department of Water Resources, pgs. 21-22.

43/ Rancho Santa Margarita v. Vail, 11 Cal. 2d 501, 529, 81 P.2d 533, 547 (1938).

44/ California Civil Code Section 670.

45/ California Civil Code Section 830.

46/ See Crum v. Mount Shasta Power Corp., 117 Cal. App. 586, 591-597, 4 P.2d 564 (1931); City of Oakland v. E. K. Wood Lumber Co., 211 Cal. 16, 292 Pac. 1076 (1936).

rights into consideration 47/ in determining the water rights of the Delta and provisions have been made to supply water to the Delta to meet all assumed riparian rights.

Federal-State Relationships in the Delta.

May 16, 1960 Agreement. Since both the Department and the Bureau of Reclamation will be exporting water from the Delta, the Department of Water Resources and the Bureau of Reclamation entered into an operation agreement on May 16, 1960, to adjust the operational patterns of the Federal Central Valley Project and State Water Project so as to make them compatible. By handling complicated unresolved questions of priorities on an operational basis, an adjudication of conflicting state-federal water rights was avoided. This agreement establishes a firm foundation for the operation of both projects. Of course, this does not bind the Delta water users and, therefore, both the State and Federal Governments, as required by applicable law, must acquire water rights and must work out any necessary adjustments with those not parties to the agreement.

In essence, the agreement provides for a method of allocating shortages of water supplies from the Sacramento River and Delta as between the state and federal projects and provides that both the State and Federal Governments would not object to the establishment by the other of water rights under state law consistent with the agreement. By reason of the formula for sharing shortages, both projects will share in the conservation of water made possible by coordinated operation.

It is important to note, however, that the agreement did not cover the question of the quantity of outflow from the Delta to be maintained for salinity control. In Article 12 it was recognized that there would be such outflows which would have to be met from water supplies available in the Delta, but no agreement was reached concerning the quantities. The agreement was based on the premise, however, that outflows of 1,000 cfs would be adequate since certain areas of the Delta would be supplied by overland facilities.

By the nature of the agreement and its shortage-sharing provision, the required outflow is a charge on both projects. Neither project is more responsible for it than the other, nor is one project responsible for half. All of the project reservoirs of both the State and the Bureau will be operated together so as

47/ On page 22 of the report on 1956 Cooperative Study Program, supra note 1, it was stated that "In the determination of physically riparian lands along the Sacramento River above Sacramento and in the Delta lowlands no study was made of the possible modification of the right of such lands by reason of adverse use developing into a prescriptive right".

to produce maximum yields and the outflow requirement is merely one of the demands that must be met. This requirement has been modified since 1960 by the November 19, 1965 Criteria which will require an outflow greater than the 1,000 cfs.

Regulation of Water Quality in the Delta. Recently, an additional problem has arisen with another federal agency -- the Federal Water Pollution Control Administration (FWPCA) which is within the Department of the Interior. Pursuant to the Federal Water Pollution Control Act (as amended) the FWPCA is attempting to set salinity standards in the Delta which can only be met by freshwater releases from storage.

If the FWPCA is effective in setting salinity standards or the State Water Resources Control Board and Regional Water Quality Control Boards effectively set such standards, the feasibility of the State Water Project will be impaired. The following is an analysis of the authority of the State Water Resources Control Board, the Regional Water Quality Control Boards, and the FWPCA, to set salinity standards in the Delta.

State Water Quality Control

In 1967, the California Legislature abolished the State Water Rights Board and the State Water Quality Control Board and created in their place the State Water Resources Control Board, 48/ which was vested with all the duties and functions of the State Water Rights Board and the State Water Quality Control Board. 49/

The State Water Resources Control Board and the nine regional water quality control boards 50/ are empowered to formulate and adopt policies for the control of water pollution and water quality. 51/ While these boards are given wide discretion in formulating policy, 52/ they must take cognizance of the California Water Plan or any other general or coordinated plan of the State for the development, utilization, or conservation of the water resources of the State. 53/

48/ Water Code Section 175 (as amended by Calif. Stats. 1967, Ch. 284, Sec. 2.4).

49/ Water Code Section 179 (as amended by Calif. Stats. 1967, Ch. 284, Sec. 4).

50/ Water Code Sections 13040, 13041.

51/ Water Code Sections 13022, 13022.1, 13052(e).

52/ For example, they may consider such matters as salinity intrusion and the reduction of waste assimilative capacity caused by reductions in the quantity of water (44 Op. Cal. Atty. Gen. 126, 1964).

53/ Water Code Section 13022.2 (as amended by Calif. Stats. 1967, Ch. 284, Sec. 146).

Although the boards, unlike the Secretary of the Interior under the Federal Water Pollution Control Act, appear to have authority to establish policies that may require the release of stored water, they are without authority to enforce any policy which would require releases of stored water from state-operated reservoirs. No provisions of Division 7 of the Water Code nor any water quality ruling of the State Water Resources Control Board or of the regional water quality control boards is a limitation on the power of a state agency (including the Department of Water Resources) in the enforcement or administration of any provision of law which it is specifically permitted or required to enforce or administer. 54/ Also, no provision of Division 7 can be construed as affecting the right of any person (including the State) to the use of water for any beneficial use other than the use for disposal of sewage and industrial wastes. 55/ While the boards are granted limited enforcement powers 56/ against the State, such powers pertain only to the discharge of sewage and industrial wastes and do not extend to releases from storage in reservoirs.

Sections 13054 and 13054.1 of the Water Code require that persons 57/ proposing to "discharge sewage or industrial waste" file a report of the proposed discharge with the appropriate regional water quality control board. The regional board is authorized under these sections to impose requirements as to the nature of such discharge. If a person fails to file a report or to comply with requirements set by the board pursuant to a filed report, Sections 13054.5 and 13080 expressly authorize the district attorney, at the request of the regional board, to petition the superior court for an injunction requiring such person to file a report and to comply with requirements set by the regional board.

The injunction proceedings authorized by Sections 13054.5 and 13080 of the Water Code are the only injunction proceedings authorized by Division 7 of the Water Code. It is clear that these sections are limited to enjoining the discharge of sewage and industrial waste and do not empower the regional board and the district attorney to seek augmentation of streamflow by release of stored waters.

Federal Water Pollution Control Act

The Water Quality Act of 1965 58/ amended the Federal Water Pollution Control Act 59/ to create the Federal Water Pollution

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54/ Water Code Section 13001 (as amended by Calif. Stats. 1967, Ch. 284, Sec. 137).

55/ Water Code Section 13002.

56/ Water Code Sections 13025, 13053, 13054, 13054.1, 13054.3, 13054.5, 13055, 13080.

57/ Water Code Section 13005 defines "person" as including the State or any Department or agency thereof.

58/ P.L. 89-234, 79 Stat. 903 (1965).

59/ P.L. 84-660, 70 Stat. 498 (1956); P.L. 87-88, 75 Stat. 204 (1961).

Control Administration, 60/ revise the procedures for securing abatement of waste discharges, and require the establishment of specific quality standards on interstate waters. 61/

Section 10(c)(1) 62/ of the act requires that each state establish water quality criteria applicable to interstate waters, or portions thereof, within each state by June 30, 1967. Section 10(c)(2) 63/ provides that if any state fails to establish water quality standards by June 30, 1967, then the Secretary of the Interior may, after first holding a conference among federal, state, and local representatives, prepare regulations setting forth the standards. The affected state may either adopt the standards set forth in the regulations or, by petition of its governor, petition the Secretary of the Interior for a public hearing under Section 10(c)(4). 64/

If a public hearing is requested, the Secretary would appoint a hearing board of five or more persons. Each state affected by the standards would be entitled to select one member of this hearing board. All other members would come from other affected federal departments and agencies. Not less than a majority of the board members, however, would be persons other than officers or employees of the Department of the Interior. The hearing board would take evidence and make findings whether the standards established by the Secretary should be approved or modified.

The function of standards adopted by the states, the Secretary of the Interior, or the hearing board, is to provide a

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60/ The Federal Water Pollution Control Administration was transferred from the Department of Health, Education, and Welfare, to the Department of the Interior pursuant to the Reorganization Plan No. 2 of 1966, 31 Fed. Reg. 6857, 5 U.S.C.A. 133(z)-15.

61/ Section 13(e) of the act, 75 Stat. 210, §9 (1961), as renumbered, 33 U.S.C.A. 466(j)(e) specifies that interstate waters include coastal waters. By memorandum opinion No. M-36690, dated June 13, 1966, from Mr. Edward Weinberg, acting Solicitor of the U. S. Department of the Interior, to Mr. James M. Quigley, Commissioner, Federal Water Pollution Control Administration, coastal waters was interpreted to mean "waters of the sea within the territorial jurisdiction of the United States and all inland waters in which the tide ebbs and flows". Under this definition the Sacramento-San Joaquin Delta would constitute "interstate" waters for which quality standards must be established.

62/ 79 Stat. 907, §5(a) (1965), 33 U.S.C.A. 466 (g)(c)(1).

63/ 79 Stat. 907, §5(a) (1965), 33 U.S.C.A. 466 (g)(c)(2).

64/ 79 Stat. 907, §5(a) (1965), 33 U.S.C.A. 466 (g)(c)(4).

basis for initiation of abatement proceedings. Section 10(c)(5) 65/ of the act provides in part:

> "The discharge of matter into such interstate waters or portions thereof, which reduces the quality of such waters below the water quality standards established under this subsection is subject to abatement...."

The standards required by Section 10(c)(1) are limited to those which could be achieved only through the abatement of waste discharge. Since Section 10(c)(1) requires only those standards which can be achieved through abatement of waste discharge, then standards relating to the intrusion of salinity in the Sacramento-San Joaquin Delta are not required. The control of salinity in the Delta can be achieved only through flow augmentation, not abatement of waste discharge.

Language in Senate Report No. 10 66/, on the Federal Water Pollution Control Act Amendments of 1965, supports the interpretation that the standards required by Section 10(c)(1) are limited to those which can be achieved through the abatement of waste discharges. On page 9 of the report, emphasis is placed on the use of the standards to foster the construction of expanded waste treatment facilities:

> "The correction of damaging pollution after it has built up is vastly more complex and costly than prevention of such buildups. Standards of water quality to provide reliable and sound guidelines and effective measuring devices are an important and necessary part of any program of water pollution prevention, abatement, and control. The bill herewith reported would provide a basis for preventive action and a clear understanding of pollution abatement and control requirements by authorizing the establishment of water quality standards.
>
> "Water quality standards would provide an engineering base for design of treatment works by municipalities and industries. Such standards would enable municipalities and industries to develop realistic plans for new plants or expanded facilities, without uncertainties about waste disposal requirements on interstate waters."

The statutory organization of the Federal Water Pollution Control Act adds further support to an interpretation limiting the scope of Section 10(c)(1). Both the procedure for establishing standards, and the procedure for enforcing them through abatement

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65/ 79 Stat. 907, §5(a) (1965), 33 U.S.C.A. 466(g)(c)(5).

66/ Federal Water Pollution Control Act Amendments of 1965 (S. Rept. No. 10, 89th Congress, 1st Sess. 1965).

of waste discharges are contained in the same section, Section 10 67/ designated "Enforcement Measures Against Pollution of Interstate or Navigable Streams".

Lastly, the pamphlet prepared by the Federal Water Pollution Control Administration, entitled "Guidelines for Establishing Water Quality Standards for Interstate Waters", 68/ clearly emphasizes quality criteria which can be achieved by regulation of waste discharge:

> "Policy Guidelines
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> "1. ...the standards should be designed to prevent any increase in pollution.
>
> "2. No standards of water quality will be approved which provide for the use of any stream or portion thereof for the sole or principal purpose of transporting wastes.
>
> "3. ...The criteria should identify the water uses to be protected and establish limits on pollutants or effects of pollution necessary to provide for such uses.
>
> " * * *
>
> "7. The plan should include consideration of all relevant pollutional sources, such as municipal and industrial wastes, cooling water discharges, irrigation return flows, and combined sewer overflows.
>
> "8. No standard will be approved which allows any wastes amenable to treatment or control to be discharged into any interstate water without treatment or control regardless of the water quality criteria and water use or uses adopted. Further, no standard will be approved which does not require all wastes, prior to discharge into any interstate water, to receive the best practicable treatment or control unless it can be demonstrated that a lesser degree of treatment or control will provide for water quality enhancement commensurate with proposed present and future water uses."

Even assuming that Section 10(c)(1) of the Federal Water Pollution Control Act does require that salinity standards be established for the Sacramento-San Joaquin Delta, no provision of the Act authorizes institution of any proceedings to require

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67/ 75 Stat. 208, §7(a) (1961), 33 U.S.C.A. 466(g).

68/ Revised December 1966 by the U. S. Department of the Interior, Federal Water Pollution Control Administration.

that the State Water Project release water to meet these standards. The enforcement provisions of the act are clearly limited to the abatement of waste discharge and, as to that, may be initiated only with the consent of the Governor in those situations where the discharge affects only persons located within the same state as the discharger, e.g., the situation in the Sacramento-San Joaquin Delta.

Section 10(c)(5) 69/ provides:

> "The discharge of matter into such interstate waters or portions thereof, which reduces the quality of such waters below the water quality standards established under this subsection ... is subject to abatement in accordance with the provisions of paragraph (1) or (2) of subsection (g) of this section . . . ." (Emphasis added.)

Section 10(g)(2) 70/ provides:

> "In the case of pollution of waters which is endangering the health or welfare of persons only in the State in which the discharge or discharges (causing or contributing to such pollution) originate, [the Secretary of the Interior] may, with the written consent of the Governor of such State, request the Attorney General to bring a suit on behalf of the United States to secure abatement of the pollution." (Emphasis added.)

The significance of the failure of the Congress to include specifically streamflow augmentation in the standard-setting and enforcement provisions of Section 10(c) is enhanced by the fact that streamflow augmentation to improve water quality is dealt with elsewhere in the act. Section 3(b) provides that, with respect to federal projects, consideration should be given, by the appropriate federal agency, to the inclusion of capacity for streamflow regulation for the purposes of water quality control. It reads:

> "In the survey or planning of any reservoir by the Corps of Engineers, Bureau of Reclamation, or other Federal agency, consideration shall be given to inclusion of storage for regulation of streamflow for the purpose of water quality control, except that any such storage and water releases shall not be provided as a substitute for adequate treatment or other methods of controlling waste at the source." 71/

69/ 79 Stat. 907, §5(a) (1965), 33 U.S.C.A. 466(g)(c)(5).

70/ 75 Stat. 209 (1961), 33 U.S.C.A. 466(g)(g)(2), as renumbered 75 Stat. 208, §8(c)(1961).

71/ Section 3(b)(1), 75 Stat. 204, §2 (1961), 33 U.S.C.A.466(a)(b)(1).

It further requires an appropriate allocation in federal projects to water quality control through streamflow augmentation in the reporting of such allocation to the Congress prior to authorization (thus it applies to new reservoirs, not existing reservoirs). Nonreimbursable allocations for water quality improvement through streamflow augmentation are authorized where benefits are widespread in the following terms:

> "Costs of water quality control features incorporated in any Federal reservoir or other impoundment under the provisions of this Act shall be determined and the beneficiaries identified and if the benefits are widespread or national in scope the costs of such features shall be non-reimbursable." 72/

In Section 5(d)(d) 73/ the Secretary is directed to study methods and procedures for evaluating the effects on water quality of augmented streamflows to control pollution not susceptible to other means of abatement. This section authorizes a study and research program, including grants-in-aid to public and private institutions, but certainly does not imply that augmentation should be used as an abatement device under Section 10.

From what has been presented, the pattern that the Congress envisioned in the Federal Water Pollution Control Act emerges. Under Section 10 it provided for the establishment of standards for the discharge of pollutants into interstate water and for enforcement of these standards. With regard to water quality improvement through streamflow augmentation, however, it provided for nonreimbursable allocations in federal reservoir projects under Section 3 and investigation, research, and demonstration by the Secretary and cooperating agencies under Section 5 for the evaluation of the effects on water quality of augmented streamflows. The Congress recognized augmented streamflow as an available technique for water quality improvement, but chose not to include it in the standard-setting and enforcement provisions of the act.

72/ Section 3(b)(4), 75 Stat. 204, §2 (1961), 33 U.S.C.A.466(a)(b)(4).

73/ 75 Stat. 205, §3(b) (1961), 33 U.S.C.A.466(c)(d)(1)(c).

APPENDIX A

DELTA WATER QUALITY CRITERIA
NOVEMBER 19, 1965

DELTA WATER QUALITY CRITERIA

Negotiations regarding Delta water problems have been in progress among negotiating teams representing the following groups and agencies:

Sacramento River and Delta Water Association, representing the Delta areas shown on Plate 1
San Joaquin Water Rights Committee, representing the Delta areas shown on Plate 2
California Department of Water Resources
United States Bureau of Reclamation

Although the negotiating teams are not authorized to commit the groups and agencies that they respectively represent, they do approve the attached proposed Delta Water Quality Criteria dated November 19, 1965, as an appropriate basis for further negotiations leading to agreements between Delta interests and the operators of the Federal and State projects affecting water supplies in the Delta which will assure the Delta area represented of a dependable supply of water of suitable quality sufficient to meet its present and future needs.

Dated: November 19, 1965

Sacramento River and Delta Water Association

By /s/ John M. Luther

California Department of Water Resources

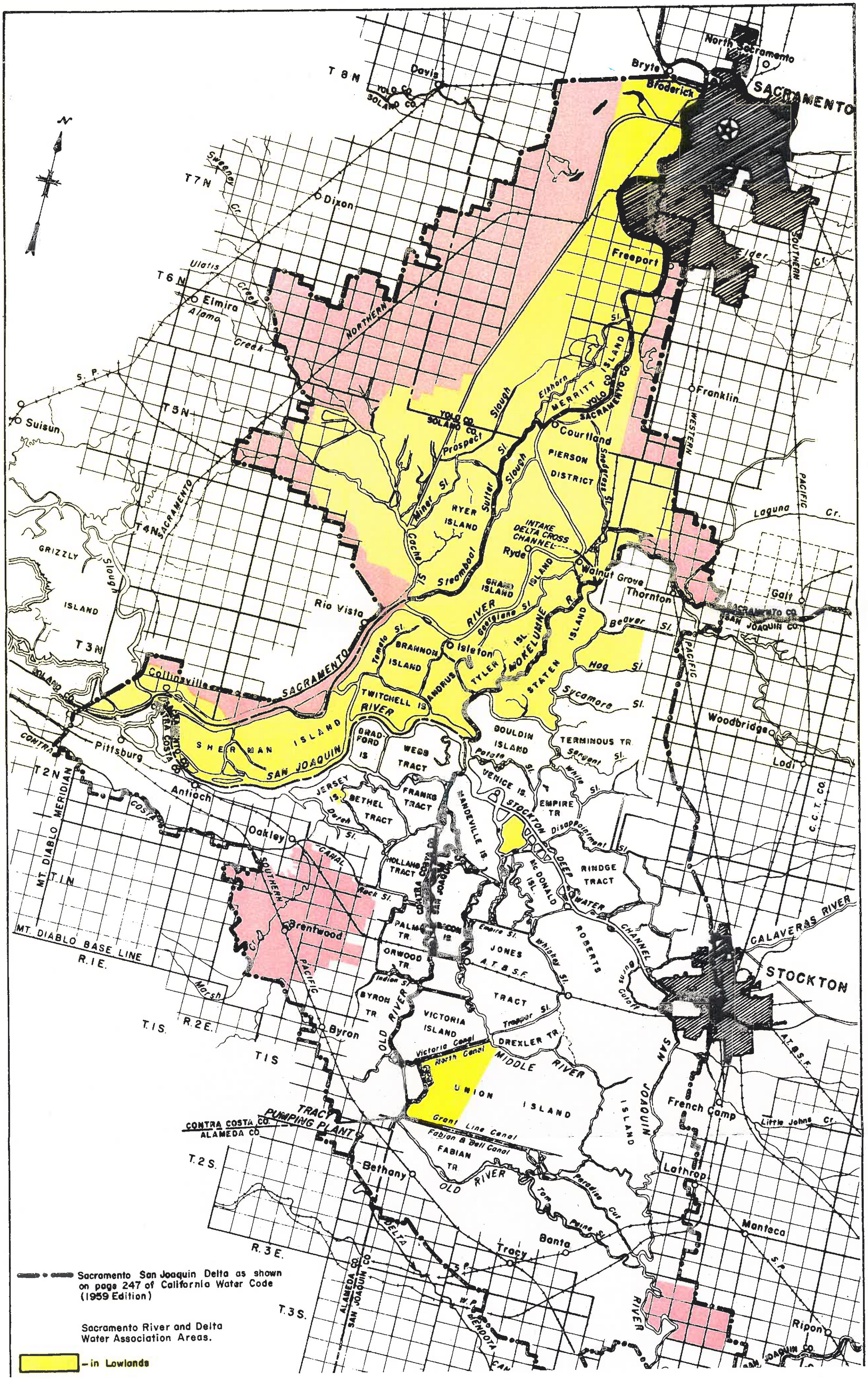
By /s/ Reginald C. Price

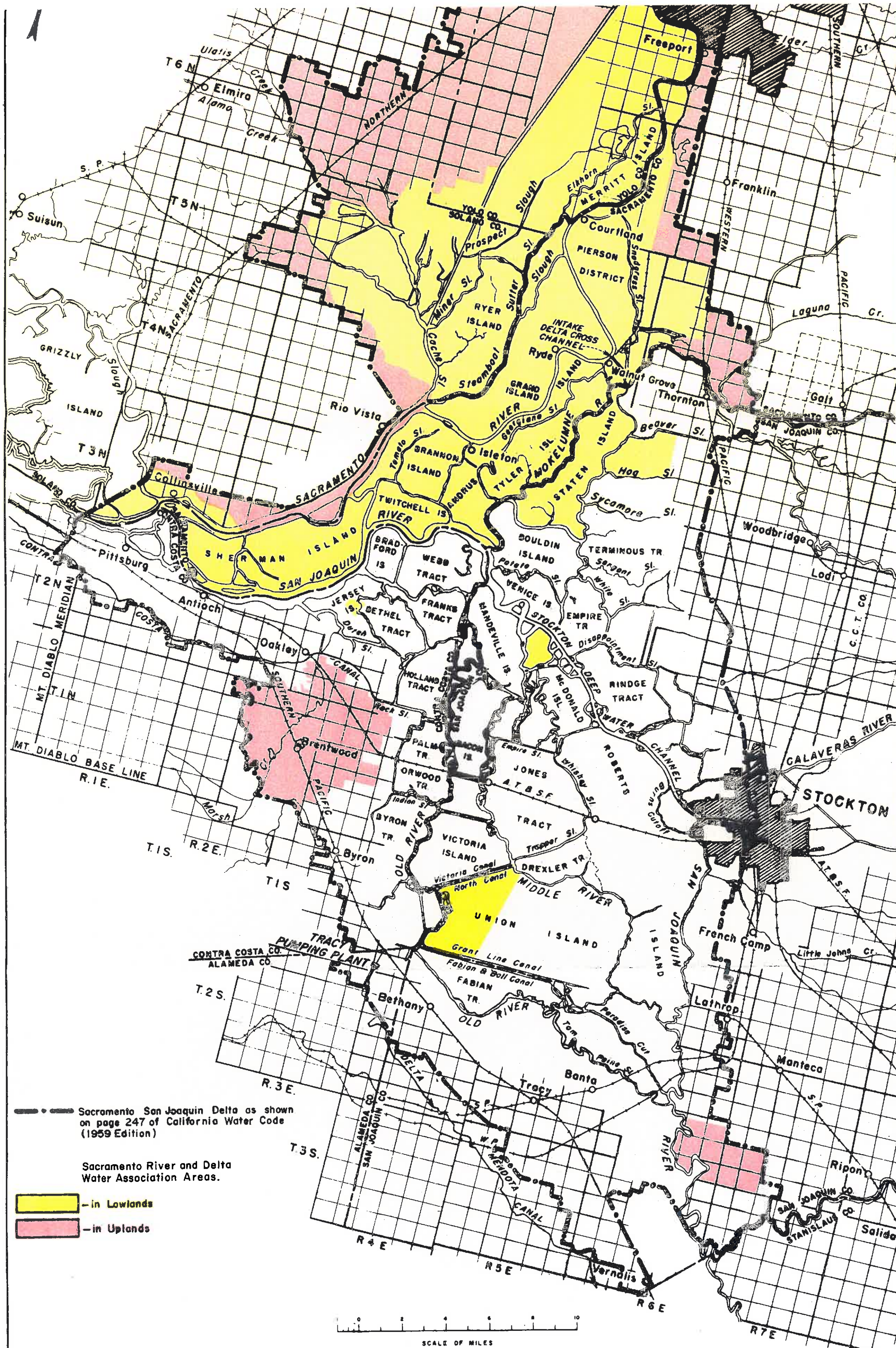
San Joaquin Water Rights Committee

By /s/ John A. Wilson

United States Bureau of Reclamation

By /s/ E.F. Sullivan


SACRAMENTO
North Sacramento
Bryte
Broderick
Davis
Dixon
Elmira
Suisun
Freeport
Franklin
Courtland
Ryde
Walnut Grove
Thornton
Galt
Rio Vista
Isleton
Collinsville
Pittsburg
Antioch
Oakley
Brentwood
Byron
Woodbridge
Lodi
STOCKTON
French Camp
Lathrop
Manteca
Bethany
Tracy
Banta
Ripon
TRACY PUMPING PLANT
MERRITT ISLAND
PIERSON DISTRICT
RYER ISLAND
GRAND ISLAND
BRANNON ISLAND
TYLER ISL
STATEN ISLAND
TWITCHELL IS
SHERMAN ISLAND
BRADFORD IS
WEBB TRACT
BOULDIN ISLAND
TERMINOUS TR
VENICE IS.
EMPIRE TR
JERSEY IS.
BETHEL TRACT
FRANKS TRACT
MANDEVILLE IS
HOLLAND TRACT
McDONALD ISL.
RINDGE TRACT
PALM TR.
ORWOOD TR.
JONES TRACT
ROBERTS ISLAND
BYRON TR
VICTORIA ISLAND
DREXLER TR
UNION ISLAND
FABIAN TR
INTAKE DELTA CROSS CHANNEL
STOCKTON DEEP WATER CHANNEL
SACRAMENTO RIVER
SAN JOAQUIN RIVER
MOKELUMNE R.
OLD RIVER
MIDDLE RIVER
CALAVERAS RIVER
YOLO CO.
SOLANO CO.
SACRAMENTO CO.
SAN JOAQUIN CO.
CONTRA COSTA CO.
ALAMEDA CO.
MT. DIABLO MERIDIAN
MT. DIABLO BASE LINE
T 8 N
T 7 N
T 6 N
T 5 N
T 4 N
T 3 N
T 2 N
T 1 N
T 1 S
T.2 S.
T.3 S.
R.1 E.
R.2 E.
R.3 E.
Sacramento San Joaquin Delta as shown on page 247 of California Water Code (1959 Edition)
Sacramento River and Delta Water Association Areas.
- in Lowlands


Sacramento San Joaquin Delta as shown on page 247 of California Water Code (1959 Edition)
Sacramento River and Delta Water Association Areas.
-in Lowlands
-in Uplands
Freeport
Elmira
Suisun
Franklin
Courtland
Ryde
Walnut Grove
Thornton
Galt
Rio Vista
Isleton
Collinsville
Pittsburg
Antioch
Oakley
Brentwood
Byron
Woodbridge
Lodi
STOCKTON
French Camp
Lathrop
Manteca
Bethany
Banta
Tracy
Vernalis
Ripon
Salida
TRACY PUMPING PLANT
CONTRA COSTA CO.
ALAMEDA CO.
SACRAMENTO CO.
SAN JOAQUIN CO.
YOLO CO.
SOLANO CO.
SACRAMENTO RIVER
SAN JOAQUIN RIVER
MOKELUMNE R.
CALAVERAS RIVER
OLD RIVER
MIDDLE RIVER
STOCKTON DEEP WATER CHANNEL
INTAKE DELTA CROSS CHANNEL
SHERMAN ISLAND
TWITCHELL IS
BRANNON ISLAND
TYLER ISL.
STATEN ISLAND
GRAND ISLAND
RYER ISLAND
PIERSON DISTRICT
MERRITT ISLAND
BOULDIN ISLAND
WEBB TRACT
BRADFORD IS
JERSEY IS.
BETHEL TRACT
FRANKS TRACT
VENICE IS
EMPIRE TR
TERMINOUS TR
MANDEVILLE IS.
HOLLAND TRACT
McDONALD ISL
RINDGE TRACT
PALM TR.
ORWOOD TR.
JONES TRACT
ROBERTS ISLAND
BYRON TR.
VICTORIA ISLAND
DREXLER TR
UNION ISLAND
FABIAN TR.
GRIZZLY ISLAND
MT. DIABLO BASE LINE
MT. DIABLO MERIDIAN
T6N
T5N
T4N
T3N
T2N
T1N
T1S
T2S
T3S
R1E
R2E
R3E
R4E
R5E
R6E
R7E
R8E
SCALE OF MILES

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

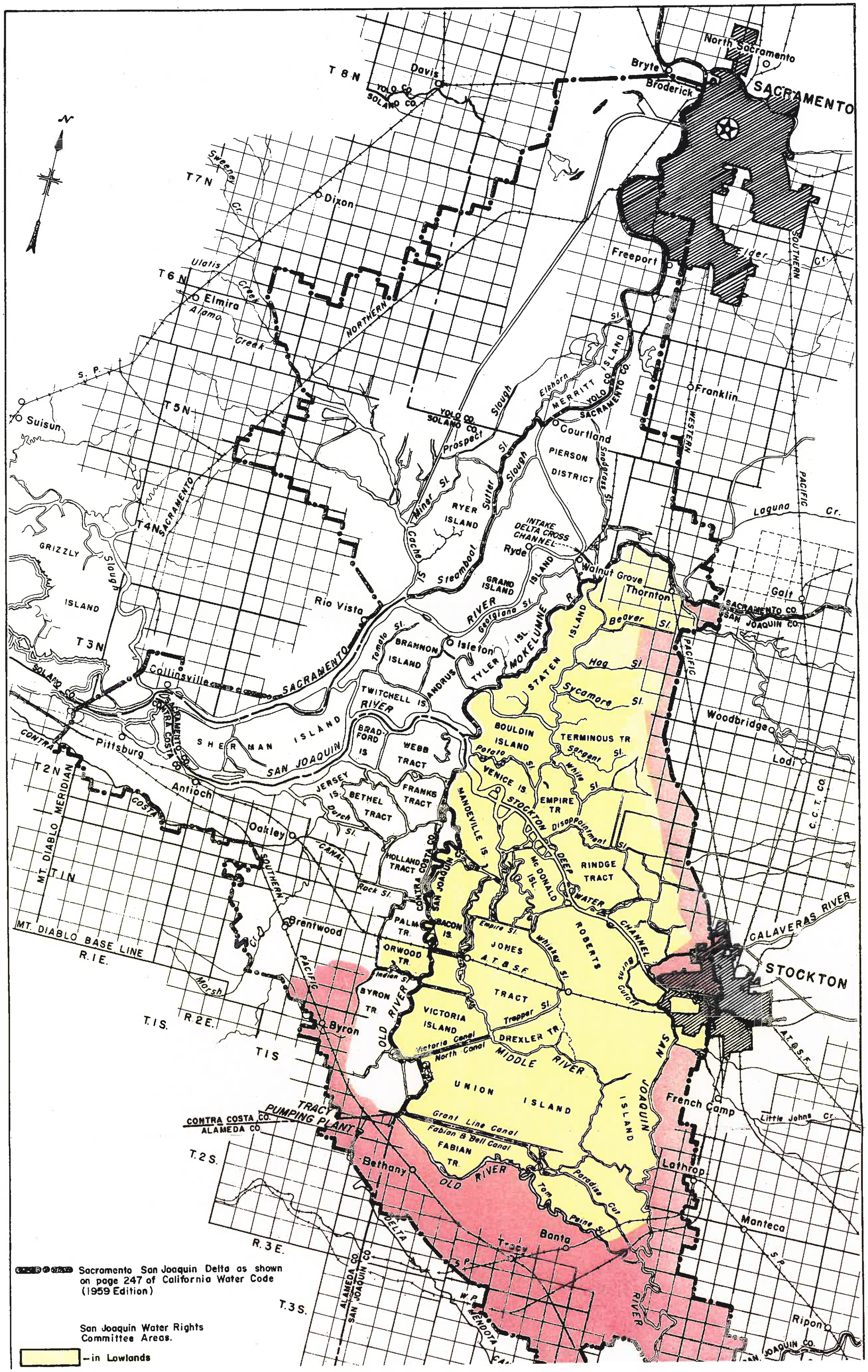
CENTRAL VALLEY PROJECT
DELTA - DIVISION - CALIF.

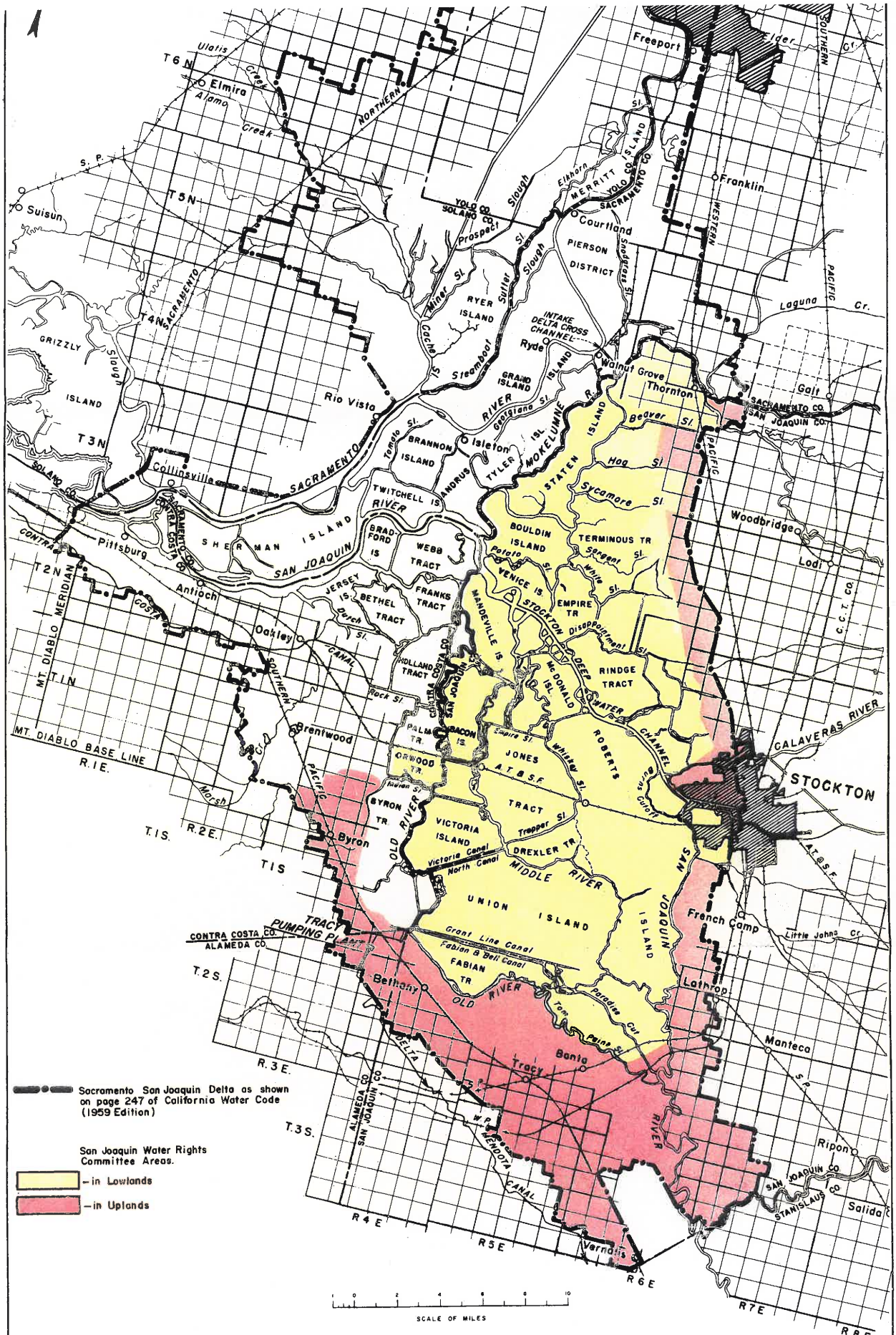
SACRAMENTO-SAN JOAQUIN DELTA AREA

SEPT. 30, 1964, REV. 12-7-65

863-208-205

GPO 971-911


Sacramento San Joaquin Delta as shown on page 247 of California Water Code (1959 Edition)
San Joaquin Water Rights Committee Areas.
—in Lowlands
SACRAMENTO
North Sacramento
Bryte
Broderick
Davis
Dixon
Elmira
Suisun
Freeport
Franklin
Courtland
Ryde
Walnut Grove
Thornton
Galt
Rio Vista
Isleton
Collinsville
Pittsburg
Antioch
Oakley
Brentwood
Byron
Woodbridge
Lodi
STOCKTON
French Camp
Lathrop
Manteca
Bethany
Banta
Tracy
Ripon
TRACY PUMPING PLANT
T 8 N
T 7 N
T 6 N
T 5 N
T4N
T 3 N
T2N
T1N
T.1S.
T1S
T.2S.
T.3S.
R.1E.
R.2E.
R.3E.
MT. DIABLO MERIDIAN
MT. DIABLO BASE LINE
YOLO CO.
SOLANO CO.
SACRAMENTO CO.
SAN JOAQUIN CO.
CONTRA COSTA CO.
ALAMEDA CO.
GRIZZLY ISLAND
SHERMAN ISLAND
RYER ISLAND
GRAND ISLAND
BRANNON ISLAND
TWITCHELL IS.
BRADFORD IS
WEBB TRACT
JERSEY IS.
BETHEL TRACT
FRANKS TRACT
HOLLAND TRACT
PALM TR.
BACON IS.
ORWOOD TR.
BYRON TR
VICTORIA ISLAND
UNION ISLAND
FABIAN TR.
STATEN ISLAND
BOULDIN ISLAND
TERMINOUS TR
VENICE IS.
EMPIRE TR
MANDEVILLE IS.
McDONALD ISL.
RINDGE TRACT
ROBERTS
JONES TRACT
DREXLER TR.
TYLER ISL.
ANDRUS
PIERSON DISTRICT
MERRITT ISLAND
INTAKE DELTA CROSS CHANNEL
SACRAMENTO RIVER
SAN JOAQUIN RIVER
MOKELUMNE R.
OLD RIVER
MIDDLE RIVER
CALAVERAS RIVER
STOCKTON DEEP WATER CHANNEL
Grant Line Canal
Fabian & Bell Canal
Victoria Canal
North Canal
Paradise Cut
Tom Paine Sl.
Steamboat Sl.
Sutter Sl.
Miner Sl.
Cache Sl.
Prospect Slough
Elk Slough
Georgiana Sl.
Beaver Sl.
Hog Sl.
Sycamore Sl.
Potato Sl.
White Sl.
Disappointment Sl.
Empire Sl.
Whiskey Sl.
Trapper Sl.
Indian Sl.
Rock Sl.
Dutch Sl.
Tomato Sl.
Laguna Cr.
Elder Cr.
Little Johns Cr.
Ulatis Creek
Alamo Creek
Sweeney Cr.
Marsh Cr.
CONTRA COSTA CANAL
NORTHERN
SOUTHERN
PACIFIC
WESTERN
A.T. & S.F.
C.C.T. CO.
S.P.
W.P.



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CENTRAL VALLEY PROJECT
DELTA – DIVISION – CALIF.

SACRAMENTO-SAN JOAQUIN DELTA AREA

863-208-200

JUNE 18, 1964, REV. 12-1-65

GPO 971-912

Bureau of Reclamation
Department of Water Resources
San Joaquin Water Rights Committee
Sacramento River and Delta Water
Association

November 19, 1965

DELTA WATER QUALITY CRITERIA

A. Delta Area: Delta area will include both Delta lowlands and Delta uplands and may include as much but no more than the area described in Section 12220 of the Water Code of the State of California.

B. General Objectives: The general objectives of these criteria are as follows:

1. To protect the Western Delta channels against the intrusion of ocean salinity.

2. To provide water of suitable quality in the interior Delta channels acceptable for the contemplated uses.

C. Definitions: The definitions of certain terms used in these criteria are as follows:

1. "Critical year" shall mean any year in which either of the following eventualities exists:

a. The forecasted full natural inflow to Shasta Lake for the current water year (October 1 of the preceding calendar year through September 30 of the current calendar year) is equal to or less than 3,200,000 acre-feet; or

b. The total accumulated actual deficiencies below 4,000,000 acre-feet in the immediately prior water year or series of successive prior water years each of which had inflows of less than 4,000,000 acre-feet, together with the forecasted deficiency for the current water year, exceed 800,000 acre-feet.

2. "Dry year" shall mean any year other than a critical year in which the forecasted full natural inflow to Shasta Lake for the current water year is equal to or less than 4,000,000 acre-feet.

3. "Below normal year" shall mean any year in which the forecasted full natural inflow to Shasta Lake for the current water year is equal to or less than 4,500,000 acre-feet but more than 4,000,000 acre-feet.

4. "Full natural inflow to Shasta Lake" shall mean the computed inflow to Shasta Lake under present water development above Shasta Lake. In the event that a major water project is completed above Shasta Lake after September 1, 1963, which materially alters the present regimen of the stream systems contributing to Shasta Lake, the computed inflow to Shasta Lake will be adjusted to eliminate the effect of such water project. After consultation with the State, the Weather Bureau, and other recognized forecasting agencies, the U. S. Bureau of Reclamation will select the forecast to be used and

will make the details of it available to the Delta water users. The same forecasts used by the United States for the operation of the Central Valley Project shall be used to make the forecasts under this agreement. Such forecasts shall be made by February 15 of each year and may be revised as frequently thereafter as conditions and information warrant.

D. Quality Criteria: The quality criteria for water in the channels of the Delta required to satisfy the general objectives set forth in Article B are as follows:

1. At Jersey Point in San Joaquin River and at Emmaton (southwest end of Horseshoe Bend) in Sacramento River, a mean daily chloride content of 1,000 parts per million or less when measured on the basis of the average mean daily value for any 10 consecutive days, except that after August 1 of a critical year and until December 31 of the same calendar year, the quality criteria set forth above may be increased from 1,000 parts per million to 1,400 parts per million of chloride.

2. At Jersey Point in San Joaquin River and at Emmaton in Sacramento River, an average mean daily chloride content of 200 parts per million or less for a period of at least 10 consecutive days each year at some time during the period between April 1 and May 31, except in dry or critical years.

3. At Terminous in Little Potato Slough, at Rio Vista in Sacramento River, at San Andreas Landing in San Joaquin River, at Clifton Court Ferry in Old River, and after the initial operation of the Peripheral Canal, at the bifurcation of Middle River and Old River,

a. A mean daily total dissolved solids content of 700 parts per million or less when measured on the basis of the average mean daily value for any 10 consecutive days,

b. A mean monthly total dissolved solids content of 500 parts per million or less when measured on the basis of the average mean daily value for any calendar month,

c. A mean annual total dissolved solids content of 450 parts per million or less when measured on the basis of the average mean daily value for any calendar year.

4. After April 1 in a dry or critical year and after August 1 in a below normal year and until December 31 of the same calendar year, the total dissolved solids criteria specified in Article D, Part 3, may reach, but not exceed, 800 parts per million for item a, 600 parts per million for item b, and 500 parts per million for item c; provided, however, the average of the

values of the total dissolved solids content at all of the named locations shall not exceed, for the balance of the calendar year, the mean values specified in Article D, Part 3.

5. Whenever the recorded total dissolved solids content in Sacramento River at Green's Landing exceeds a mean 10-day or a mean monthly value of 150 parts per million, the quality criteria in Article D, Parts 3 and 4 may be changed by adding to those values the product of 1-1/2 times the amount by which the recorded total dissolved solids content at Green's Landing exceeds 150.

E. Conditions Permitting Change of Location of Control Stations at Emmaton and Jersey Point: After 1980, the locations of the control stations at Emmaton and Jersey Point may be moved upstream to, but not beyond, (1) the south end of Threemile Slough in San Joaquin River and (2) the north end of Threemile Slough in Sacramento River and substitute water facilities provided for the area affected by such move, if the parties agree that operating experience indicates that the water quality criteria in Article D, Part 1 will create undue hardship to the operators of the State or Federal projects, and agree upon terms and conditions as may be authorized by law and mutually agreeable to the parties at that time; provided, however, nothing in this agreement shall be construed to waive whatever rights the project operators may otherwise have to provide

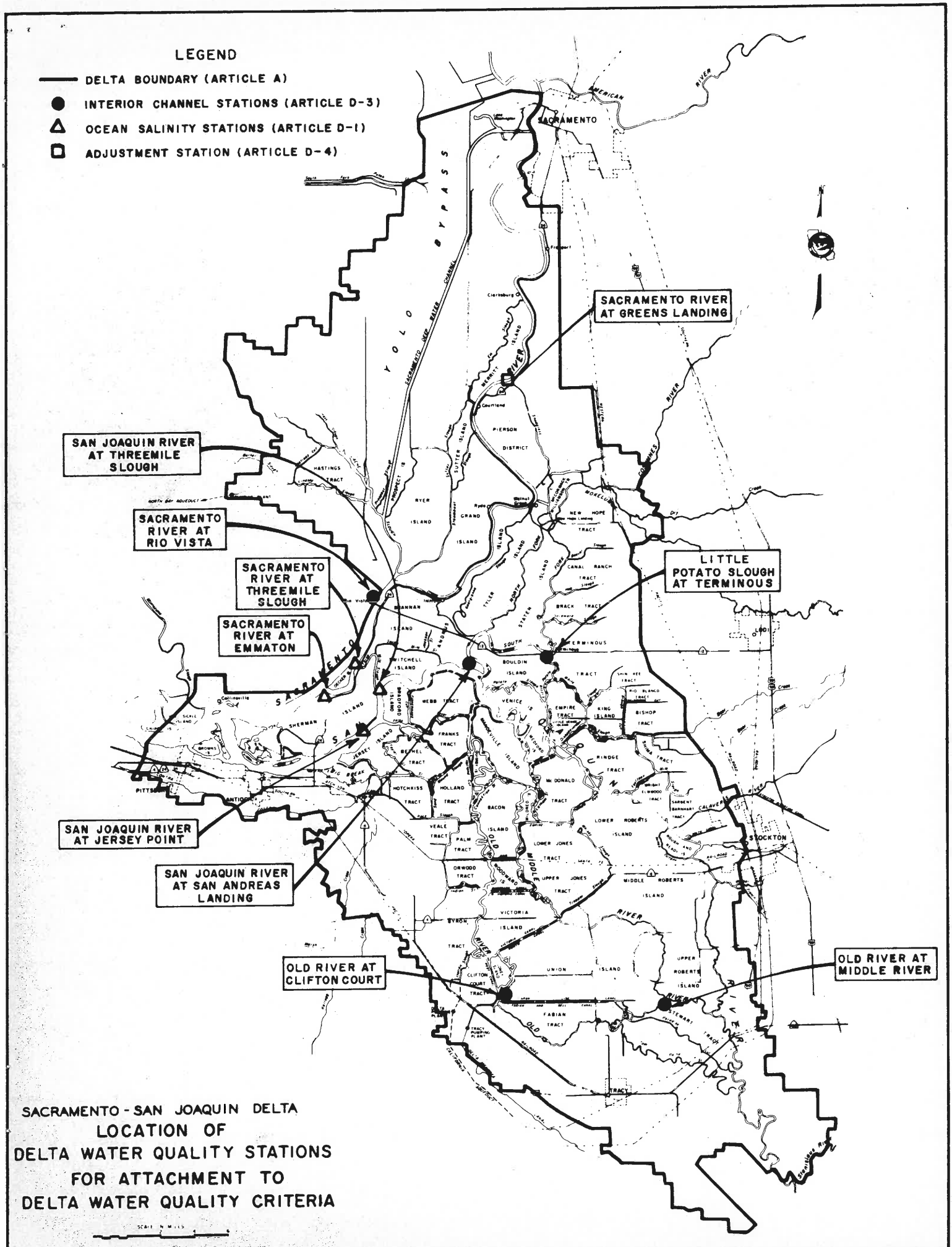
in the public interest a substitute water supply in lieu of the water supply provided by these criteria subject to applicable law including the obligations of the State under Sections 12200-12205 of the Water Code.

After 1980, if operating experience indicates that the water quality criteria specified in Article D is creating undue hardship to the Delta water users, the quality of the water may be improved if the parties so agree, and then upon such terms and conditions as may be mutually agreeable to the parties.

F. Peripheral Canal and Other Projects: The proposed Peripheral Canal, and any other projects of the United States or the State of California, will be operated in such a manner so as not to violate the foregoing objectives. Flows in Sacramento River and releases from Peripheral Canal into Delta channels will be in such quantities and at such locations as will provide the best quality of water over the Delta as a whole and specifically not less than the quality provided in Article D.

G. New Melones: In the event New Melones Reservoir on Stanislaus River is operated to provide water quality control, the quality of the water in San Joaquin River at Vernalis will be maintained at 500 parts per million of total dissolved solids content or less, when measured on the basis of the average mean daily value for any 30 consecutive days,

provided that not more than 70,000 acre-feet shall be released from New Melones Reservoir in any one calendar year specifically for water quality, in addition to the water released for fishery and other purposes and downstream prior rights.


LEGEND
DELTA BOUNDARY (ARTICLE A)
INTERIOR CHANNEL STATIONS (ARTICLE D-3)
OCEAN SALINITY STATIONS (ARTICLE D-1)
ADJUSTMENT STATION (ARTICLE D-4)
SACRAMENTO RIVER AT GREENS LANDING
SAN JOAQUIN RIVER AT THREEMILE SLOUGH
SACRAMENTO RIVER AT RIO VISTA
SACRAMENTO RIVER AT THREEMILE SLOUGH
SACRAMENTO RIVER AT EMMATON
LITTLE POTATO SLOUGH AT TERMINOUS
SAN JOAQUIN RIVER AT JERSEY POINT
SAN JOAQUIN RIVER AT SAN ANDREAS LANDING
OLD RIVER AT CLIFTON COURT
OLD RIVER AT MIDDLE RIVER
SACRAMENTO
STOCKTON
YOLO BYPASS
SACRAMENTO - SAN JOAQUIN DELTA
LOCATION OF
DELTA WATER QUALITY STATIONS
FOR ATTACHMENT TO
DELTA WATER QUALITY CRITERIA

NOV. 19. 1965

APPENDIX B

WATER ENTITLEMENT AGREEMENTS WITH WESTERN DELTA INTERESTS

C
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P
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DWR #456263

C
O
P
Y

AGREEMENT

THIS AGREEMENT made this 21st day of April, 1967, between the STATE OF CALIFORNIA, acting by and through its Department of Water Resources, hereinafter referred to as the "State", and CONTRA COSTA COUNTY WATER DISTRICT, a public body organized and existing pursuant to Division 12 of the Water Code of the State of California, hereinafter referred to as the "District",

WITNESSETH:

WHEREAS, since 1930 the District and its predecessor, California Water Service Company, have been diverting water from Mallard Slough on Suisun Bay in Contra Costa County pursuant to Water Right Permit to Appropriate Water number 3167 issued on Application number 5941 filed on November 19, 1928. Said diversions have been for direct beneficial use and to storage for later beneficial use within the service area of the Treated Water Division of the District when the water in Mallard Slough had a chloride ion content (mean tidal cycle surface zone) of 100 parts per million or less and was not otherwise polluted to make it unsuitable for treatment for municipal and domestic use (hereinafter referred to as usable river water), and

WHEREAS, the average number of days per water year (October 1 to September 30, hereinafter referred to as "year") that usable river water has been available to the District at said point of diversion is 142 and the median period of said availability is from January 15 to June 5, both days inclusive, and

WHEREAS, during each day usable river water has been and will in the future be available to the District the quantity thereof has been and will be adequate to meet the water requirements of the District from that point of diversion during such day, and

WHEREAS, in the future the average number of days per year that usable river water will be available to the District will decrease and such decrease will be due in part to the operation of the State Water Resources Development System as defined in Section 12931 of the Water Code, and

WHEREAS, it is contemplated that the Contra Costa Canal, supplemented by the Kellogg Unit or other facilities to be constructed by the Bureau of Reclamation, will meet the District's future water requirements which are not met by usable river water. If such facilities are not constructed by the Bureau of Reclamation, water supply facilities will have to be constructed by another agency or agencies to meet the District's future requirements including a substitute water supply equal to the District's water deficiency entitlement as defined in this agreement;

NOW, THEREFORE, the parties agree as follows:

1. The term of this agreement shall begin on the first day of October, 1967, and shall continue in effect until terminated by either party by written notice to the other party given at least 12 months prior to the effective date of such termination. The effective date of termination shall be the last day of a year (September 30) and no termination shall be effective prior to September 30, 2007.

2. The State shall reimburse the District in the manner hereinafter provided for any decrease in availability to the District of usable river water in Mallard Slough during the term of this agreement caused by operation of the State Water Resources Development System. Such decrease in availability of usable river water is hereinafter referred to as the District's "water deficiency entitlement".

3. The quantity of the District's water deficiency entitlement shall be determined for each year during the term of this agreement by the formula

$$E = \frac{(142-D)}{3} \quad \frac{(R+P)}{142}$$

where E is the District's water deficiency entitlement for such year in acre-feet, D is the number of days during such year that usable river water is available to the District at Mallard Slough, R is the total quantity of water in acre-feet diverted by the District from Mallard Slough from 8:00 A.M. on January 15 to 8:00 A.M. on June 6 and P is the total quantity of water in acre-feet purchased by the District and introduced into its facilities in the vicinity of Chenery Reservoir from 8:00 A.M. on January 15 to 8:00 A.M. on June 6. If in any year D exceeds 142, the District shall have no water entitlement for such year and the amount of such excess shall offset any water entitlement of the District for an equal number of days in the next succeeding year or years when D is less than 142.

4. For the purpose of computing the District's water deficiency entitlement, the District will at its expense measure the chloride ion content of water in Mallard Slough at such intervals as shall be reasonably necessary and shall make the results of such measurements available to the State. The State may at its expense verify the accuracy of the District's measurements and any error thus disclosed shall be corrected by the District.

5. Each year during the term of this agreement that the District has a water deficiency entitlement it shall purchase a quantity of substitute water equal thereto from the Contra Costa Canal as supplemented by the Kellogg Unit or other facilities constructed by the Bureau of Reclamation to meet the District's requirement, but if sufficient water is not available to the District from such source it shall purchase said quantity of substitute water from a project or projects constructed by another

agency or agencies to meet the District's future water requirements. For the purposes of this agreement, substitute water shall be deemed to have been purchased during the period beginning at 8:00 A.M. on January 15 and ending at 8:00 A.M. on June 6 of such year and the price paid by the District for substitute water shall be deemed to be the average price per acre-foot paid by the District for all untreated water purchased by it for introduction into its facilities in the vicinity of Chenery Reservoir during said period without deduction for any discount, allowance or rebate that may hereafter be made or allowed by the U. S. Bureau of Reclamation in the event the District hereafter undertakes, to any extent to operate and maintain any facilities of the U. S. Bureau of Reclamation not operated and maintained by the District as of the date of this agreement.

6. Each year during the term of this agreement that the District purchases substitute water for its water deficiency entitlement, the State will pay the District an amount of money computed in accordance with the formula M=E(Cw + Ce - $4.90) where M is the amount in dollars to be paid by the State, E is the District's water deficiency entitlement for such year determined in the manner provided in Section 3 hereof, Cw is the amount per acre-foot paid by the District for substitute water delivered to the District as provided in Section 5 hereof, and Ce is the average amount (if any) per acre-foot paid by the District for electric energy to transport substitute water from the point of delivery thereof to the District to the District's facilities in the vicinity of Chenery Reservoir. The State shall pay said amount to the District not later than October 31 of the following year. Such payments are hereby determined to be reasonable costs of the annual maintenance and operation of the State Water Resources Development System and shall be disbursed from the California Water Resources Development Bond Fund pursuant to subsection (b)(1) of Section 12937 of the Water Code.

7. The District, in consideration of the payments by the State herein provided, releases the State from liability for any decrease in the availability to the District of usable river water at Mallard Slough caused by operation of the State Water Resources Development System during the term of this agreement.

8. The obligations of the State herein shall not be affected by any modification or discontinuance of the District's Mallard Slough pumping plant or Chenery Reservoir.

9. Nothing herein shall be deemed to be a release or waiver of any right of the District to purchase supplemental water supplies from the State with the priorities established by Water Code Section 11460, 12201 to 12204 inclusive, and 12931.

IN WITNESS WHEREOF the parties hereto have executed this agreement by their respective officers thereunto duly authorized on the date first above written.

Approved as to legal form and sufficiency:

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

By /s/ P. A. Towner
Chief Counsel

By /s/ W. R. Gianelli
Director

ATTEST:

CONTRA COSTA COUNTY WATER DISTRICT

/s/ McClosky
Secretary

By /s/ F. Bollman
President

C O P Y

DWR #557338 C O P Y

AGREEMENT

THIS AGREEMENT made this 11th day of April, 1968, between the STATE OF CALIFORNIA, acting by and through its Department of Water Resources, hereinafter referred to as the "State" and the CITY OF ANTIOCH, a municipal corporation, hereinafter referred to as the "City",

WITNESSETH:

WHEREAS, for over 100 years water has been diverted from the San Joaquin River for municipal and industrial use in and around the area which is now in the corporate limits of the City, and

WHEREAS, since 1904 such water has been diverted at a pumping plant located near the foot of A Street and has been treated and distributed to users by the City, and

WHEREAS, the City diverts such water whenever the chloride ion content in the surface zone at slack current after daily higher high tide (HHT) is 250 parts per million or less, hereinafter called "usuable river water", and

WHEREAS, the average number of days per water year (October 1 to September 30, hereinafter referred to as "year") that usable river water has been available to the City at said point of diversion is 208 and the median period of said availability is from December 9 to July 5, both days inclusive, and

WHEREAS, during each day usable river water has been and will in the future be available to the City the quantity thereof has been and will be adequate to meet the water requirements of the City during such day, and

WHEREAS, in the future the average number of days per year that usable river water will be available to the City will be caused to decrease, and such decrease will be due in part to operation of the State Water Resources Development System, as defined in Section 12931 of the Water Code, and

WHEREAS, it is contemplated that the Contra Costa Canal, supplemented by the Kellogg Unit or other facilities to be constructed by the Bureau of Reclamation, will meet the City's future water requirements which are not met by usable river water. If such facilities are not constructed by the Bureau of Reclamation, water supply facilities will have to be constructed by another agency or agencies to meet the City's future requirements including a substitute water supply equal to the City's water deficiency entitlement as defined in this agreement.

NOW, THEREFORE, the parties agree as follows:

1. The term of this agreement shall begin on the first day of October 1968, and shall continue in effect until terminated by either party by written notice to the other party given at least 12 months prior to the effective date of such termination. The effective date of termination shall be the last day of a year (September 30) and no termination shall be effective prior to September 30, 2008.

2. The State shall reimburse the City in a manner hereinafter provided for any decrease in availability to the City of usable river water during the term of this agreement caused by operation of the State Water Resources Development System. Such decrease in availability of usable river water is hereinafter referred to as the City's "water deficiency entitlement".

3. The quantity of the City's water deficiency entitlement shall be determined for each year during the term of this agreement by the formula

$$E = \frac{(208-D)}{3} \quad \frac{(V)}{208}$$

where E is the City's water deficiency entitlement for such year in acre-feet, D is the number of days during such year that usable river water is available to the City in the San Joaquin River at its pumping plant, and V is the total quantity of water in acre-feet introduced into the City's transmission facilities for delivery within the City's service area as shown on Exhibit "A" attached hereto and by this reference made a part hereof from 8:00 a.m. on December 9, to 8:00 a.m. on July 6: Provided, That

$$\frac{V}{208}$$

shall not exceed the maximum diversion rate of the City's San Joaquin River diversion facility in acre-feet/day as such facility exists in such year. If in any year D exceeds 208, the City shall have no water deficiency entitlement for such year and the amount of such excess shall offset any water deficiency entitlement of the City for an equal number of days in the next succeeding year or years when D is less than 208.

4. For the purpose of computing the City's water deficiency entitlement, the City at no cost to the State, shall provide:

(a) A covered facility or facilities wherein the State can install devices to measure the chloride ion content of water in the San Joaquin River at or in the vicinity of the City's pumping plant,

(b) Sufficient power to operate all necessary measuring devices, and

(c) Sufficient right-of-way to such facilities to enable the State to install, service, remove, and take readings from any such devices.

The size of such facilities and the amount and type of power to be supplied shall be as mutually agreed upon.

The State shall be responsible for the actual measuring of the chloride ion content; all such measurements will be made available to the City.

Such measurements will be made at such intervals as shall be reasonably necessary and as mutually agreed upon.

The City shall have the right, at its expense, to verify the accuracy of the State's measurements and any inaccuracy thus disclosed shall be corrected by the State.

5. Each year during the term of this agreement that the City has a water deficiency entitlement it shall purchase substitute water from a project or projects constructed by an agency or agencies to supply the supplemental water requirements of an area including the City. For the purposes of this agreement, substitute water shall be deemed to have been purchased during the period beginning at 8:00 a.m. on December 9 and ending at 8:00 a.m. on July 6 of such year and the price paid by the City for substitute water shall be deemed to be the average price per acre-foot paid by the City for all untreated water purchased by it for introduction into its water transmission facilities during said period.

6. Each year during the term of this agreement that the City purchases substitute water for its water deficiency entitlement, the State will pay the City an amount of money computed in accordance with the formula $M = E (C_w + C_e - 4.90)$ where M is the amount in dollars to be paid by the State, E is the City's water deficiency entitlement for such year determined in the manner provided in Section 3 hereof, C_w is the amount per acre-foot paid by the City for substitute water delivered to the City as provided in Section 5 hereof, and C_e is the average amount (if any) per acre-foot paid by the City for electric energy to transport substitute water from the point of delivery thereof to the City to a storage reservoir or treatment plant operated by the City. The State shall pay said amount to the City not later than October 31 of the following year. Such payments are hereby determined to be reasonable costs of the annual maintenance and operation of the State Water Resources Development System and shall be disbursed from the California Water Resources Development Bond Fund pursuant to subsection (b) (1) of Section 12937 of the Water Code.

7. The City, in consideration of the payments by the State herein provided,

releases the State from any liability due to

any change in regimen of flows of water in the Delta or the San Joaquin River and the effects of such changes caused by operation of the State Water Resources Development System: Provided, That nothing herein shall be deemed to be a release of State liability resulting from the utilization by the State of any facilities for removal of drainage water from the San Joaquin Valley.

8. The obligations of the State herein shall not be affected by any modification of the City's facilities to divert river water, except as provided in Section 3 hereof.

9. Nothing herein shall be deemed to be a release or waiver of any right of the City to purchase supplemental water supplies from the State with the priorities established by Water Code Sections 11460, 12201 to 12204 inclusive, and 12931.

10. State agrees that other municipal and industrial entities in the Delta will not be granted compensation for damages caused by the State Water Resources Development System under substantially more favorable terms than those used to Compensate the City hereunder.

IN WITNESS WHEREOF, the parties hereto have executed this agreement by their respective officers thereunto duly authorized on the date first above written.

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

By /s/ W. R. Gianelli
Director

Approved as to legal form
and sufficiency:

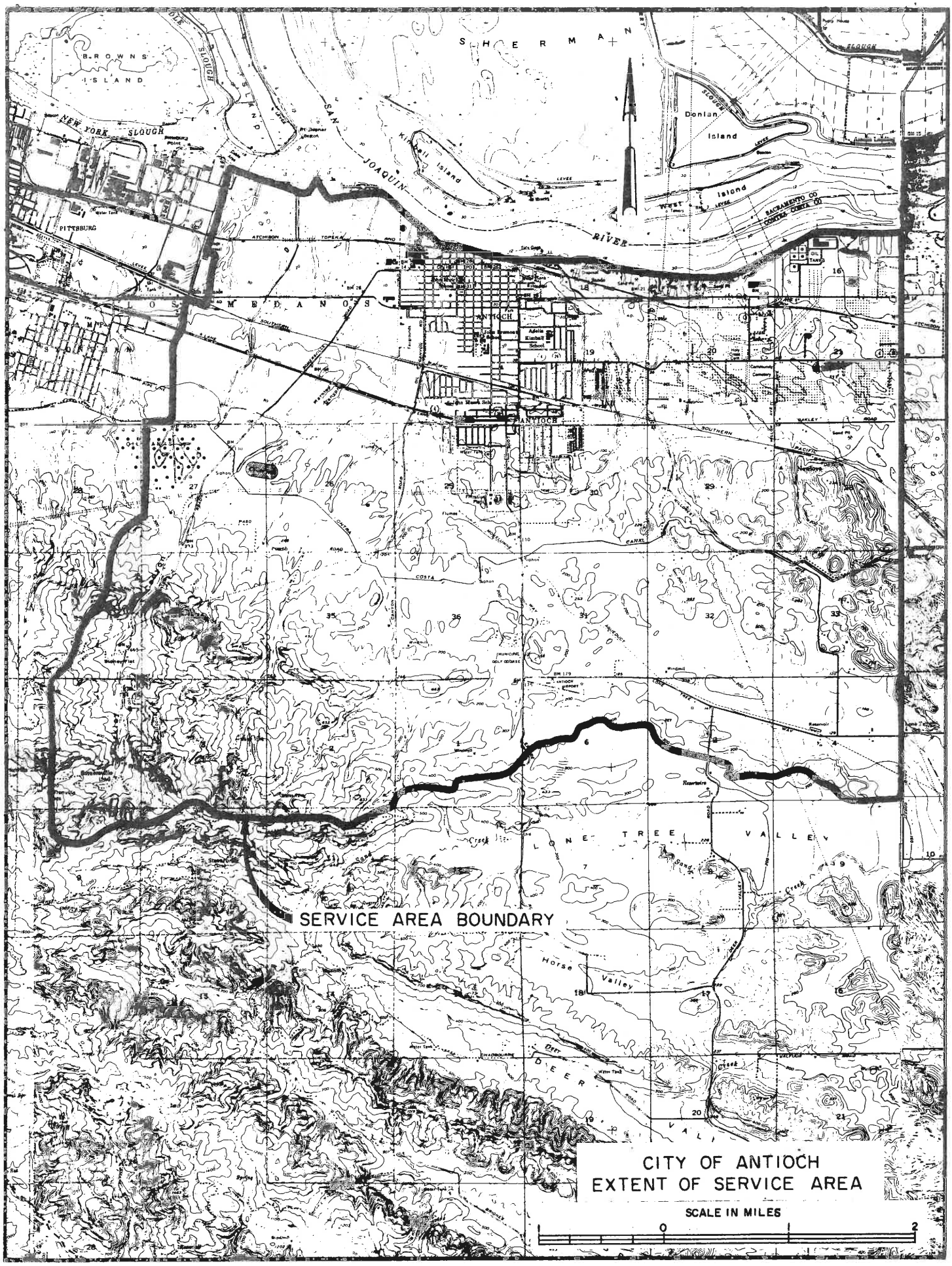
By /s/ P. A. Towner
Chief Counsel

CITY OF ANTIOCH

By /s/ P. Lopez
Mayor

ATTEST:

/s/ J. Fashbough
City Clerk


SHERMAN
BROWNS ISLAND
NEW YORK SLOUGH
SAN JOAQUIN RIVER
Kimball Island
Dionlan Island
West Island
PITTSBURG
ANTIOCH
LONE TREE VALLEY
Horse Valley
DEER VALLEY
SERVICE AREA BOUNDARY
CITY OF ANTIOCH
EXTENT OF SERVICE AREA
SCALE IN MILES
0
2

APPENDIX C

DELTA WATER REQUIREMENTS

Introduction

The numerous Delta channels supply a natural and convenient source of water for local agriculture, municipal, and industrial uses. This Appendix presents estimates of future agricultural water requirements for the entire Delta and municipal and industrial requirements (which will be met from Delta channels) in the western Delta. Water requirements for the entire Contra Costa County Water District are included to indicate demands on the Contra Costa Canal-Kellogg system. Local municipalities and industries in the surrounding upland areas of the Delta, except in the western portion, obtain their water supply from other surface or underground sources that are, or will be, with further development, adequate to meet future needs.

Estimates of future water requirements for industrial, municipal, and agricultural uses in the Delta have been developed by various studies and agencies. The most recent estimates for each water-use category are presented in the following sections. Source of data is indicated by numerical reference [ ] to the Water Requirement Bibliography shown on page C5.

Industrial Water Requirements

Since the early 1900's, industrial development of the Delta area has kept pace with the tremendous economic growth of California. With natural location and resource advantages, the cities of Stockton, Antioch, and Pittsburg have become major industrial centers, with lesser development in the Rio Vista and Tracy areas. The attraction of industry is directly attributable to abundant water supply, railroad, highway, and waterborne transportation facilities, large assimilative capacity for industrial wastes, nearness to labor forces, and availability of land for future expansion.

The estimated future industrial water requirements to be supplied from Delta channels are presented in Table C-1.

TABLE C-1
INDUSTRIAL WATER REQUIREMENTS
(Thousands of Acre-Feet Annually)

Area	1970	1980	1990	2000	2010	2020
High Quality Water						
Contra Costa County [1]	96.0	125.7	157.0	190.2	225.4	254.8
Solano County, Denverton-Collinsville [2]*	0	0	1.4	16.3	50.8	120.1
TOTALS	96.0	125.7	158.4	206.5	276.2	374.9
Low Quality and Cooling Water*						
Contra Costa County [3]	1,200	1,709	2,218	2,727	2,747	2,767

*These values are subject to change because National Steel Company plans to develop a new plant at Collinsville.

Municipal Water Requirements

As previously mentioned, local municipalities in the surrounding upland areas of the Delta, except in the western portion, obtain their water supplies from sources other than Delta channels. Cities in the Contra Costa County Water District rely on both direct offshore diversions and, to a greater extent, on supplies from the Contra Costa Canal. Additional capacity for future requirements in the Contra Costa County Water District is anticipated from the proposed Kellogg Unit. Rio Vista is presently supplied by ground water; however, with the development of the Denverton-Collinsville area, Delta diversions to this portion of Solano County may be required.

The estimated future municipal water requirements to be supplied from the Delta channels are presented in Table C-2.

TABLE C-2
MUNICIPAL WATER REQUIREMENTS
(Thousands of Acre-Feet Annually)

Area	1970	1980	1990	2000	2010	2020
Contra Costa County [1]	41.3	73.8	110.0	148.0	175.0	194.0
Solano County, Denverton-Collinsville [2]*	0	0	0.1	1.7	4.2	10.0
TOTALS	41.3	73.8	110.1	149.7	179.2	204.0

*These values are subject to change because National Steel Company plans to develop a new plant at Collinsville.

Agricultural Water Requirements

Agricultural use of water began in the 1850's with the initial reclamation of marshlands; and by 1930, all but minor areas of swampland were in production. Today, agricultural water requirements are essentially at a maximum. Future increases will be the result of more intensive farming (double cropping), but these increases will be offset by urban encroachment.

The estimated future agricultural water requirements (channel depletion) for the Delta lowlands and uplands with average water-year conditions are presented in Table C-3.

TABLE C-3
AGRICULTURAL WATER REQUIREMENTS
(Thousands of Acre-feet Annually)

Area	1973	1980	1990	2000	2020
Delta Lowlands	1,266	1,266	1,266	1,266	1,266
Delta Uplands	340	340	340	340	340
Contra Costa County Water District [1]	7	17	24	23	23
TOTALS	1,613	1,623	1,630	1,629	1,629

The monthly agricultural water requirements are based on channel depletion rather than consumptive use. Both methods result in the same annual requirement. The estimated average monthly channel depletion in the Delta is shown in Table C-4.

TABLE C-4
AVERAGE MONTHLY CHANNEL DEPLETION IN THE DELTA*
(Values in 1,000 Acre-Feet)

Month	Delta Lowlands	Delta Uplands	Totals
Oct.	134	8	142
Nov.	103	1	104
Dec.	95	0	95
Jan.	57	0	57
Feb.	38	0	38
Mar.	51	1	52
Apr.	78	22	100
May	82	49	131
Jun	130	62	192
Jul	193	75	268
Aug.	177	75	252
Sep.	128	47	175
TOTALS	1,266	340	1,606

* Contra Costa County Water District requirements not included.

Contra Costa Canal Requirements

The total water requirements of the Contra Costa County Water District have been presented in the preceding sections. However, the demands on the proposed Contra Costa Canal-Kellogg system vary directly with the annual hydrologic conditions. In a wet year, a considerable portion of the total requirement is met from direct offshore diversion, whereas in a dry year, most of the requirement must be obtained from the canal system. Estimated annual water demands on the Contra Costa Canal-Kellogg system for wet, dry, and median hydrologic conditions are presented in Table C-5.

TABLE C-5
ESTIMATED CANAL WATER REQUIREMENTS [1]
CONTRA COSTA COUNTY WATER DISTRICT
1970-2020
(Thousands of Acre-Feet Annually)

Year	Hydrologic Condition	Municipal Requirement	Industrial Requirement	Agricultural Requirement	Losses	Total
1970	Wet	19.2	58.1	6.1	4.2	87.6
	Median	29.1	66.6	6.1	5.1	106.9
	Dry	39.9	75.1	6.1	6.1	127.2
	Total*	41.3	96.0	6.1	7.2	150.6
1980	Wet	45.6	101.6	16.6	8.2	172.0
	Median	61.1	114.2	16.6	9.6	201.5
	Dry	73.9	127.5	16.6	10.9	228.9
1990	Wet	79.5	129.7	24.0	11.7	244.9
	Median	97.3	141.6	24.0	13.1	276.0
	Dry	110.2	158.9	24.0	14.7	307.8
2000	Wet	110.1	154.0	23.0	14.4	301.5
	Median	133.7	173.4	23.0	16.5	346.6
	Dry	148.1	192.4	23.0	18.2	381.7
2010	Wet	130.2	181.8	23.0	16.8	351.8
	Median	157.8	203.7	23.0	19.2	403.7
	Dry	174.7	227.7	23.0	21.3	446.7
2020	Wet	143.7	204.1	23.0	18.5	389.3
	Median	175.6	231.4	23.0	21.5	451.5
	Dry	194.3	257.0	23.0	23.7	498.0

*After 1970, dry-year requirements equal total requirements.

Total Requirements

The total consumptive Delta water requirements which would be met from Delta channels are summarized in Table C-6. These requirements do not include the export demands of South Bay

Aqueduct, North Bay Aqueduct, California Aqueduct, and Delta-Mendota Canal. Nor, do they include requirements met from surface water outside the Delta and ground water.

TABLE C-6
TOTAL DELTA WATER REQUIREMENTS
(Thousands of Acre-Feet Annually)

Year	Municipal	Industrial	Agricultural	TOTAL
1970	41.3	96.0	1,613.0	1,750.3
1980	73.8	125.7	1,623.0	1,822.5
1990	110.1	158.4	1,630.0	1,898.5
2000	149.7	206.5	1,629.0	1,985.2
2020	204.0	374.9	1,629.0	2,207.9

Water Requirement Bibliography

[1] "Summary, Future Water Requirements"; Contra Costa County Water District; April 1967.

[2] "Delta Water Requirements, Appendix to Bulletin 76, Delta Water Facilities"; Department of Water Resources; February 1962.

[3] "An Economic Evaluation of the Water Quality Aspects of Contra Costa's Offshore Water Supply"; Metcalf and Eddy for Contra Costa County Water Agency; November 1965.

APPENDIX D

PROJECT WATER QUALITY OBJECTIVES

Introduction

The State and the Bureau of Reclamation differ somewhat regarding their export water quality objectives. This nonuniformity stems largely from the fact that the ultimate uses of the two exports are not intended to meet the same types of demands. The Federal Central Valley Project supplies to the San Joaquin Valley water of a quality suitable for agricultural purposes, while the State Water Project will export beyond the San Joaquin Valley to south of the Tehachapis water of a quality suitable for municipal and industrial purposes.

The water supply contracts executed by the State with the local agencies contain water quality objectives to be met at delivery structures for delivery of project water. It is the objective of the State to make available project water of such quality that the constituents (listed in Table D-1) do not exceed the concentrations as stated.

To allow for possible degradation of the export water from cross-drainage entering the Canal at intermediate points between the export pumps and the place of use, the quality of water exported from the Delta should be about 10 percent better than the values listed in Table D-1. This corresponds to recommendations made by a special board of consultants retained by the State Water Resources Board.

The water quality objectives of the State Water Project are presented in Table D-1 and the water quality objectives of the Central Valley Project are shown in Table D-2.

TABLE D-1

WATER QUALITY OBJECTIVES OF STATE WATER PROJECT[1/]

Constituent	Unit	Monthly Average	Average for any 10-year Period	Maximum
Total Dissolved Solids	ppm	440	220	-
Total Hardness	ppm	180	110	-
Chlorides	ppm	110	55	-
Sulfates	ppm	110	20	-
Boron	ppm	0.6	-	-
Sodium Percentage	%	50	40	-
Fluoride	ppm	-	-	1.5
Lead	ppm	-	-	0.1
Selenium	ppm	-	-	0.05
Hexavalent Chromium	ppm	-	-	0.05
Arsenic	ppm	-	-	0.05
Iron and Manganese together	ppm	-	-	0.3
Magnesium	ppm	-	-	125.0
Copper	ppm	-	-	3.0
Zinc	ppm	-	-	15.0
Phenol	ppm	-	-	0.001

1/ Article 19a, Standard Provisions for Water Supply Contract, Bulletin No. 141, Volume II, "The California State Water Project, Water Supply Contracts", November 1965.

TABLE D-2

WATER QUALITY OBJECTIVES OF CENTRAL VALLEY PROJECT

Tracy Pumping Plant[1/]
Delta-Mendota Canal

	Maximum Total Dissolved Solids in ppm
Daily average	800
Calendar month, average	600
Calendar year, annual average	450
5-year average	400

Contra Costa Canal

	Maximum Chlorides in ppm
Limiting criteria	250

Kellogg Unit

	Maximum Chlorides in ppm
Limiting criteria	100

[1/] Presented in USBR Proposed Feasibility Report on "Peripheral Canal Unit", dated April 1966.

APPENDIX E

PROPOSALS TO UPGRADE SALINITY CONTROL STANDARDS

Introduction

With Agency Order No. 18, dated April 11, 1965, The Resources Agency of California established interim water quality objectives for San Francisco Bay and the Delta to govern the units of The Resources Agency. These objectives were established for the interim period preceding the establishment of permanent objectives by the State Water Quality Control Board. Former Administrator Fisher placed a condition on the objectives with the following text:

> "Because negotiations are currently under way between Federal, State, and local interests concerning salinity control and important water rights considerations in many parts of the Delta, I will defer setting interim objectives for mineral constituents, salinity and total dissolved solids (TDS) in those areas."

On November 19, 1965, these negotiations reached their first concrete achievement with agreement on Delta Water Quality Criteria. This Appendix presents a more detailed discussion of the various proposals to control natural salinity intrusion. These proposals seek to establish standards for limiting the degree of salinity intrusion over and above those provided by the November 19, 1965 Delta Water Quality Criteria.

The Department of Water Resources has studied the effects of these proposals on storage and cost of water and on the benefits to be derived. As a result of these studies (discussed in the report) the Department has opposed several of the proposals because of higher costs, more practical alternatives, and the unreasonable use and waste of water.

The Department maintains that the provisions of the November 19 criteria, supplemented by water supplies from overland water conveyance facilities and modifications to certain industrial cooling systems, will provide for an adequate supply of good-quality water to those areas in the western Delta affected by operation of the State Water Project.

The following sections discuss several of the more significant proposals for increased salinity control.

San Francisco Regional Water Quality Control Board

In its resolution of June 13, 1967, the San Francisco Regional Water Quality Control Board included a proposed water quality objective for intrusion of natural salinity east of the westerly end of Chipps Island, or about, at Mallard Slough. The tentative objective was proposed to protect the historic water quality conditions until an alternative water supply is developed for the western Delta. The objective was stated as follows:

"III-B. Water Quality Objectives Applicable to Tidal Waters East of the Westerly End of Chipps Island.

"Chloride

"Mean chloride concentration shall not exceed 150 mg/l for a 21-year moving average of 150 days, a 5-year moving average of 127 days nor to exceed a minimum of 74 days during the period between November 1 and June 30 of each year.

"Note C

"This objective shall be maintained until the domestic, industrial, and agricultural water supplied are provided by alternate means to the satisfaction of the Regional Board."

In comments presented at a public hearing before the Regional Board, the Department of Water Resources noted that the objective was based on average historic water quality and did not allow relief in case of adverse hydrologic conditions. The Department recommended to the Board that Note C be amended as follows:

"This objective shall be maintained to the extent that it is reasonably practicable until the domestic, industrial, and agricultural water supplies are provided by alternate means to the satisfaction of the Regional Board."

Central Valley Regional Water Quality Control Board

Among a group of objectives adopted by the Central Valley Regional Water Quality Control Board on April 28, 1967, were three proposals to reduce natural salinity in specified areas of the western Delta. Unlike the proposal of San Francisco regional board, these objectives did not consider the possibility of alternative supplies, and thus would freeze rigid salinity limits into federal law. The text of these objectives (16C, 17B, 17D) follows:

"16. Total dissolved solids (TDS) concentration of Delta water shall be maintained below these limits:

***

"C. The mean tidal cycle total dissolved solids content in the Sacramento River upstream from Threemile Slough and in the San Joaquin and False Rivers from Jersey Point to Venice Island;

"a. 350 mg/l from 1 April until the water temperature at these locations reaches 60°F, and

"b. 180 mg/l for at least 5 weeks after the temperature, as identified in (a), reaches 60°F.

"17. Chloride concentration shall be maintained below these limits:

***

"B. San Joaquin River at the City of Antioch water intake:

"a. 100 mg/l, as measured 1-1/2 hours after high tide, at least 50% of any year, and

"b. 250 mg/l, as measured 1-1/2 hours after high tide, at least 60% of any year.

***

"D. San Joaquin River at Jersey Point; 250 mg/l, as measured 1-1/2 hours after high tide, at least 79% of any year."

The Department of Water Resources made several presentations to various groups including the Regional Board, California Water Commission, and State Water Quality Control Board opposing these objectives. In opposing the objectives, the Department stressed it would be wasteful and costly to require the release of great quantities of conserved water to reduce natural salinity in an area of the western Delta and ignore the Department's program to provide all Delta users with good-quality water by overland transportation or substitute supplies.

Contra Costa County Water Agency

The Contra Costa County Water Agency has made several proposals for increased salinity control during the past several years. Two recommendations dealing with natural salinity control were presented in a report entitled "A Reevaluation of this Agency's Objectives and Positions With Respect to Protecting the County's Offshore Water", dated June 14, 1966, and approved by the Board of Supervisors June 21, 1966. These recommendations were as follows:

"1. The Board take immediate steps to have introduced into the U. S. Congress and the next general session of the State Legislature, bills establishing legislative directive to the effect:

> "a. That, as a minimum condition, the Federal Central Valley Project must be operated within the original intent of the Project, i.e., the prevention of salinity intrusion so that the maximum mean daily salinity intrusion shall not exceed 1,000 parts of chloride ion per million parts of water at a point 0.6 mile west of Antioch;
>
> ***

"5. The Board finds for the apparent necessity of maintaining adequate flushing flows as well as a sufficiently high level of minimum Delta outflows for the protection of this County's and the San Francisco Bay's areas environment and directs Counsel and Staff to protest all Applications to divert water which would naturally flow into the Delta and request all Permits subject to State Water Rights Board jurisdiction be conditioned as follows:

> "a. Permittee shall not divert water for either 'direct use' or to 'storage' at any time that the mean chlorinity for a tidal cycle exceeds the following limits:
>
> "(1) At Jersey Point - 100 parts of chloride ion per million parts of water;
>
> "(2) At the mouth of Mallard Slough during any one-hundred fifty (150) consecutive days during the period from November 1 to June 30, - 100 parts of chloride ion per million parts water."

In a resolution dated October 25, 1966, to the State Water Rights Board, the Contra Costa County Board of Supervisors protested the Department of Water Resources' applications for appropriation of unappropriated water for the operation of the State Water Project. This resolution included objective (5a) above with the following modification to part (2):

> "At the mouth of Mallard Slough during any one hundred forty-two (142) consecutive days during the period from November 1, to June 30, of the following year - 100 parts of chloride ion per million parts water."

On September 27, 1967, the Contra Costa County Water Agency made another proposal for salinity control in a statement before the Advisory Water Commission - San Joaquin County Flood Control and Water Conservation District. The text of this proposal follows:

> "To us, based upon our present knowledge, a satisfactory and reasonable level of water quality to be maintained in the Delta can be generalized by the broad requirement, i.e., the chloride-ion concentration at Jersey Point shall not exceed 100 parts per million and that adequate flushing flows be provided as needed. This criteria has been adopted by the 'Negotiating Committee for Contra Costa County Water Requirements' and represents a consensus of the agricultural, recreational, municipal, and industrial interests within our County."

Although the wording of this proposal varies from their objective (1-a) of the 1966 proposal, 100 parts chloride per million at Jersey Point is approximately the same as 1,000 parts chloride per million at a point 0.6 miles west of Antioch.

The text of the above proposal implies that the "Negotiating Committee for Contra Costa County Water Requirements" represents all the agricultural, recreational, municipal, and industrial interests in the County. This is not the case. Various interests in Contra Costa County are negotiating separately with the Department of Water Resources. These interests include the Contra Costa County Water District, the City of Antioch, most of the affected industries, and agricultural interests in the western Delta.

On March 25, 1968, the "Negotiating Committee for Contra Costa County Water Requirements" again proposed a Delta Water Quality Criteria to the State Water Resources Control Board at water rights hearings regarding the federal San Felipe Project. Article D of the proposal dealt with water quality criteria in the Delta channels and included the following points:

> "1. At Blind Point, in San Joaquin River, and at Emmaton (southwest end of Horseshoe Bend) in Sacramento River, a maximum daily chloride content of 250 parts per million or less, except that after August 31, of a critical year and until December 31, of the same calendar year, the quality criteria set forth above may be increased from 250 parts per million to 500 parts per million of chloride.
>
> "2. At Jersey Point, in San Joaquin River, and Three Mile Slough, in the Sacramento River, the mean tidal cycle total dissolved solids content shall not exceed:

"a. 350 parts per million from April 1, until the water temperature at these locations reaches 60°F, and

"b. 180 parts per million for at least five weeks after the temperature, as identified in 'a.', reaches 60°F

"3. Except as provided in Article D, Part 2, at Terminous in Little Potato Slough, at Rio Vista, in Sacramento River, at San Andreas Landing, in San Joaquin River, at mouth of Rock Slough on Old River, and after the initial operation of the Peripheral Canal, at the bifurcation of Middle River and Old River,

"a. A maximum daily total dissolved solids content of 500 parts per million or less,

"b. A mean monthly total dissolved solids content of 400 parts per million or less when measured on the basis of the average mean daily value for any calendar month.

"4. After August 31, in a dry or critical year and until December 31 of the same calendar year, the total dissolved solids criteria specified in Article D, Part 3, may reach, but not exceed, 800 parts per million for item 'a.', 600 parts per million for item 'b.'.

"5. The U. S. Bureau of Reclamation and the Department of Water Resources shall not pump into the Delta - Mendota Canal and/or the California Aqueduct during the period April 1, to a date to be determined annually by the California Department of Fish and Game when striped bass spawning has terminated and that adequate numbers of larvae have moved into the Suisun Bay nursery ground, and during the period October 1, through November 30.

"6. Whenever the recorded total dissolved solids content in Sacramento River at Green's Landing exceeds a mean 10-day or a mean monthly value of 150 parts per million, the quality criteria in Article D, Parts 3 and 4, may be changed by adding to those values the amount by which the recorded total dissolved solids content at Green's Landing exceeds 150.

"7. All other individual and combinations of mineral and chemical constituents such as, but not limited to, boron, phosphates, and nitrates shall be maintained at levels consistent with historical occurrence or lower levels in the event such historical levels are shown to be harmful to the contemplated uses of Delta waters."

These criteria place unrealistic and unnecessary restrictions and demands on the operation of any project in the Delta, such as (1) setting excessively high quality limits for interior Delta channel water (Articles D-2 and -4); (2) eliminating deficiency allowances (Articles D-1 and -4); and (3) eliminating spring and fall export from the Delta (Article D-5).

In addition, Article D-1 would require an excessive outflow of between 1 and 2 million acre-feet per year in addition to that required to meet the November 19 criteria. The only significant benefit to be realized from this increased outflow would be an all-year inchannel water supply to some 15,000 acres in the western Delta. This area can be more efficiently served through overland facilities without such an excessive waste of California's water supplies. The Contra Costa Canal is an excellent example of an overland facility. Overland facilities as a solution to the western Delta problem are specifically recognized in Section 12202 of the Water Code.

On September 5, 1968, the Contra Costa County Water Agency proposed minimal Delta water quality standards for the interim period to and including 1975 at a preliminary hearing before the State Water Resources Control Board. These interim standards were comprised of Articles D-1, D-2, and D-5 of the March 25, 1968 criteria proposed by the Agency.

Federal Water Pollution Control Administration

On June 23, 1967, the State Water Resources Control Board submitted water quality control policy for the Delta to the Secretary of the Interior as proposed federal water pollution control standards pursuant to the provisions of the Federal Water Pollution Control Act.

The FWPCA regional staff reviewed this policy and stated that in its opinion, the criteria did not fully protect all of the beneficial uses identified in that policy. Subsequently, the staff submitted for consideration to the Board, "Proposed Supplemental Delta Water Quality Standards" which contained additional criteria developed within the Department of the Interior.

All but two of the proposed supplemental standards were essentially the same as the November 19, 1965 Delta Water Quality Criteria and were acceptable to the Department. The two additional standards (B-2 and B-5, as stated below), however, were not considered acceptable.

> "2. Above Three Mile Slough in Sacramento River and between Jersey Point and Venice Island in San Joaquin and False Rivers, except in below normal, dry, and critical years, there shall be maintained a daily mean total dissolved solids concentration of:
>
> > "a. 350 milligrams per liter or less from April 1 until the water temperature at these locations reaches 60°F,

"b. 180 milligrams per liter or less thereafter for five weeks. This provision shall continue in effect until the initial operation of the Peripheral Canal at which time modification to enhance striped bass spawning in interior Delta channels shall be considered.

"5. Within the normal operating capability of local, state and Federal water projects there shall be maintained at Antioch in the San Joaquin River until September 30, 1972 a mean total dissolved solids concentration of 450 milligrams per liter when measured on the basis of the average of the daily mean values for any 10 consecutive days throughout a period of at least 150 days each water year, except that the period is reduced to 120 days or during dry years and 100 days during critical years; provided; that the criteria contained in this paragraph shall not apply when contractual arrangements regarding substitute supplies have been completed between the water users in the Delta and the State and the Federal governments."

State Water Quality Control Board (State Water Resources Control Board)

In May 1966, the U. S. Department of the Interior (Federal Water Pollution Control Administration) developed "Guidelines for Establishing Water Quality Standards for Interstate Waters". Following these guidelines, the Governor designated the State Water Quality Control Board as the agency of the State with the responsibility for submitting standards to the Department of the Interior before June 30, 1967.

The State Water Quality Control Board asked each regional board to do the staff work and hold the necessary public hearings. As previously discussed, two of the regional boards (Central Valley and San Francisco) included criteria for controlling natural salinity in the western Delta in their proposals to the State Board. At its June 14, 1967 meeting, the State Board received comments on the proposed standards and adopted policies for the control of water quality in California's interstate waters, including San Francisco Bay and the Sacramento-San Joaquin Delta. These policies eliminated criteria relating to control of natural salinity in the western Delta and consequently nullified the proposals of the regional boards. On June 23, 1967, the adopted policies were submitted to the Secretary of the Interior as required by the Federal Water Quality Control Act of 1965. Excerpts from the adopted policy for the Sacramento-San Joaquin Delta are contained in Table E-1.

One week prior to the State Water Quality Control Board meeting mentioned above, the Governor signed legislation forming the State Water Resources Control Board, which combined the functions of the State Water Quality Control Board and State Water

Rights Board, effective in December 1967. The legislation did not directly affect the regional water quality control boards.

On July 19, 1968, after extended review, the Secretary of the Interior returned the policies adopted by the State and requested that the State Board consider supplemental standards related to control of natural salinity in the western Delta. Salinity control criteria contained in the supplemental standards were essentially the same as those contained in the November 19, 1965 criteria except for two additional standards (B-2 and B-5) relating to striped bass and substitute water supplies.

Additional hearings on the matter were held by the State Board on September 5 and October 3, 1968. On October 24, 1968, the Board adopted Resolution 68-17, "The Supplemental Water Quality Control Policy for Sacramento-San Joaquin Delta", which augmented the original policies adopted by the Board in 1967. The Resolution included the supplemental standards (Table E-2) proposed by the FWPCA, except for the two additional standards (B-2 and B-5).

The Board, however, reserved the right to consider salinity control further in connection with water rights for the State Water Project and the Federal Central Valley Project, since salinity is controlled by release of stored water from these projects. Additional hearings on water rights are scheduled for the summer of 1969.

On January 9, 1969, the Secretary of the Interior approved the Board's Water Quality Control Policy for the Delta, as supplemented on October 24, 1968, with the understanding salinity control would be considered further in connection with hearings for issuance of water rights permits for the state and federal projects.

TABLE E-1

WATER QUALITY OBJECTIVES
EXCERPTED FROM
STATE WATER QUALITY CONTROL POLICY FOR
SACRAMENTO-SAN JOAQUIN DELTA

Adopted June 14, 1967

1. Apparent color of Delta waters shall not be visibly altered from its natural appearance.

2. Odors, other than of natural causes, shall be absent from Delta waters.

3. Floating or emulsified grease and oil shall not be present in Delta waters in objectionable quantities.

4. Floating solids, foam and debris, in objectionable quantities from other than natural causes, shall be absent from Delta waters.

5. Bottom deposits, of other than natural causes shall be absent from Delta waters.

6. Bacteriological quality of Delta waters shall not exceed a median of 200 fecal coliform per 100 ml.

7. Trace constituents in Delta waters shall be maintained below the following levels, in mg/l:

Arsenic	0.01	Fluoride	0.5
Barium	0.1	Iron	0.3
Boron	0.5	Lead	0.05
Cadmium	0.01	Manganese	0.05
Chromium, hexavalent	0.05	Selenium	0.01
Copper	0.01	Silver	0.01
Cyanide	0.01	Zinc	0.1

8. pH of Delta waters shall remain between the limits of 6.5 to 8.5.

9. Taste and odor producing substances shall not be present in concentrations that will impair public water supplies, or in such concentrations as to cause tainting of the flesh of fish or wildfowl.

10. Levels of radioactivity in water shall be in accordance with the provisions of Chapter 5, Title 17, of the California Administrative Code or such modifications as may be made from time to time.

11. Temperature of Delta water shall not be altered to a degree that adversely affects water uses.

12. Turbidity, except for periods of storm runoff, shall not exceed:

    a. 50 JTU in the waters of the central Delta.

    b. 150 JTU in other Delta waters.

13. Dissolved oxygen shall not fall below 5.0 mg/l with the following exceptions:

    a. In the water bodies where the reduction occurs as a result of natural causes.

    b. In certain bodies of water which are constructed for special purposes and from which fish have been excluded or the fishery is not important as a beneficial use.

14. Total nitrogen content of Delta waters shall not exceed:

    a. 1.0 mg/l in the central Delta.

    b. 2.0 mg/l in the western Delta.

    c. 3.0 mg/l in the eastern Delta.

15. Biocide content of Delta waters shall not exceed 0.6 µg/l as determined by the summation of individual concentrations; nor shall concentrations of individual or combinations of biocide reach that level found to be detrimental to fish and wildlife.

16. Total dissolved solids (TDS) concentration of Delta waters shall be maintained below these limits:

    a. Old River at Clifton Court Ferry;

Calendar year, annual average	450 mg/l
Calendar month, average	600 mg/l
Daily, average	800 mg/l
5-year average	400 mg/l

    b. Cache Slough at City of Vallejo intake; 250 mg/l

    c. Rock Slough at Contra Costa Canal intake:

        1. 750 mg/l, mean tidal cycle value, and
        2. 380 mg/l, mean tidal cycle value, for at least 65 percent of any year.

    d. San Joaquin River near Vernalis; 500 mg/l mean average concentration over any consecutive 30-day period.

    e. Eastern Delta channels; 700 mg/l mean monthly concentration.

17. **Chloride concentration** shall be maintained below these limits:

    a. Rock Slough at Contra Costa Canal intake;

        1. 250 mg/l, mean tidal cycle value, and
        2. 100 mg/l, mean tidal cycle value, for at least 65 percent of any year.

    b. Cache Slough at City of Vallejo intake; 100 mg/l.

18. Toxic materials shall not be present in quantities sufficient to be harmful to human, plant, animal or aquatic life.

19. Materials stimulating algal growth shall not be present in concentrations sufficient to cause objectionable algal densities.

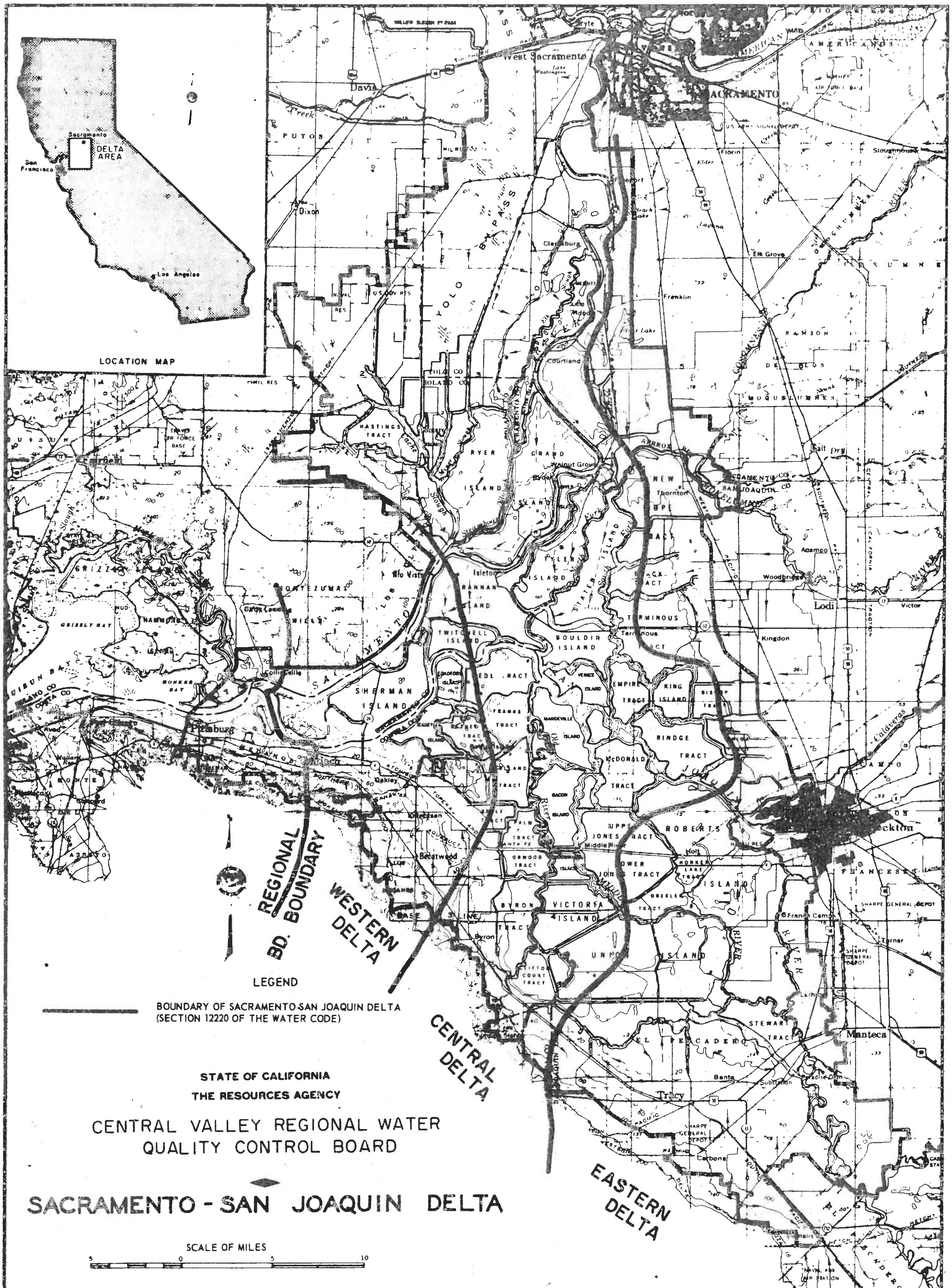

LOCATION MAP
Sacramento
DELTA AREA
San Francisco
Los Angeles
REGIONAL BD. BOUNDARY
WESTERN DELTA
CENTRAL DELTA
EASTERN DELTA
LEGEND
BOUNDARY OF SACRAMENTO-SAN JOAQUIN DELTA
(SECTION 12220 OF THE WATER CODE)
STATE OF CALIFORNIA
THE RESOURCES AGENCY
CENTRAL VALLEY REGIONAL WATER
QUALITY CONTROL BOARD
SACRAMENTO - SAN JOAQUIN DELTA
SCALE OF MILES
5
0
5
10
West Sacramento
SACRAMENTO
Davis
Dixon
Clarksburg
Courtland
Walnut Grove
Thornton
Rio Vista
Isleton
Terminous
Lodi
Kingdon
Woodbridge
Pittsburg
Oakley
Brentwood
Byron
Tracy
Manteca
Stockton
Holt
Banta
Carbona
Franklin
Elk Grove
Florin
Freeport
Victor
Acampo
YOLO BY PASS
HASTINGS TRACT
RYER ISLAND
GRAND ISLAND
TYLER ISLAND
STATEN ISLAND
TWITCHELL ISLAND
SHERMAN ISLAND
BOULDIN ISLAND
TERMINOUS
EMPIRE TRACT
KING ISLAND
RINDGE TRACT
McDONALD TRACT
ROBERTS
UPPER JONES TRACT
VICTORIA ISLAND
BYRON TRACT
UNION ISLAND
STEWART TRACT
EL PESCADERO
NEW HOPE
MONTEZUMA HILLS
GRIZZLY BAY
SUISUN BAY
FRANKS TRACT
MANDEVILLE ISLAND
BACON ISLAND
PALM TRACT
ORWOOD TRACT
CLIFTON COURT TRACT
SHARPE GENERAL DEPOT

TABLE E-2
SUPPLEMENTAL WATER QUALITY CONTROL POLICY
FOR SACRAMENTO-SAN JOAQUIN DELTA
Adopted October 24, 1968

A. Definitions: The definitions of certain terms used in these objectives are as follows:

1. "Critical year" shall mean any year in which either of the following eventualities exists:

   a. The forecasted full natural inflow to Shasta Lake for the current water year (October 1 of the preceding calendar year through September 30 of the current calendar year) is equal to or less than 3,200,000 acre-feet; or

   b. The total accumulated actual deficiencies below 4,000,000 acre-feet in the immediately prior water year or series of successive prior water years each of which had inflows of less than 4,000,000 acre-feet, together with the forecasted deficiency for the current water year, exceed 800,000 acre-feet.

2. "Dry year" shall mean any year other than a critical year in which the forecasted full natural inflow to Shasta Lake for the current water year is equal to or less than 4,000,000 acre-feet.

3. "Below normal year" shall mean any year in which the forecasted full natural inflow to Shasta Lake for the current water year is equal to or less than 4,500,000 acre-feet but more than 4,000,000 acre-feet.

4. "Full natural inflow to Shasta Lake" shall mean the computed inflow to Shasta Lake under present water development above Shasta Lake. In the event that a major water project is completed above Shasta Lake after September 1, 1963, which materially alters the present regimen of the stream systems contributing to Shasta Lake, the computed inflow to Shasta Lake will be adjusted to eliminate the effect of such water project. After consultation with the State, the Weather Bureau, and other recognized forecasting agencies, the United States Bureau of Reclamation will select the forecast to be used and will make the details of it available to the Delta water users. The same forecasts used by the United States for the operation of the Central Valley Project shall be used to make the forecasts under this agreement. Such forecasts shall be made by February 15 of each year and may be revised as frequently thereafter as conditions and information warrant.

B. Water Quality Objectives:

1. At Jersey Point in the San Joaquin River and at Emmaton (southwest end of Horseshoe Bend) in the Sacramento River, a mean daily chloride content of 1,000 parts per million or less when measured on the basis of the average mean daily value for any 10 consecutive days, except that after August 1 of a critical year and until December 31 of the same calendar year, the quality criteria set forth above may be increased from 1,000 parts per million to 1,400 parts per million of chloride.

2. At Jersey Point in the San Joaquin River and at Emmaton in the Sacramento River, an average mean daily chloride content of 200 parts per million or less for a period of at least 10 consecutive days each year at sometime during the period between April 1 and May 31, except in dry or critical years.

3. At Terminous in Little Potato Slough, at Rio Vista in the Sacramento River, at San Andreas Landing in the San Joaquin River, at Clifton Court Ferry in Old River, and after the initial operation of the Peripheral Canal, at the bifurcation of Middle River and Old River,

   a. A mean daily total dissolved solids content of 700 parts per million or less when measured on the basis of the average mean daily value for any 10 consecutive days,

   b. A mean monthly total dissolved solids content of 500 parts per million or less when measured on the basis of the average mean daily value for any calendar month,

   c. A mean annual total dissolved solids content of 450 parts per million or less when measured on the basis of the average mean daily value for any calendar year.

4. After April 1 in a dry or critical year and after August 1 in a below normal year and until December 31 of the same calendar year, the total dissolved solids criteria specified in Article B, Part 3, may reach, but not exceed, 800 parts per million for item a, 600 parts per million for item b, and 500 parts per million for item c; provided, however, the average of the values of the total dissolved solids content at all of the named locations shall not exceed, for the balance of the calendar year, the mean values specified in Article B, Part 3.

5. Whenever the recorded total dissolved solids content in the Sacramento River at Green's Landing exceeds a mean 10-day or a mean monthly value of 150 parts per million, the quality criteria in Article B, Parts 3 and 4, may be changed by adding to those values the product of 1-1/2 times the amount by which the recorded total dissolved solids content at Green's Landing exceeds 150.

C. Implementation

The implementation of these objectives shall be obtained through the conditioning of water right permits issued to the United States Bureau of Reclamation and the California Department of Water Resources for projects affecting the Delta.

APPENDIX F

ECONOMIC ASPECTS OF SALINITY CONTROL

Introduction

Economics of water quality include the examination and evaluation of benefits, detriments, and costs as result from changing water quality. Theoretically, the objective should be to maximize the net benefits so that the last incremental benefit added to the system under study is equal to the incremental cost. Several reports on the Delta have included sections on the economics of water quality, but none have covered all the parameters of the standard "with and without" evaluation for any of the specific proposals for increased salinity control above the November 19 Criteria. The water quality economics presented in the more significant reports are discussed in this Appendix.

Metcalf and Eddy Report

Metcalf and Eddy, in its economic report on the water quality aspects of offshore water supply to the Contra Costa County Water Agency in November 1965, examines the water quantity and quality strictly from the County's point of view. It suggests that offshore water quality for two levels, 10 ppm and 10,000 ppm chloride at Antioch, be the basis for benefit and detriment computation. The cost of providing these concentrations is not considered an economic cost in the report on the basis that such cost would not be a financial burden to the County.

The report evaluates benefits and detriments to municipal, industrial, and agricultural water users for the stated salinities, as measured against recent average or assumed base water quality conditions. These evaluations were based on inchannel water quality, without consideration of substitute supplies. The report also assumes 12-month availability of the evaluated salinity concentrations. For these reasons, the report grossly overstates the benefits derived at 10 ppm chloride and the detriments caused at 10,000 ppm chloride.

In general, the Metcalf and Eddy report does not present an economic evaluation of benefits and detriments, but rather a limited analysis of desirable water quality without consideration of costs or possible alternatives for providing such service. A summary of the estimated benefits and detriments presented in the report for a year-round inchannel salinity concentration at Antioch of 10 ppm chlorides and 10,000 ppm chlorides, under ultimate conditions of development, is shown in Table F-1. The difference in economic value between these two quality limits for the indicated uses is about $6.7 million annually.

TABLE F-1
SUMMARY OF BENEFITS AND DETRIMENTS TO CONTRA COSTA COUNTY FOR INDICATED SALINITY CONCENTRATIONS AT ANTIOCH

Affected Economy	Annual Benefits (+) & Detriments (-), in Millions of Dollars: 10 ppm Cl^-	10,000 ppm Cl^-	Difference in Annual Economic Value in Millions of $
Industry	+1.957	-1.420	3.377
Ground Water	0	0	0
Recreation	0	-0.292	0.292
Agriculture	+0.240	-0.700	0.940
Municipal	+0.564	-0.633	1.197
Waste Assimilation	+0.336	-0.551	0.887
Annual Totals	+3.097	-3.596	6.693

Although the Department of Water Resources does not necessarily agree with the analysis by Metcalf and Eddy Engineers, the dollar values have been used, with modification, to indicate the magnitude of benefits to the western Delta that might be derived from increasing the degree of salinity control beyond that provided by the November 19 Criteria. The values for each use were adjusted to represent the annual dollar difference between salinity control of 10 ppm chlorides at Antioch and that provided by the November 19 Criteria (approximately 2,000 to 2,500 ppm chlorides at Antioch). In addition, $0.2 million was added to represent possible agricultural benefits in the Sacramento County portion of the western Delta. As shown in Table F-2, these adjustments result in a total annual value of about $5.7 million. This value represents the magnitude of benefits without considering the overland water facilities to serve the western Delta. If the western Delta facilities were considered, the benefit of increasing salinity control would be reduced.

TABLE F-2
ESTIMATED BENEFITS FOR INCREASED
SALINITY CONTROL BEYOND THE NOVEMBER 19 CRITERIA

Affected Economy	Annual Benefits In Millions of $
Contra Costa County	
Industry	3.377
Recreation	0
Agriculture	0.340
Municipal	1.197
Waste Assimilation	0.600
SUBTOTAL	5.514
Sacramento County	
Agriculture	0.2
TOTAL	5.714

The Metcalf and Eddy analysis also included changes in industrial land values. These values are not used in this report because: (1) The factors cited as affecting land values are substantially those used in estimating benefits and detriments earlier in the report so that increases in land values are not land enhancement as usually measured and cannot be added to the above benefits; and (2) Much of the increase in land values is the result of projected normal land appreciation and not dependent on water quality.

FWPCA Report

The report of the Federal Water Pollution Control Administration, "Effects of the San Joaquin Master Drain on Water Quality of the San Francisco Bay and Delta (January 1967)", examines the effect of saline agricultural drainage waters from the San Joaquin Valley upon the receiving waters of the Delta. With the use of a model, the FWPCA simulates the hydrology of the Delta under several static, outflow conditions with resultant changes in the level of total dissolved salts, pesticides, and algae growth in the Delta.

The FWPCA report is concerned basically with the pollution potential of the Delta waters by the San Joaquin Drain and secondarily with salinity intrusion into undefined, general waterways of the Delta. The circumstances of analyses are basically chemical and biological. Dollar values of detriments are cited but no economic evaluations are made. For example, detriments to Delta agriculture are estimated as incremental costs in leaching under "with" and "without" drain conditions, but the alternative of substitute water supply and its costs are not considered. For fisheries, the methods of determining the effect of incremental changes in water quality to fisheries in dollar detriments are not

shown. Similarly, arbitrary values are placed on shoreline properties.

The Department of Water Resources does not agree with the FWPCA hydraulic studies nor the resulting water quality (TDS concentrations) in the Delta. The Department further disagrees that the cited nitrate-nitrogen concentrations would cause the predicted algae "bloom" with resulting adverse conditions on recreation and fish and wildlife.

Interagency Delta Committee Report

The Interagency Delta Committee Task Force in its draft report, "Coordinated Plan for the Sacramento-San Joaquin Delta (September 1964)", compared four basic concepts to transfer water from the Sacramento River across the Delta area. One of the planning objectives was to protect water in the Delta against salinity intrusion and waste water discharges.

Since all transfer concepts require the same quantity of export water, the report analyzes the need for stored quantities, their respective costs, and resultant quality of water under specified outflow criteria which vary by the transport method considered.

The consideration of water quality in the Delta was one among several factors which suggested that the Peripheral Canal concept be selected as the water transfer method. A comparative analysis of water quality was made to determine relative advantages in terms of cost savings caused by higher-quality water for municipal, industrial, and agricultural uses. Where inchannel water was deemed unsuited for contemplated uses, an alternative water supply was considered.

Since the purpose of the task force was to select a transfer method, local water quality benefits, per se, were not computed, but rather, relative advantages among transfer concepts were determined. In view of the lack of without-project condition, benefits attributable to the project would be generally understated.

In conclusion, the Interagency Delta Committee report selected the Peripheral Canal concept as the water transfer method through the Delta, but did not estimate total benefits and economic costs for the selected plan.

USBR Peripheral Canal Report

The U. S. Bureau of Reclamation's preliminary feasibility report, "Peripheral Canal Unit, Central Valley Project, California", April 1966, analyzes the water quality aspect of the project, basically, as it affects the export quality of water for federal and state deliveries. The probable effect of quality upon local Delta water users is assumed to be sufficiently covered by the provisions of a tentative agreement among the federal, state, and

local water-user agencies to provide inchannel water quality at agreed levels (November 19, 1965 Delta Water Quality Criteria).

While the Bureau discussed negotiations with Delta water users for contracting with users who may benefit from receiving higher-quality water, it is mute on the water quality levels and probable economic costs to the western Delta water users.

Unlike the Interagency Delta Committee report, the overland water supply is not mentioned as a feature of the project. The report, in general, refers qualitatively to better water quality in the Delta channels due to releases from the Peripheral Canal which contribute to agricultural water use, and fish and wildlife. Later, benefits are estimated and attributed directly to water quality.

The U. S. Public Health Service, in commenting on the feasibility report, suggested that economic costs to local water users be considered in the economic evaluation of the Peripheral Canal even though these costs may be relatively small due to the huge quantity of export water involved.

Other References

There are two documents which pertain to Delta water quality but do not directly evaluate economic effects of inchannel water quality: (1) U. S. Department of Health and Welfare, "An Evaluation of the Economic Benefits Derived from the Improvement of Water Quality in Contra Costa County", June 30, 1962; and (2) California Department of Water Resources, "Agreement with Contra Costa County Water District", April 21, 1967.

The U. S. Public Health report examines the benefits arising to Contra Costa County water users by availability of water from the Kellogg Project under standard treatment cost alternatives of lower-quality water.

The department agreement with the Contra Costa County Water District provides for payment to the latter for water entitlement deficiencies arising from the loss of usable river water at Mallard Slough due to operation of the State Water Project. No economic evaluation is made. A formula for financial settlement was agreed upon by the State and the Water District.

APPENDIX G

COST OF WATER FROM NORTH COASTAL PROJECTS

PRELIMINARY INFORMATION ON NORTH COASTAL WATER DEVELOPMENT
MAY 1969
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

The following cost information on North Coastal water development is based on but one of many possible staging plans and should not be construed as a recommended course of action. This information is preliminary and intended only for use in planning studies of the Sacramento-San Joaquin Delta conducted by the Central District of the Department.

Assumptions

The demand buildup used in computing these costs is based on information taken from Bulletin 160-66. The initial demands for imported water from the North Coast was assumed to occur in 1986 and reach a total demand of 6.4 million acre-feet per year in 2020. Information on the Middle Fork Eel River Development (Dos Rios Reservoir and Conveyance Facilities to the Sacramento Valley) was taken from Director Gianelli's presentation to the Senate Committee on Water Resources and the Assembly Water Committee on October 17, 1968. For all other projects, the following criteria were used.

1. No distinction was made between possible state or federal expenditures.

2. A uniform interest rate of 4 percent and a study period of 50 years were used.

3. Capital costs include allowances for engineering, contingencies and interest during construction.

4. Costs for project purposes other than water supply were not included.

5. Unit costs presented do reflect demand buildup and reservoir filling times.

Plan of Development -- Costs and Accomplishments

The following tabulation presents the staged plan of development and the costs and accomplishments of this plan.

Feature	Net Yield (1000 AF)	Costs Allocated to Water Supply		Equivalent Unit Costs ($/AF)			
		Capital Cost ($1,000,000)	Total AAE Cost ($1,000,000)	Total	Capital	Fixed OM&R	Variable O&M
1st Stage							
Middle Fork Eel (Dos Rios + Conv.)	900	340	16.3				
Subtotal	900	340	16.3	26	25	1	0
2nd Stage							
Paskenta-Newville R.	300	98	4.9				
Subtotal	300	98	4.9	28	26	2	0
3rd Stage							
Cottonwood Creek	230	113	5.7				
Subtotal	230	113	5.7	30	28	2	0
4th Stage							
Helena Res.	360	146	7.3				
Cottonwood Tunnel	---	72	3.4				
Subtotal	360	218	10.7	37	35	2	0
5th Stage							
Burnt Ranch R.	140	116	6.8				
Eltapom R.	400	106	6.3				
War Cry Tunnel	---	31	1.4				
Helena P.P.	---	21	1.4				
Subtotal	540	274	15.9	31	25	5	1

Feature	Net Yield (1000 AF)	Costs Allocated to Water Supply: Capital Cost ($1,000,000)	Costs Allocated to Water Supply: Total AAE Cost ($1,000,000)	Equivalent Unit Costs ($/AF): Total	Capital	Fixed OM&R	Variable O&M
6th Stage							
Yellow Jacket R.	760	236	11.9				
Rail Road Rel.	---	151	7.0				
Pumping Plant	---	99	5.8				
Tunnel	---	20	0.9				
Subtotal	760	506	25.6	38	34	2	2
7th Stage							
Rancheria Res.	350	112	5.6				
Westside Conv.	100	220	11.2				
Subtotal	450	332	16.8	40	36	4	0
8th Stage							
Beaver Res.	1780	317	16.2				
Burnt Ranch P.P.	---	130	9.3				
Helena P.P.	---	48	5.0				
Cottonwood T.	---	98	4.6				
Subtotal	1780	593	35.1	25	20	3	2
9th Stage							
Beaver F.B.	---	8	0.5				
Klamath P.P.	2030	15	2.6				
Beaver P.P.	---	132	11.9				
Burnt Ranch P.P.	---	31	4.7				
Helena P.P.	---	27	4.2				
Subtotal	2030	213	23.9	16	7	4	5
Overall Costs of North Coast Water Development	7350	2687	154.9	30	25	3	2

APPENDIX H

DELTA ECONOMIC STATISTICS

Introduction

The Delta's rich agricultural lands contribute significantly to the economy of California and the nation. A summary of Delta land-use acreages, by county, is presented in Table H-1. Table H-2 summarizes the crop statistics and farm income for the statutory Delta.

Mineral production, retail sales, and manufacturing also add to the Delta economy. Table H-3 presents general economic statistics relating to the counties of the Delta. Table H-4 compares the general economic statistics of the State, the Delta counties, and the statutory Delta. The source of the data in Table H-3 is tabulated in Table H-5.

TABLE H-1
SUMMARY OF LAND USE ACREAGES
SACRAMENTO-SAN JOAQUIN DELTA
(1,000 Acres)

Counties	Agricultural: Irrigated	Agricultural: Non Irrigated	Agricultural: Total	Urban and Recreational	Native Vegetation	Native Riparian	Water Surface	Total
Delta Lowlands[a]								
1. Alameda	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
2. Contra Costa	34	3	37	1	7	1	12	58
3. Sacramento	62	17	79	1	6	3	12	100
4. San Joaquin	161	20	181	2	12	4	12	210
5. Solano	25	11	36	b/	5	b/	6	48
6. Yolo	32	9	41	3	4	0	2	50
Totals	313	59	373	6	35	8	44	465
Delta Uplands[c]								
1. Alameda	2	b/	3	b/	2	0	b/	5
2. Contra Costa	29	6	35	8	8	2	2	56
3. Sacramento	7	3	10	1	5	1	1	18
4. San Joaquin	78	5	82	11	12	b/	2	107
5. Solano	16	6	22	b/	19	2	1	45
6. Yolo	18	7	26	0	15	0	1	42
Totals	150	28	178	20	62	5	7	273
Statutory Delta[d]								
1. Alameda	2	b/	3	b/	2	0	b/	5
2. Contra Costa	63	9	72	9	16	3	14	113
3. Sacramento	68	20	89	2	11	3	13	118
4. San Joaquin	238	24	263	12	24	5	14	317
5. Solano	42	17	59	b/	25	3	7	93
6. Yolo	50	16	66	3	19	0	4	92
Totals	463	87	551	26	97	13	51	738

a/ Lands within the statutory Delta between elevation +5' and -20' MSL.
b/ Less than 0.5.
c/ Lands within the statutory Delta above elevation +5' MSL.
d/ Statutory Delta (Figure 3) as defined by California Water Code Section 12220.

NOTE: Detail figures may not add to total because of rounding.

SOURCE: Department of Water Resources, Sacramento-San Joaquin Delta Area Land Use Survey Data. Office Report, June 1965, pp. 10 and 13.

TABLE H-2
CROP STATISTICS
AND FARM INCOME
FOR STATUTORY DELTA

Crop	Percentage of Cropped Area[a/]	Cropped Land[a/] (Acres)	Gross Farm Income Per Acre[b/] (Dollars)	Gross Farm Income ($1,000)	Net Farm Income[c/] ($1,000)
Field Crops					
Rice	.66	4,000	245	980	294
Sugar Beet	7.81	43,000	285	12,255	3,676
Safflower	3.47	19,000	125	2,375	712
Other Field	17.47	97,000	130	12,610	3,783
Vegetable Crops					
Asparagus	8.78	48,000	375	18,000	5,400
Tomato	8.74	48,000	560	26,880	8,064
Other Vegetable	9.33	51,000	590	30,090	9,027
Alfalfa	10.71	59,000	175	10,325	3,098
Pasture, Irrigated	11.13	61,000	50	3,050	915
Hay and Grain	17.05	94,000	80[d/]	7,520	2,256
Orchard[e/]	4.85	27,000	590	15,930	4,779
Total	100.00	551,000	254[f/g/]	140,015[g/]	42,004[g/]

a/ Cropped lands for statutory Delta (Water Code Section 12220) estimated from land-use surveys for the Delta Service Area encompassing years 1957, 1958, and 1961. Crop pattern changes from year to year; consequently, the pattern and acreages and averages are approximations.
b/ Gross farm income per acre are annual averages covering 1959-1965 (excludes any government payments). Values do not include income from livestock and poultry.
c/ Net return to the farm owner for his labor, management, and investment.
d/ Weighted average of barley, wheat, and grain hay (excluding alfalfa hay).
e/ Includes small acreage of vineyards.
f/ Weighted average.
g/ Incomes for 1966 would be greater than the 1959-65 average values, but data not available. Comparable State and Delta Counties' figures show 13-percent and 22-percent increases, respectively.

TABLE H-3

GENERAL ECONOMIC STATISTICS RELATING TO THE COUNTIES OF THE SACRAMENTO-SAN JOAQUIN DELTA a/

Item	Unit	Delta Counties: Alameda	Contra Costa	Sacramento	San Joaquin	Solano	Yolo	Total
Total for Delta Counties								
1. Area, Gross	1,000 acres	524	516	638	911	577	662	3,828
2. Agricultural Land, Harvested	1,000 acres (1959)	54	76	179	463	161	326	1,259
3. Employment	1,000 persons (1965)	257	85	117	70	20	18	567
4. Population	1,000 persons (1966)	1,048	531	624	279	165	81	2,728
5. Assessed Valuation b/	$Million (1966)	1,581	1,200	1,032	477	237	162	4,689
6. Agricultural Production c/	$Million (1959-65 Average)	25	20	39	153	29	77	343
7. Retail Sales	$Million (1965)	1,978	668	987	437	186	126	4,382
8. Manufacturing, Net Value Added	$Million (1963)	1,023	546	471	217	24	46	2,327
9. Mineral Production	$Million (1963)	22	6	23	16	14	4	85
Portion Within Delta								
10. Area, Gross	1,000 acres	5	113	118	317	93	92	738
11. Agricultural Land, Harvested	1,000 acres (various years)	3	72	89	262	59	66	551
12. Employment		Not available						
13. Population	1,000 persons (1966)	d/	62	14	108	3	25	212
14. Assessed Valuation b/	$Million (1966)	d/	7	13	34	10	10	74
15. Agricultural Production c/	$Million (1959-65)	-	-	-	-	-	-	140
16. Retail Sales		Not available						
17. Manufacturing, Net Value Added		Not available						
18. Mineral Production		Not available						

a/ Source of data tabulated in Table H-5.

b/ Land and improvements.

c/ Excludes livestock and poultry. Item 6 (from Table H-5) also shows values including these categories for Delta counties and State. Values for 1966 show 13 and 22 percent increases above the 1959-65 average for the State and Delta counties, respectively. Delta figures for 1966 could not be computed with data on hand.

d/ Less than 0.5

TABLE H-4

GENERAL ECONOMIC STATISTICS OF THE STATE, THE DELTA COUNTIES, AND THE STATUTORY DELTA

Item	Units	State Total	Delta Counties[a] Total	Delta Counties[a] Percent of State	Statutory Delta[b] Total	Statutory Delta[b] Percent of State	Statutory Delta[b] Percent of Delta Counties
1. Area, Gross	1,000 acres	101,564	3,828	3.8	738	0.7	19.3
2. Agricultural Land, Harvested	1,000 acres	8,022	1,259	15.7	551	6.9	43.8
3. Employment	1,000 persons (1959)	4,725	567	12.0	n.a.	-	-
4. Population	1,000 persons (1966)	19,195	2,728	14.2	212	1.1	7.8
5. Assessed Valuation[c]	Million dollars (1966)	37,388	4,689	12.5	74	0.2	1.6
6. Agricultural Production[d]	Million dollars (1959-65 av.)	2,608	343	13.2	140	5.4	40.8
7. Retail Sales	Million dollars (1965)	31,908	4,382	13.7	n.a.	-	-
8. Manufacturing, Net Value, Added	Million dollars (1963)	17,157	2,327	13.6	n.a.	-	-
9. Mineral Production	Million dollars (1963)	1,526	85	5.6	n.a.	-	-

[a] The Delta Counties are Alameda, Contra Costa, Sacramento, San Joaquin, Solano, and Yolo. Statutory Delta area is 1.0 percent, 21.9 percent, 18.5 percent, 34.8 percent, 16.1 percent, and 13.9 percent, respectively, of these Counties.

[b] Statutory Delta is defined in California Water Code, Section 12220.

[c] Land and improvements.

[d] Excludes livestock and poultry. Values for 1966 are 13 percent greater for the State; and 22 percent, for Delta counties. Statutory Delta data not available for 1966.

n.a. - not available.

TABLE H-5
SOURCE OF DATA FOR TABLE H-3

Item No.	Source
1.	California Statistical Abstract, 1966 Edition, p. 123.
2.	California Statistical Abstract, 1966 Edition, p. 123.
3.	California Statistical Abstract, 1966 Edition, p. 21 (Employment covered by the Calif. Unemployment Insurance Code).
4.	State Controller Annual Report of Financial Transactions re counties of Calif., 1965-66 FY, p. 1.
5.	Calif. State Board of Equalization. Annual Report 1965-66, p. A-14 (covers assessed valuation of land and improvements only).
6.	Calif. Dept. of Agriculture. Annual summary of gross values of crops & livestock production reported by County Agricultural Commissioners. Annually 1959-1965, 1966.

	1959-65 Average	1966	Percent Increase 1959-65 Average to 1966
Delta Counties: Total annual agricultural values	$ 451,000,000	$ 548,000,000	21.5
Delta Counties: Annual agricultural values, excluding livestock & poultry	$ 343,000,000	$ 419,000,000	22.2
State: Total annual agricultural values	$3,858,000,000	$4,421,000,000	14.6
State: Annual agricultural values, excluding livestock & poultry	$2,608,000,000	$2,939,000,000	12.7

7.	Calif. Statistical Abstract, 1966 Edition, p. 183.
8.	Calif. Statistical Abstract, 1966 Edition, p. 147.
9.	Doubleday Company, Calif. Information Almanac, 1966 Edition, p. 229.
10.	DWR, Sacramento-San Joaquin Delta Area Land-Use Study, Office Report, June 1965, p. 13.
11.	DWR, loc. cit.
12.	Not available.
13.	DWR, special tabulation by Phil Warren adjusted to 1966.
14.	DWR, assessed valuation estimated for land & improvements, data available from Peripheral Canal and Clifton Court studies.
15.	DWR, computed from segmented land-use surveys covering 1955, 1958, & 1961; & average per-acre values for years 1959-65
16.	Not available.
17.	Not available.
18.	Not available.

APPENDIX I

INTERIM FISH PROTECTIVE MEASURES IN THE DELTA

DWR #458183
March 10, 1969

C O P Y

C O P Y

Memorandum of Understanding on Interim Measures to Protect Fish in the Sacramento-San Joaquin River Delta Prior to the Construction of the Peripheral Canal

It is recognized that fishery problems exist in the Sacramento-San Joaquin Delta. A factor affecting these problems is the operation of the Central Valley Project and State Water Project. Certain operation procedures could reduce these problems until the Peripheral Canal is operational.

The attached report by the Bureau of Reclamation on "Interim Measures for Protection of Fish and Water Quality", dated January 1968, is accepted as a statement of the current problems associated with fish in the Sacramento-San Joaquin River Delta, need for interim measures, types of measures, priorities, and costs.

This Memorandum of Understanding summarizes objectives to reduce the problems, actions which have been taken to meet these objectives, and a procedure to implement a protection program in the period prior to operation of the Peripheral Canal. This Memorandum will be reevaluated and revised as may be necessary in 1976 if the Peripheral Canal is not operational by that time.

Objectives

Objectives have been established to achieve desirable measures that are compatible with other water resource needs until the proposed joint Federal-State Peripheral Canal can be put in operation. Among these objectives and actions to meet these objectives are:

I. Improve fish salvage operation at the Tracy Pumping Plant of the Bureau of Reclamation.

A. Modify tank trucks to relieve problems of plugging with fish and debris.

B. Select, develop, and construct two sites in the western Delta for release of fish offshore in deep water.

C. Employ a full-time fishery biologist with responsibilities for developing operational procedures for fish handling.

II. Maintain remnant salmon stocks in the San Joaquin River tributaries.

A. Rear juvenile salmon to yearling size by trapping and artificially spawning fall run

king salmon in San Joaquin River tributaries and taking sufficient eggs to produce 200,000 yearling fish annually.

B. Transport yearling salmon in years of low river flow from the San Joaquin River tributaries by live car or truck to release points in the Delta out of the influence of the pumps.

III. Minimize detrimental effects of flow reversal and low levels of dissolved oxygen on salmon runs of the San Joaquin River.

A. Have control structure in Old River in operation when fall flows in the San Joaquin River at Vernalis drop below 1,800 cfs and/or critical problems with salmon migration are predicted.

B. Supplement the flows of the San Joaquin River when the control structure is in place to maintain the dissolved oxygen content in the Stockton Ship Channel generally above 6 ppm when necessary. Supplemental flow not to exceed 60,000 acre-feet in any year.

IV. Protect striped bass eggs and larvae and provide a water quality suitable for bass migration and spawning.

A. Annually plan to reduce pumping during the striped bass spawning period to the maximum extent possible consistent with other project purposes.

B. Annually plan to increase outflow during the period of curtailed pumping to the extent possible consistent with other project purposes.

Action in Progress

To date there has been substantial progress in meeting the above objectives. A summary of the action in progress -- numbered to correspond with the objectives enumerated above -- is as follows:

I. A. Modification of tank trucks is in progress by the Bureau of Reclamation and should be completed about April 1, 1969.

B. Tentative sites for release of fish in deep water in the western Delta have been selected and their development has been discussed with

California Department of Fish and Game and U. S. Bureau of Sport Fisheries and Wildlife. Cost of development of each site is estimated to be from $15,000 to $20,000. Two sites will be constructed by the Bureau of Reclamation as soon as possible depending on budget limitations. Two sites already developed by the Department of Water Resources are operational and can be utilized by the Bureau of Reclamation pending completion of other sites.

C. Preliminary action has been taken by the Bureau of Reclamation to employ a full-time fishery biologist by July 1970. (The Department of Water Resources has employed a fishery biologist under contract with the Department of Fish and Game to guide the fish salvage program at the State's Delta Pumping Plant and coordinate the operation of the state fish facilities with that of the federal facilities at the Tracy Pumping Plant.)

II. A program to meet these objectives has been carried out by the California Department of Fish and Game for the past three years at a cost of $30,000 annually.

III. The California Department of Water Resources and the U. S. Bureau of Reclamation have acted in 1963, 1964, and 1968 when critical levels of dissolved oxygen have developed in the Stockton Ship Channel to achieve a substantial part of the desired objective. This was accomplished by installing a temporary control structure in Old River together with augmentation of flow in the San Joaquin River.

IV. Action on this objective has not been necessary to date because of the limited diversions of the state and federal projects.

The Secretary of the Interior has accepted a proposal of the Bureau of Reclamation to operate the Central Valley Project, beginning in 1969, to achieve certain water quality objectives in the Delta for striped bass migration and spawning until September 30, 1972.

Future Implementation

After reviewing the progress to date and work now in progress, it is apparent that objective No. I will be substantially achieved and should be continued as planned. The California Department of Fish and Game will continue to fulfill objective No. II as required. To achieve objectives Nos. III and IV, it will be necessary to provide for a year-by-year review of conditions relating to the total operational requirements of the federal and state water projects. To insure that objectives

Nos. III and IV are given full consideration, the following procedure will be adopted.

1. In March of each year, the four agencies will meet to consider the striped bass needs in the forthcoming spring months in relation to runoff conditions, operation schedules, and local Delta needs. Differences which cannot be resolved at this meeting will be decided upon at a special meeting of the Directors of the agencies.

2. In June of each year the four agencies will meet for the purpose of discussing the needs of the salmon fishery during the fall, and more specifically, to determine the need and/or scheduling of a closure of Old River and the estimated flow augmentation required. The same procedure for considering operational plans and resolving differences will be followed as set forth in Item 1 above.

Division of Responsibilities

Subject to the availability of funds, the initial assignment of responsibility for implementing measures to achieve protection of San Joaquin salmon is as follows:

1. The Department of Fish and Game will be responsible for the rearing and transporting of yearling salmon.

2. The Department of Water Resources will be responsible for the control structure in Old River.

3. The U. S. Bureau of Reclamation will be responsible for San Joaquin River flow augmentation.

4. The U. S. Bureau of Sport Fisheries and Wildlife will be responsible for coordination of measures with the Department of Fish and Game and continued evaluation of the adequacy of the current measures.

CALIFORNIA DEPARTMENT OF
WATER RESOURCES

By /s/ W. R. Gianelli

U. S. BUREAU OF RECLAMATION
REGION II

By /s/ R. J. Pafford, Jr.

CALIFORNIA DEPARTMENT OF
FISH AND GAME

By /s/ James S. Leiby
Administrative Officer

U. S. BUREAU OF SPORT FISHERIES
AND WILDLIFE, REGION I

By /s/ Travis S. Roberts
Acting Regional Director

Attachment