

STATE OF CALIFORNIA  
STATE WATER RIGHTS BOARD

In the Matter of Applications 5625, )  
5626, 9363, 9364, 9365, 9366, 9367, )  
9368 and 10588, )

UNITED STATES OF AMERICA, )  
BUREAU OF RECLAMATION, )

Applicant )

SACRAMENTO RIVER AND DELTA WATER )  
ASSOCIATION, et al., )

Protestants )

---

OPINION BY  
BOARD MEMBER W. P. ROWE  
CONCURRING IN PART WITH,  
AND DISSENTING IN PART  
FROM, DECISION D 990

February 9, 1961

STATE OF CALIFORNIA  
STATE WATER RIGHTS BOARD

In the Matter of Applications 5625, 5626,  
9363, 9364, 9365, 9366, 9367, 9368, 10588,  
and 15764,

UNITED STATES OF AMERICA,  
BUREAU OF RECLAMATION,

Applicant

SACRAMENTO RIVER AND DELTA WATER  
ASSOCIATION, ET AL.,

Protestants

Sources: Sacramento  
River, Rock Slough,  
Old River, and  
Channels of the  
Sacramento-  
San Joaquin Delta

*Adopted December 23, 1965*

ORDER EXTENDING TIME IN WHICH  
TO FORMULATE TERMS AND CONDITIONS  
RELATIVE TO SALINITY CONTROL  
PURSUANT TO DECISIONS D 990 AND D 1020

Condition No. 25 of the Board's order under Decision D 990, made on February 9, 1961, and condition No. 9 of the Board's order under Decision D 1020, made on June 30, 1961, reserved continuing jurisdiction over permits issued pursuant to Applications 5625, 5626, 9363, 9364, 9365, 9366, 9367, 9368, 10588, and 15764 until March 1, 1964, or such additional time as may be prescribed by the Board, for the purpose of formulating terms and conditions relative to salinity control in the Sacramento-San Joaquin Delta.

The initial period of three years was considered reasonable in order to allow the United States, the State of California, and the water users in the Delta an opportunity to work out their problems by mutual agreement; or, failing to reach agreement, to provide the Board with information upon which to make such further order as may be necessary and proper relating to salinity control in the Delta.

A to D 990

The Board finds that no emergency has arisen in the interim requiring imposition of specific permit terms; that additional time for the parties to resolve their problems would not cause injury to any lawful user of water; and that there has been no material change in project operations which would alter the conditions under which salinity incursion is now controlled.

Upon such findings, the Board concludes that the reservation of continuing jurisdiction should be extended.

IT IS HEREBY ORDERED that the State Water Rights Board reserve continuing jurisdiction over permits issued pursuant to Applications 5625, 5626, 9363, 9364, 9365, 9366, 9367, 9368, 10588, and 15764 until further order of the Board, for the purpose of formulating terms and conditions relative to salinity control in the Sacramento-San Joaquin Delta.

Adopted as the order of the State Water Rights Board at a meeting duly called and held in Sacramento, California, on the                      day of                      , 19                      .

/s/ Kent Silverthorne  
Kent Silverthorne, Chairman

/s/ Ralph J. McGill  
Ralph J. McGill, Member

/s/ W. A. Alexander  
W. A. Alexander, Member

TABLE OF CONTENTS

	Page
Opinion.....	2
Chronology of Events Regarding Salinity Control.....	4
Power to Condition Permits.....	10
Salinity Incursion into the Delta.....	12
Coordination of Federal-State Projects.....	56
Watershed Protection.....	63

TABLES

Table Number

1	Comparison of Reclamation in Delta with Areas Irrigated from Sacramento and San Joaquin River Systems.....	15
2	Inflow to Delta for July and August and Maximum Chloride Ions at Antioch.....	21
3	Flows of Sacramento River at Sacramento below American River and Chloride Ions at Antioch and Contra Costa Canal for August.....	32
4	Disposal of Water of Sacramento Valley and Delta during August of Non-flood Years.....	33
5	Disposal of Water of Sacramento Valley and Delta during August of Non-flood Years (Acre-feet).....	35
6	Flows, Diversions, and Claimed Rights from Sacramento River, July and August, 1943.....	65
7	Area Irrigated between Red Bluff and Knights Landing.....	66
8	Flows, Diversions, and Claimed Rights from Sacramento River, July and August, 1954.....	68

OPINION BY BOARD MEMBER W. P. ROWE  
CONCURRING IN PART WITH, AND DISSENTING  
IN PART FROM, DECISION D 990

I concur in Decision D 990 of the State Water Rights Board except with respect to the issue of Salinity Control and on this I dissent and submit herewith the supporting data for my dissent. I concur in the balance of the Decision but submit herewith explanatory material in support of "Watershed Protection" and "Coordination of Federal-State Projects" which I believe will be helpful to some of the parties.

When the first proposed decision prepared by the staff was submitted to the Board, I filed my comments which were directed principally toward the salinity control issue. There was also submitted my supporting data for these comments which were made available to the other two Board members. When my comments were filed, I stated that if my colleague and acting chairman during the hearing could not accept my views on salinity control it would be understood that we were in disagreement, which would automatically qualify our third Board member and chairman so that a decision could be agreed upon by a majority of at least two members as required by law.

The staff then prepared the final Decision which included much of the material in my supporting data. At the time I filed my comments and supporting data it was with the understanding that if the other two members agreed on the final Decision, I would dissent as regards salinity control

and include the supporting data as part of my dissenting opinion. We have now reached that stage of the proceedings.

I wish to make clear at the outset that no one on our Board is more appreciative of the great work the Bureau has done in helping to solve the State's water problems. I also feel it will be called upon for assistance in solving the State's new water problems created when the voters endorsed the present State Water Plan on November 8, 1960. I do believe, however, that the Bureau has some unfulfilled obligations, one of which is a clear-cut commitment on salinity control as it was originally conceived and understood by all parties until July 10, 1957 (USBR 154).

There are few, if any, present employees of either the State or the Bureau who were in the employ of these parties when the State Water Plan (which was turned over to the Bureau for construction during the depression years) was being formulated. It is mainly for this reason that my supporting data is so lengthy. I hope to recreate the atmosphere that prevailed during those early times. I do not believe it would be amiss in stating that my association with those early problems began in the mid-twenties. It may be that my lack of success with my fellow Board members in this effort is due, in part, to what I consider to be in the public interest rather than cold legal argument and also in the belief that promises, whether written or oral, are meant to be kept.

My supporting data begins with a chronology of events regarding salinity control as follows:

## Chronology of Events Regarding Salinity Control

1850 "Arkansas Act" (Swamp and Overflow Act), giving such lands to States passed by Congress in 1850 (DWR 5, p. 157).

1861 State Legislature established Board of Swamplands Commissioners in 1861 (DWR 5, p. 157).

1917 California and United States started dredging channel 3000 feet wide on north side Sherman Island in 1917 (H. Doc. 791, 71st Cong., 1931).

1918 Stream flow of Sacramento River and main tributaries (Feather and American Rivers) during July plus August, 1918 was tenth lowest of 1905-1958 record (USGS Water Supply Papers). Inflow to Delta in July plus August, 1918 was also tenth lowest of record from 1892 through 1957 (DWR 5, pp. 88 & 428; USBR 155).

1918 Chlorides at Antioch in 1918 reached a maximum of 1800 ppm (DWR 5, p. 380).

1919 Inflow to Delta in July plus August, 1919 was ninth lowest of record (392,000 acre-feet) while maximum chlorides at Antioch were only 1050 ppm (DWR 5, pp. 428 & 380).

1920 Reclamation of Delta lands practically completed by 1920 (DWR 5, p. 160).

1920 Inflow to Delta in July plus August, 1920 was fourth lowest of record (199,000 acre-feet) while maximum chlorides at Antioch were 7,660 ppm (DWR 5, pp. 428 & 380).

1920 California and Hawaiian Sugar Refining Corporation abandoned use of barges for water supply in summer months beginning in 1920 because travel distance on Sacramento and San Joaquin Rivers was too long to reach good water.

1920 Walker Young, Construction Engineer for U. S. Bureau of Reclamation, in his report paid for jointly by State and Bureau, stated, "Generally speaking, any increase in the carrying capacity of the lower rivers through deepening, widening, or straightening of the channel, will, in the writer's opinion, permit of easier access of salt water into the Delta" (CCCWA 22, p. 190, 1929).

1920 The authors of State Bulletin 27 stated, "The increase in tidal flow from this work (dredging of 1917-20) did not become effective to much extent until after 1920 and gradually approached the full amount estimated during the succeeding ten years" (DWR 5, p. 162, 1931).

1923 State proposed salt water barrier at Carquinez Straits (USBR 9, pp. 47 & 48, 1923).

1927 State bulletins for State Water Plan began to concentrate on Kennett Reservoir (Shasta) as key to solution of water problems (USBR 12, DWR 2, CCCWA 2).

1930 Bulletin 25 outlined State Water Plan and showed need for large storage reservoirs (USBR 14, pp. 36 & 37, 1930).

1931 Comprehensive study of salinity problems of Delta published by State. Flow of 3300 second-feet adopted as



minimum flow past Antioch. "This would put the control point for a maximum degree of mean tidal cycle surface zone salinity of 100 parts of chlorine per 100,000 parts of water about 0.6 mile below Antioch" (DWR 5, p. 224, 1931).

1933 Contribution of \$7,000,000 toward construction of Kennett Dam recommended by U. S. Board of Engineers for Rivers and Harbors (CCCWA 19A, p. 1).

1933 Mr. W. A. Bashore, later the Commissioner of Reclamation, advocated construction of Folsom Dam as a means of resisting salinity advances (Staff 9, pp. 528-529, 1933).

1934 Chief of Engineers, U. S. Army, recommended direct participation of the Federal government of \$12,000,000 in the construction of Kennett Dam because it remedies "the intrusion of salt water into the Delta" (Staff 9, p. 549).

1940 Contra Costa Canal started delivering water to users (USBR 162).

1943 Shasta Dam began regulating flow of Sacramento River December 30, 1943.

1945 Interdepartmental controversy between Secretary of Interior and Secretary of the Army over construction of and repayment for flood control dams was in full swing (Staff 9, p. 1050).

1946 Bureau allocated \$18,083,000 to navigation and we can assume this included the \$12,000,000 recommendation and authorization for "remedying the intrusion of salt water into the Delta" (Staff 9, p. 576).

1946 Water to be delivered within the Project area under the so-called 9(e) contracts which provide for canal-side or river-bank delivery (Staff 9, p. 578).

1947 Estimates for prevention of salinity intrusion into the Delta ranged from 3300 to 5000 cubic feet per second (Staff 9, p. 586).

1951 Bureau amended Applications 5626 and 9364 to provide up to 6000 cfs to dispose of chemical elements that would otherwise accumulate in the irrigation waters flowing in the Delta channels of the Sacramento and San Joaquin Rivers (USBR 87A).

1951 Bureau and State agreed on an estimate of 4500 cfs for consumptive uses in the Delta and an additional 4500 cfs for salinity repulsion (Staff 9, p. 745).

1951 State Engineer, in his Feasibility Report on the Feather River Project, allotted 4500 cfs for salinity control.

1952 The Bureau decided to release from Shasta about 12,000 second-feet to take care of the multiple uses of the Project (CCCWA 37A, p. 4 & Table 4 of this opinion).

1957 On July 10, 1957 the Bureau first promulgated the theory that its only obligation as regards salinity control was to provide a satisfactory quality of water at the intakes to the Contra Costa and Tracy pumping plants (USBR 154, p. 3).

1957 More than 3,000,000 acre-feet of fresh water must flow to Suisun Bay in period June 15 to September 1 (77 days) in order to provide fresh water at most westerly Delta lands (USBR 154, p. 4).

1957 If a water user is at the lower end of Sherman Island, which is within the Sacramento-Delta Service Area as agreed to in 1954 (Trial Water Distribution - 1954) by the State and the Bureau, he could demand delivery of water by the Bureau of good quality river-bank at his pump or syphon at the prevailing Bureau charge for similar water, even though it resulted in a flow of 3,000,000 acre-feet of fresh water past his land during the period June 15 through August 31, unless the Bureau furnished a substitute means of delivery (Staff 9, p. 578 & USBR 154).

1958 The Supreme Court of the United States in the so-called Ivanhoe case held that the expense of salinity prevention was nonreimbursable (78 Supreme Court Reporter 357).

1959 With the diversion of Trinity River water into the Sacramento River watershed and the release of water into the American River from Folsom Dam that will be diverted only if and when the Folsom North and Folsom South Canals are constructed, there will be an abundance of water available for salinity control for several years.

1960 The Bureau and water users in the Sacramento Valley have been negotiating for over 15 years without a contract. The fixing of the responsibility for salinity control should speed up the time for solving this problem as well as that presented when the State seeks a permit for its State Water Plan facilities.

It is my opinion that the Bureau should so operate its facilities as to maintain a flow of water at a point

0.6 mile west of Antioch that will not exceed 1000 ppm of chlorides until it can negotiate a settlement with the water users of Sherman and Jersey Islands and the shoreline of Contra Costa County east of Antioch by which their points of diversion can be moved upstream in order to conserve water. It is also my opinion that whenever the State constructs any dams within the drainage area of the Sacramento River or diverts water from the Delta during the irrigation season April 1 through October 31, it should reach an agreement with the Bureau as to the amount of money it should reimburse the Bureau for that portion of the expenditure properly chargeable to the State as the result of future Bureau constructions for salinity control.

The following sections contain my opinion on salinity control and comments for clarification of other subject matters listed in the "Table of Contents".

## POWER TO CONDITION PERMITS

The Chief Counsel for the Board has prepared a valuable and helpful treatise on the subject of the power of the Board to condition permits issued to the Bureau. The problem of the Board in this regard is confined to two main categories. These are: (1) the inclusion of the Watershed Protection Law so that potential users of water in the Sacramento Valley will receive a priority when contracting for new or supplemental water; and (2) a provision for salinity control. If the Board can condition permits for watershed protection, it can, in my opinion, condition them for salinity control.

Under the section "Salinity Incursion into Delta" attention is called to the problem which would arise when a water user, at the lower end of the Delta using a river-bank pump or syphon, who would be content if the chlorides in his irrigation supply did not exceed 1000 ppm, should demand delivery of water from the Bureau under a contract similar to those with irrigators on the Contra Costa and Delta-Mendota Canals. Such a contracting party's land would be in the watershed of the Sacramento River, his land would be within the Sacramento Valley-Delta Service Area and he would have the river-bank facilities to divert the water. It is my opinion that he would be entitled to water of a quality similar to that furnished by the Bureau through the Contra Costa and

Delta-Mendota Canals, and that it would be up to the Bureau to devise the means whereby he would get what he paid for.

The Chief Counsel of the Board refers to the Ivanhoe and the Gerlach Livestock Company cases in his statement. It will be shown that the United States Supreme Court in the Ivanhoe case has held that salinity control was a non-reimbursible item in the Bureau's Central Valley Project. The Bureau, in its Exhibit 81, showed that it had paid out over \$4,000,000 in acquiring water rights and settling claims along the San Joaquin River. This would be another method which the Bureau might use in the case of the landowner at the lower end of the Delta should he demand the water to which he is entitled under the Watershed Protection Law.

## SALINITY INCURSION INTO THE DELTA

When the early history of the Sacramento-San Joaquin Delta is considered, it should be understood that the period of minimum inflow of river water to the Delta usually occurs in August (DWR 5, pp. 428, 429). This coincides with the maximum evapo-transpiration loss or consumptive use by native vegetation and irrigated crops in this area (DWR 5, Pl. X, Opp. p. 74).

The first recorded visit to the Delta area was made by Commander Don Juan Manuel de Ayola in the packet "San Carlos". He reached a position about midway between the lower end of Suisun Bay and the confluence of the Sacramento and San Joaquin Rivers in August, 1775. He found sweet water similar to a lake at this point (DWR 5, p. 46). The next visit of record to the Delta by boat was made by Commander Ringgold in August, 1841. He went up the San Joaquin River to the approximate location of Antioch where he camped and found brackish water in the river (DWR 5, p. 47). His log states that the winter of 1840 had been very dry (DWR 5, p. 47). The profile of the Sacramento River shown in Bulletin 27 for 1841 was prepared from data Ringgold compiled on this same voyage (DWR 5, Pl. XXXV). The historians do not say if he found brackish water in the Sacramento River on this trip.

A witness in the Antioch case testified to the invasion of saline tidal water up the San Joaquin River on one or two occasions some time between 1870 and 1876 (DWR 8, p. 192).

As the three-year period 1868-1871 was a dry one with an average annual precipitation of 70 percent of normal, it was concluded by an engineer in that trial that this occurred in 1871 (CCCWA 8, p. 192). The historical information presented as to salinity conditions in 1775, 1841 and in the 1860's and 1870's "shows that the invasion of saline tidal water into the delta, under natural conditions before reclamation, extended only a short distance above the confluence of the Sacramento and San Joaquin Rivers, even in dry years" (DWR 5, p. 161). Prior to 1920, the invasion of saline tidal flows above Antioch happened at such rare intervals that their occurrence was news.

"The reclamation of the lands in the Delta has eliminated a large area of aquatic vegetation such as cat-tails and tules which consume three to four times as much water as the crops which are grown on these reclaimed lands. As a result, it appears probable that the consumption of water within the Delta has been decreased by reclamation development, and that a greater proportion of the stream flow entering the Delta now reaches the lower end of the Delta to repel saline invasion than before reclamation" (DWR 5, p. 161). The estimates of the amounts of water diverted from the Sacramento River during the early stages of development make no allowances for consumptive uses by native vegetation in the flood plain of the Sacramento River that were conserved when these lands were cleared for farming (DWR 5, Pl. XXXIII).



Reclamation in the Delta began at a rapid rate about ten years after the passage of the Federal "Swamp and Overflow Act" in 1850 granting these lands to the State. The value of the Delta lands was recognized about that time and the State Legislature established the Board of Swampland Commissioners in 1861. As the purchasers of these lands were required to reclaim them and the lands had to be protected by levees before they could be reclaimed, it was natural that all the purchasers of an island in the Delta would unite in sharing the cost (DWR 5, p. 157).

Reclamation of the Delta lands in large areas began at an earlier date than in the Sacramento and San Joaquin Valleys. Table 1 (page 15) presents a comparison of the acreages reclaimed in the Delta and the acreages irrigated by direct diversion from the Sacramento and San Joaquin River Systems by decades or for the nearest year of the decade. The bulk of the reclamation development in the Delta was completed prior to 1920 (DWR 5, p. 160).

Farms in the Sacramento Valley irrigated in 1912, except for areas around Woodland on Cache Creek and around Yuba City on the Feather River were spotted throughout the area with not over one-fourth of any township being irrigated. The Central Canal of what became the Glenn-Colusa Irrigation District was serving water to scattered farms at this time (Staff 12). The acreage listed for the Sacramento Valley in 1920 includes land irrigated along the Feather River and the Sierra foothills.

TABLE 1

COMPARISON OF RECLAMATION IN DELTA WITH  
 AREAS IRRIGATED FROM SACRAMENTO AND  
 SAN JOAQUIN RIVER SYSTEMS  
 (Thousands of Acres)

Year	Delta (1)		Sacramento System (2)		San Joaquin System (2)	
	Increase	Total	Increase	Total	Increase	Total
1860		0				
1870	15.0	15.0				
1880 (3)	92.0	107.0		80.0		70.0
1890	70.0	177.0				
1900 (4)	58.0	235.0		160.0		170.0
1910	88.6	323.6	60.0	220.0	230.0	400.0
1920	94.0	417.6	282.0	502.0	257.0	657.0
1930 (5)	24.0	441.6	35.0	537.0	123.0	780.0

NOTES: (1) From DWR 5, p. 158, Table 22.

(2) From DWR 5, p. 126, Table 12.

(3) Acreages for Sacramento and San Joaquin Systems are for 1879..

(4) Acreages for Sacramento and San Joaquin Systems are for 1900.

(5) Acreages for Sacramento and San Joaquin Systems are for 1929.

The area of irrigated crops in the Delta in 1929 was 318,500 acres (DWR 5, p. 73).

The reclamation of the Delta lands required the leaching out of salts from the soil. The drainage of leach water from the Delta islands is accomplished by gathering the water in drains and pumping over the levees to discharge into the river. Most of the lands farmed in the Delta are near or below sea level depending on the consolidation of the peat soils (CCCWA 48, Pl. 7). Some of the lands lie as much as fifteen feet below sea level. Irrigation water is withdrawn from the river by syphoning or pumping over the levees in most cases (SRDWA 65).

In some instances these lands, because of their depth below sea level, are sub-irrigated by percolation of river water (DWR 16). In any event, the drainage water must be disposed of in order to maintain a balance between the salts in the water applied from irrigation and those in the drain water. The leach water used during the original reclamation was returned to the river channels and added to the salinity of its water. If it were not carried away by the tidal changes, it would remain around the vegetation along the outside of the levees and create a brackish condition.

A witness for the Sacramento River and Delta Water Association, Mr. Gerald Jones, testified it was his opinion that one of the main contributions to the invasion of saline water to the lower end of the Delta was the dredging done by the United States along the north side of Sherman Island from 1917 to 1920, inclusive (RT 6620). This testimony was uncontradicted during the hearing, even after its relative importance was called to the attention of the parties.

The State of California Department of Public Works, United States Bureau of Reclamation, and the Sacramento Valley Development Association entered into a contract under which Mr. Walker Young, Construction Engineer for the Bureau of Reclamation, was placed in charge of the studies, field work and writing of the report which was approved by Mr. Elwood Mead, Commissioner of Reclamation, on July 22, 1928. This study is Bulletin 22 (CCCWA 8).

In Mr. Young's Report (CCCWA 8) he commented on the new channel work that had been underway since 1917. This work made certain channel changes during the 10 to 15 years previous to 1928 in connection with reclamation and flood control works within the Delta which had the effect of increasing the tidal flow into the Delta. The principal dredging operation, which began in 1917 (House Doc. 791, 71st Congress, 1931), consisted of enlarging and straightening the Sacramento River channel from Collinsville to above Rio Vista. The work called for a channel 3,000 feet wide and 26 feet deep below mean lower low water. A portion of the channel consisted of a cut-off across a river bend on which Emmaton is located. The excavation amounted to about 141,000,000 cubic yards of material up to 1929 and the work was still in progress at that time (DWR 5, p. 162).

Prior to the deepening and widening of the Sacramento River below the junction of Cache Slough, Steamboat Slough and the Sacramento River at River Mile 65 (Rio Vista is at River Mile 63.5) to River Mile 52.5 (Collinsville is at River Mile 51.0), the average width of the Sacramento River was about

1000 feet. Mile zero is at the Golden Gate (DWR 5). The dredged channel had an average width of 3000 feet and a depth of 26 feet below mean lower low water (DWR 5, p. 162). The San Joaquin River channel had an average width of 3500 feet from the San Joaquin River at Mile 52.0 at the junction of San Joaquin and Sacramento Rivers, to Mile 61.5 at Jersey Point. The San Joaquin River narrowed to about 1250 feet at Kimball Island at San Joaquin River Mile 54 about a mile below Antioch. There have been no changes in the width of the San Joaquin River in this reach, except for the inundation of the lower end of Sherman Island.

"The increase in tidal flow from this work did not become effective to much extent until after 1920 and gradually approached the full amount estimated during the succeeding ten years" (DWR 5, p. 162). The effect of this dredging increased the volume of the tidal prism above Collinsville by about 9000 acre-feet which would have the effect of increasing the tidal flow passing Collinsville by 36,000 acre-feet per lunar day (DWR 5, p. 162). A similar increase was caused along the San Joaquin River by the flooding of the lower portion of Sherman Island and the reclamation south of Dutch Island (DWR 5, p. 162).

In a discussion of the effects of this dredging and the effect it had on the Delta tidal flows, Mr. Young stated, "Deep channels permit the heavier salt water to flow upstream along the bottom underneath the fresh water which it tends to displace. It follows that any dredging done to deepen the

channels through the bays and up the rivers would result in increased salinity in the Delta region. Generally speaking, any increase in the carrying capacity of the lower rivers through deepening, widening, or straightening of the channel, will, in the writer's opinion, permit of easier access of salt water into the Delta" (CCCWA 8, p. 190). "The flood-control works constructed by the Federal and State Governments have also been partly responsible for the invasion of salt water" (Staff 9, p. 496).

The statement regarding the "heavier salt water to flow upstream along the bottom beneath the fresh water which it tends to displace" was not borne out during the investigations presented by Bulletin No. 27, at least for the Bay areas as far upstream as Collinsville. However, data presented by Surveys No. 9 and No. 17 at Antioch and by Survey No. 1 at Curtis Landing in Bulletin No. 27 show that where the channels are narrow this action does take place (DWR 5, pp. 190-193 & Plate LXIV).

Chloride records at Antioch, based on analysis and by interpolation from analyses at Pittsburg, did not exceed 1000 parts per million (ppm) for the period of record 1910 through 1919 except for one analysis in 1913 (112) and two in 1918 (158 and 180). These analyses were made in the critical months of August or September but the tidal phase is not given. Beginning in 1920, there was a decided increase in chlorides out of proportion to the relationship between inflow to the Delta during July and August and chlorides at Antioch than

had existed previously. The total inflow to the Delta in July and August, 1919, was 391,800 acre-feet and in 1929 the total inflow to the Delta for these same months was 407,800 acre-feet. The maximum chlorides at Antioch for these same years (1919 and 1929) were 1050 ppm and 5800 ppm, respectively (DWR 5, pp. 428, 332 & 380). This fivefold increase in chlorides at Antioch can be attributed to the dredged channel. The chlorides at Antioch have never been below 1000 ppm since 1919 except when the inflow to the Delta during July plus August has exceeded 1,000,000 acre-feet. Table 2 (page 21) presents the inflow to the Delta for July and August and maximum chlorides at Antioch for the 11 driest years for the period of record.

The effects of the dredged channel were probably first apparent in 1920. Chlorides at Antioch in that year exceeded anything that had occurred previously, reaching 7660 ppm in September. Inflows to the Delta during July and August, 1920, were 129,700 and 69,700 acre-feet, respectively, the lowest of record up to this time. In only 3 years (1931, 1934 and 1924) was there less inflow to the Delta during similar periods of July and August. Total annual diversions from the Sacramento River and its two tributaries, Feather and Yuba Rivers, during 1931 were the largest up to that time and were not exceeded until 12 years later. Diversions from these streams during July and August, 1931 were not exceeded for six years. Table 2 (page 21) presents a comparison between inflow to the Delta in July plus August and the maximum

TABLE 2

INFLOW TO DELTA FOR JULY AND AUGUST  
AND MAXIMUM CHLORIDE IONS AT ANTIOCH (1)

Year	Inflow (1000's Ac. Ft.)			Chloride Ions	
	July	August	Total	ppm	Date
1931 (2)	0	38	38	12,400	September 6
1934 (2)	86	92	178	9,600	September 10
1924 (3)	77	106	183	10,850	August 20
1920 (3)	130	70	200	7,660	September 17
1939 (2)	99	110	209	9,200	August 18
1926 (3)	144	141	285	9,200	August 26
1933 (2)	235	130	365	5,800	August 26
1929 (2)	200	187	387	5,800	August 30
1919 (3)	221	171	392	1,050	September 14
1918 (3)	249	186	435	1,800	August 13
1930 (2)	240	207	447	4,700	September 14

NOTES: (1) For the 11 driest years for period of record arranged in order of lowest total inflow for July and August.

(2) Inflow less 89% of diversions from Old River, Tom Paine Slough, and San Joaquin River from Stockton to Vernalis. Chlorides from Water Supervision Reports (Staff 6).

(3) Inflow and chloride figures from Bulletin 27 (DWR 5).



chlorides at Antioch in parts per million of water. The low amount of chlorides in 1918 and 1919 as compared with those after 1925 is indicative of the changes caused by the dredging of the channel. It appears that the year 1920 was the first in which the increase in chlorides at Antioch occurred.

When the invasion of saline tidal waters became acute to the point where property rights were being destroyed, and the entire blame was placed on increasing upstream users together with the occurrence of the dry period of the runoff cycle, the first solution appeared to be by litigation. The "Antioch" suit was brought by the City of Antioch on July 2, 1920, as a claimed riparian owner seeking to enjoin upstream diverters. The final decision declared the City was an appropriator and not a riparian owner (DWR 5, p. 23). It is interesting to note that the plaintiffs asked that the upstream users "be enjoined from taking more water from that river than would permit a flow of 3500 second-feet past Sacramento (CCCWA 8, p. 50), while the operation of Kennett (Shasta) Dam, as proposed by the Board of Engineers for Rivers and Harbors some 15 years later, would provide a flow of 6000 cubic feet per second between Chico Landing and Sacramento (Staff 9, p. 519). The State Engineer in a report on the Feather River Project (May, 1951) stated that the operation of proposed Oroville Dam of the Feather River in conjunction with the Central Valley Project facilities would provide 5000 cubic feet per second at Knight's Landing for navigation.

After the decision in the Antioch case was announced, a group of 143 riparian owners brought suit against 443 named upstream users. This is known as the "Holland Land" case which was finally dismissed in 1943 by the plaintiffs. Its principal function was to keep the threat of litigation against upstream users until Shasta Reservoir was in operation. Until an adequate water supply was furnished the lands above Sacramento, there was always the possibility of their being enjoined by the water users below Sacramento. It was realized that "Adequate storage in the Sacramento River would terminate this legal action because the additional water supplies would solve the salinity problem in the delta" (CCCWA 21, Staff 9, p. 497).

During this period of threatened litigation, the State proceeded in an effort to solve the water problems of the entire State. One of the first plans was by means of a barrier across the Carquinez Straits below the confluence of the Sacramento and San Joaquin Rivers at River Mile 50. (USBR 9, pp. 47, 48, 1923). The planning of the State in 1927 began to concentrate on a large dam on the upper Sacramento River as the key to the solution of the water problems of the Delta and San Joaquin Valley. The importation of Trinity River water was also included (USBR 12, p.29, 1927). The "Coordinated Plan" of 1928 elaborated on the need for large upstream storage (DWR 2, pp. 13 & 14, 1928). In 1929, the possibilities of fitting the American River into the State's "Comprehensive Plan" were studied, as it is one of the

principal tributaries of the Sacramento River, joining it at Sacramento (CCCWA 2).

Bulletin No. 25 (1930) was the first outline of the State's plan for coordination of the State's plans. It was realized that if the intakes were at the lower end of the Delta, the water to be diverted would have passed the lands of owners of rights in the Sacramento River and its tributaries, thereby causing no legal difficulties from upstream users (USBR 14, pp. 36 & 37, 1930). The State also made extensive studies in the Sacramento and San Joaquin Valleys at this time (1931) which showed there was sufficient water to supply the needs of the Sacramento Valley and leave a surplus for the San Joaquin Valley. "The greatest water problem in the Sacramento River Basin at the present time is that of invasion of saline water into the delta region" (DWR 4, p. 52, 1931). It was also realized that the importation of Trinity River water would be needed in the future (DWR 4, p. 62, 1931).

While the studies leading to the coordinated plan of development for the State's Central Valley Project were being made, the problems of the Delta were also being considered in detail by the State. It was emphasized that the dam across the Carquinez Straits would bring unlimited quantities of fresh water to the manufacturing centers along the bay shore from Benecia and Port Costa on the west to the City of Antioch on the east (USBR 9, p. 157, 1923). In the meantime the Corps of Engineers, U. S. Army, was interested in the interference with navigation as the result of diversions

from the river for the growing of increasing acreages of rice and other crops in the Sacramento Valley. This posed the question as to whether navigation of the Sacramento River was of more importance than the increased planting of rice and other crops in the Sacramento Valley which had reduced the flow of that river to a minimum of 500 to 700 second feet at Sacramento when a flow between 3500 and 4500 second-feet at Sacramento was considered a reasonable requirement for navigation (Staff 9, p. 165, 1925).

During all of the plans and discussions relative to conserving the flood waters of the Sacramento River, "Salinity Control" was a prime objective. According to Bulletin 27, (1929) at page 221, "The point and degree of control of salinity by stream flow must be based primarily upon a consideration of the needs of the agricultural interest in the Delta and the industrial, municipal and agricultural interests in the upper bay region. It was assumed that water having a salinity of over 100 parts or more of chlorine per 100,000 parts of water would not be suitable for irrigation" (DWR 5, p. 221). After considerable discussion of industrial needs along Suisun Bay and the domestic needs of Antioch, it was concluded that a conduit from a point farther upstream was the answer to this problem (DWR 5, p. 224).

The problem of providing suitable water for agricultural uses throughout the Delta was then considered and a quantity of 3300 second-feet was adopted as the "recommended amount of net control flow to be provided as a minimum flow

in the combined river channels past Antioch into Suisun Bay. This would put the control point for a maximum degree of mean tidal cycle surface zone salinity of 100 parts of chlorine per 100,000 parts of water about 0.6 miles below Antioch" (DWR 5, p. 224, 1931).

"The maximum salinity during a tidal cycle occurs at the time of slack water following high high tide and the minimum at the time of slack water following low low tide. The salinity at any time during a tidal cycle is directly related to the height of the tide above lower low water, increasing in direct proportion to the height of the tide above its lower low stage" (CCCWA 14, p. 28, 1931).

Consideration must be given the two channels which carry water from the Sacramento River to the San Joaquin River above Antioch in solving the salinity invasion problem. "Georgiana Slough branches off from the main river on its left or easterly bank immediately downstream from Walnut Grove, or about 32 miles below Sacramento. This is the first branch channel which connects with the San Joaquin Delta. It joins the Mokelumne River about three miles upstream from the confluence of the Mokelumne and San Joaquin rivers. Three Mile Slough forms the second and farthest downstream connecting channel between the Sacramento and San Joaquin rivers. It leaves the left or easterly bank of the Sacramento River about three miles downstream from Rio Vista, or about 50 miles below Sacramento. It is located about ten miles above the confluence of the Sacramento and San Joaquin Rivers" (DWR 5, p. 109).

"The flow through Georgiana Slough is of particular importance, because this slough is the chief connecting channel through which the San Joaquin Delta obtains water from the Sacramento River. Based upon the 1929 measurements, with a flow in the Sacramento River past Sacramento of 3000 second-feet, about 1300 second-feet or  $43\frac{1}{2}$  per cent of the total flow is discharged through Georgiana Slough into San Joaquin Delta; with 5,000 second-feet, about 1800 second-feet or 36 per cent of the total flow; with 10,000 second-feet, about 2400 second-feet or 24 per cent; with 20,000 second-feet, about 3500 second-feet or  $17\frac{1}{2}$  per cent; with 40,000 second-feet, about 6000 second-feet or 15 per cent; and with 60,000 second-feet, about 9000 second-feet or 15 per cent.

"The flow through Three Mile Slough is a tidal flow, the magnitude of which depends upon the character of the tide" (DWR 5, p. 119). The flow at low stages of 2500 second-feet has varied from zero to almost 100 per cent, depending on the tidal phase.

It is interesting to note that the California-Hawaiian Sugar Refining Corporation had been obtaining, by barges, water having chlorides of not to exceed 50 ppm from the San Joaquin River at points ranging from near Collinsville to five miles above Antioch in the months of maximum salinity until 1918. In 1918, the Corporation went to the latitude of Stockton during the month of greatest salinity (September) for water having a chloride content of 140 ppm. During September, 1918, the total flow of the San Joaquin River and

tributaries was only 39,900 acre-feet. In 1919, the Corporation started to run its barges in the Sacramento River and during the month of maximum chlorides, August, the barges obtained water having 100 ppm from points between one and five miles above Rio Vista. After 1919, the Corporation ceased obtaining water from the rivers from about July 1 to about December 31 (DWR 5, Pl. IV opp. p. 48 & p. 428).

While the State was making its studies on the comprehensive State Water Plan, it announced in 1925 that the barrier at Carquinez Strait, although not a physical necessity at that time, would be an essential feature of the ultimate plan (CCCWA 5, p. 20, 1925). In 1929, the "Supplemental Report of the joint Committee of the Senate and Assembly dealing with the Water Problems of the State submitted to the Legislature of the State of California, April 9, 1929" stated that Kennett Dam should be constructed for the primary purpose of relieving the salinity problem in the Delta and furnishing water to the San Joaquin Valley (CCCWA 10A, p. 1). It was further stated that Kennett Reservoir would solve the salt water problem as far as Antioch, and make fresh water available for the industrial sites along Carquinez Strait by a conduit. It was also stated that these industries had "expressed a willingness to pay a reasonable price for water made available for their use" (Staff 9, p. 235).

It was announced in 1930 by "The California Joint Federal-State Water Resources Commission" that the building of Kennett Reservoir would make it possible at all times to

maintain a flow past Antioch and into Suisun Bay of not less than 3300 second-feet. "This flow will maintain fresh water to the lower end of the delta near Antioch, will substantially restore natural conditions in that area and will provide fresh water within reasonable distance and cost for the industries along Suisun Bay, which can easily be brought to these industries by a canal as a locally financed project" (CCCWA 11A, p. 1).

Under the State Water Plan (USBR 14, 1931), Kennett Reservoir would furnish salinity control by the release of fresh water to maintain a flow of not less than 3300 second-foot past Antioch. Studies and preliminary designs of a "Contra Costa County Conduit" were prepared with a capacity sufficient to supply the industries in the Antioch-Pittsburg area, together with the agricultural needs in the Antioch area, Clayton Valley, Ygnacio Valley and Walnut Creek. It was assumed by the State planners that the entire industrial and irrigation supply, as designed to be used, amounting to 43,500 acre-feet could be delivered at an annual cost of \$300,000 (Staff 9, pp. 270, 322, 323 & 324). There was no mention of payment for salinity control to benefit Delta irrigation.

A Federal contribution of \$7,000,000 toward the construction of Kennett Reservoir was recommended by the U. S. Board of Engineers for River and Harbors in 1933. It was estimated that the economic value of salinity control by means of a fresh water barrier of water released from Kennett was



\$355,000 per year. A "minimum flow of 3,300 second-feet past Antioch will provide suitable irrigation water for the Delta and enable industries and municipalities located on the lower river and south shore of Suisun Bay to secure fresh water by means of a diversion canal from some point in the delta" (CCCWA 19A, p. 1).

When considering the problem of salinity control, the role of Folsom Dam should not be overlooked. In the Bashore Report of 1933 (Mr. W. A. Bashore was later Commissioner of Reclamation) the following appears, "It has been claimed that in dry years the diversion and use upstream of the Sacramento and San Joaquin River waters allow salt water from the ocean to advance through tidal action into the bay and delta channels and to cause the commingled waters to be unfit for use for irrigation purposes.

"To compensate for San Joaquin waters thus utilized and prevented from reaching the San Joaquin Delta, it is planned to construct Folsom Reservoir on the American River with a total capacity of 355,000 acre-feet and an active capacity of 326,000 acre-feet, and to release the stored waters into the delta, largely during July, August, and September, to resist salinity advances" (Staff 9, pp. 528-529). The following paragraphs and tables, while out of order in some respects, are presented at this time to show how Folsom Reservoir has been operated.

The capacity was increased to 1,000,000 acre-feet by agreement between the Corps of Engineers, which was empowered

to build it, and the Bureau, which was empowered to operate it. Water has been released from Folsom in the summer months for the development of power and, because neither the Folsom North nor Folsom South Canal has been built, this water must reach the Delta until they are constructed. Table 4 (page 33) was prepared on a monthly basis as a companion for Table 3 (page 32). The increase in flow of the American River at Fair Oaks is due to this release, as shown by Table 4, Item 8.

Table 3 was prepared to show the relationship between the flow of the Sacramento River entering the Delta and the chlorides in ppm at Antioch. The years chosen were not years of heavy runoff such as occurred in 1952, 1956 and 1958. The year 1954 has been omitted for lack of space in the table. The month of August was used as it is usually the month in which the chlorides at Antioch are greatest since Shasta Dam was placed in operation in 1944. Table 3 shows the great variations in chlorides at Antioch regardless of the inflow to the Delta as exemplified by the flow of the Sacramento River at Sacramento.

Table 3 shows that the Bureau apparently can regulate the outflow from Shasta Reservoir to control the amount of chlorides at the intake of the Contra Costa Canal but, in doing so, the chlorides at Antioch have no conformity with the results at the canal. This nonconformity is probably due to the operation of the intake gates on the Delta Cross Channel being harmonized with pumping at the Contra Costa and Tracy pumping plants.

TABLE 3

FLOWS OF SACRAMENTO RIVER AT SACRAMENTO BELOW AMERICAN RIVER AND  
CHLORIDE IONS AT ANTIOCH AND CONTRA COSTA CANAL FOR AUGUST

Aug.	1949		1951		1953		1955		1957	
	Flow	Chloride ion	Flow	Chloride ion	Flow	Chloride ion	Flow	Chloride ion	Flow	Chloride ion
	cfs	ppm	cfs	ppm	cfs	ppm	cfs	ppm	cfs	ppm
1	6,640		9,860		8,450		9,390		9,560	
2	6,870	840	10,100	430	8,350	1,090	9,380	1,690	9,460	1,760
3	6,820		9,860		8,470	(45)	8,940	(62)	9,310	(66)
4	6,770		9,500		8,400		8,420		9,330	
5	7,060		9,610		8,500		8,550		9,570	
6	6,740	1,160	9,630	530	8,660	624	9,030	2,270	9,630	1,350
7	6,820		9,530		8,850	(48)	9,410	(84)	9,670	(68)
8	6,870		9,620		8,800		9,270		9,480	
9	7,030		9,590		8,920		9,680		9,430	
10	6,870	<u>1,920</u>	9,470	430	8,890	1,170	9,550	1,890	9,670	1,140
						(45)		(100)		(80)
11	6,920		9,640		8,670		9,200		9,890	
12	7,000		9,740		8,530		9,200		9,980	
13	6,980		9,890		8,590		9,230		10,000	
14	7,060	1,140	9,600	470	8,680	1,090	9,350	2,100	9,910	579
15	7,000		9,680		8,580	(44)	9,280	(109)	9,870	(84)
16	6,820		9,940		8,620		9,200		9,660	
17	7,000		9,940		8,550		9,180		9,840	
18	6,900	850	9,560	<u>270</u>	8,270	492	9,260	2,670	9,660	1,090
19	7,170		9,520		8,380	(54)	9,030	(120)	9,690	(88)
20	7,060		9,460		8,520		8,970		9,890	
21	7,030		9,190		8,600		8,860		9,770	
22	7,420	880	9,290	870	8,600	668	8,780	<u>3,320</u>	9,780	1,110
23	7,140		9,910		8,770	(50)	8,650	(146)	9,620	(88)
24	6,980		8,840		8,890		8,770		9,600	
25	7,030		8,940		9,080		8,650		9,790	
26	7,030	1,700	9,160	600	8,930	1,350	8,510	1,400	9,810	1,310
27	7,300		9,480		8,930	(44)	8,550	(160)	9,670	(86)
28	7,440		10,000		9,050		8,630		9,860	
29	7,440		9,940		9,120		8,830		10,000	
30	7,560	900	10,000	610	9,380	<u>1,440</u>	8,910	1,790	10,200	N.R.
						(42)		(155)		(90)
31	8,120		9,900		9,990		9,150		10,200	
Mean	7,061	1,174	9,590	614	8,745	991	9,025	2,141	9,735	1,042

NOTE: Flow data are from USGS Water Supply Papers (Staff 7).

Values of chloride ions not within parentheses are for Antioch and are from Water Supervision Reports (Staff 6 and 6A). The maximum chloride concentration for the year is underlined. Maximum chloride concentration at Antioch for 1957 equalled 1850 ppm on July 30. Values of chloride ions within parentheses are for the Contra Costa Canal and are from USBR 187A, 187C and 187E, for same day as those indicated for Antioch.

TABLE 4

DISPOSAL OF WATER OF SACRAMENTO VALLEY AND  
DELTA DURING AUGUST OF NON-FLOOD YEARS

Item (1)	: 1949	: 1951	: 1953	: 1954	: 1955	: 1957
1. Shasta storage, first of month	3,185	3,262	4,112	3,716	3,078	3,978
2. Shasta storage, end of month	2,816	2,766	3,732	3,294	2,670	3,669
3. Computed inflow to Shasta (2)	3,034	3,232	3,785	4,105	3,224	3,629
4. Outflow from Keswick (3)	9,018	11,349	9,975	11,062	9,922	8,660
5. Sacramento River at Keswick	9,212	11,560	9,973	11,380	10,110	8,848
6. Sacramento River near Red Bluff	9,054	11,510	10,450	11,480	10,150	8,878
7. Feather River near Oroville	1,944	1,944	2,744	2,730	1,829	1,973
8. American River at Fair Oaks	184	294	447	243	2,158	3,273
9. Sacramento River at Sacramento, inclusive of American River	7,061	9,590	8,743	9,236	9,025	9,735
10. Total Diversions, Keswick to Sacramento (4)	8,213	8,392	8,977	9,416	8,798	8,164
11. Total Inflow to Delta minus di- versions into Contra Costa and Delta-Mendota Canals (5)	7,806	9,384	7,286	7,139	6,083	7,205
12. Total diversions into Contra Costa and Delta-Mendota Canals (6)	62	1,206	2,506	2,944	3,098	3,172
13. Inflow to Delta from San Joaquin System (7)	807	1,000	1,049	815	156	642

NOTES: (1) Data from USGS Water Supply Papers (Staff 7) unless otherwise specified. Values for Items 1 and 2 are in thousands of acre-feet. Values for Items 3 through 13 are in cfs.

(2) USBR 262A.

(3) USBR 262B.

(4) USBR 100, Tables 88, 89, 90 and Staff 6A.

(5) USBR 155.

(6) USBR 162 plus 163.

(7) Computed by Item 11 plus Item 12 minus Item 9.

The values in Table 4 are mean daily flows in second feet for the month. This unit of measurement was used so that the figures could be compared with the testimony of various witnesses at former hearings. The inflow to Shasta Reservoir is the result of computations by the Bureau taking into account evaporation from the water surface and changes in storage. The outflow from Keswick Reservoir is measured by metering devices at the power house as reported by the Bureau. The measured flow at Keswick by the U. S. Geological Survey is the result of current meter measurements at the gaging station and related rating tables prepared therefrom.

The acre-foot equivalents to Table 4 have been prepared as Table 5 (page 35). These figures may be easier to understand in some instances. It should be noted that the diversions opposite Item 10 were the greatest of record in 1954, which was the first year under the trial distribution. The diversions above Sacramento include those from the Feather and Yuba Rivers.

During the hearing, when the discrepancy between the two figures for the same water at Keswick was called to the attention of the various parties, there was no one who could testify as to the reason. Table 4 shows these differences to amount to as much as 200 second feet with the flow measured by the USGS being the greater in most instances. In August 1958 this difference was 865 second feet or over 53,000 acre-feet. The USGS meters the flow of the Sacramento River at Red Bluff and other stations along the river in the same manner, and

TABLE 5

DISPOSAL OF WATER OF SACRAMENTO VALLEY AND  
DELTA DURING AUGUST OF NON-FLOOD YEARS  
(Thousands of acre-feet)

Item (1)	1949	1951	1953	1954	1955	1957
1. Shasta storage, first of month	3,185	3,262	4,112	3,716	3,078	3,978
2. Shasta storage, end of month	2,816	2,766	3,732	3,294	2,670	3,669
3. Computed inflow to Shasta (2)	187	199	233	252	198	223
4. Outflow from Keswick (3)	555	698	613	680	610	533
5. Sacramento River at Keswick	566	711	613	700	621	544
6. Sacramento River near Red Bluff	557	708	642	706	624	546
7. Feather River near Oroville	120	120	169	168	112	121
8. American River at Fair Oaks	11	18	28	15	133	201
9. Sacramento River at Sacramento, inclusive of American River	434	590	538	567	555	599
10. Total Diversions, Keswick to Sacramento (4)	505	516	552	579	541	502
11. Total inflow to Delta minus di- versions into Contra Costa and Delta-Mendota Canals (5)	480	577	448	439	374	443
12. Total diversions into Contra Costa and Delta-Mendota Canals (6)	4	74	154	181	191	195
13. Inflow to Delta from San Joaquin System (7)	50	61	64	50	10	39

NOTES: (1) Data from USGS Water Supply Papers (Staff 7) unless otherwise specified.

(2) USBR 262A.

(3) USBR 262B.

(4) USBR 100, Tables 88, 89, 90 and Staff 6A.

(5) USBR 155.

(6) USBR 162 plus 163.

(7) Computed by Item 11 plus Item 12 minus Item 9.

these results can be used for comparison purposes. The discrepancies become important when the natural flow of the Sacramento River is considered in the determination of available water if Shasta Reservoir had not been built. The importation of Trinity River water and its release into Keswick Reservoir will further complicate the determination of the natural flow of the Sacramento River at Shasta Reservoir. Continuing jurisdiction by the Board and a study program of evaporation losses from Shasta Reservoir and the proposed Whiskeytown Reservoir are necessary requirements in this regard, if the pre-Shasta rights of the water users are to be protected.

At a later time (1934), it was realized by the Corps of Army Engineers that the substitution of a fresh water barrier by releases from Shasta would make a great saving over what the United States would have spent on the barrier and locks to remedy the intrusion of salt water into the Delta. Based on this aspect of the case, as well as direct benefits to navigation and flood control on the Sacramento River, the Chief of Engineers found that "The Federal interest in the conservation of water by the construction of the Kennett (Shasta) Dam largely exceeds, in my opinion, that evaluated by the division engineer and the Board, since by remedying the intrusion of salt water into the Delta of the Sacramento and San Joaquin Rivers, it eliminates from consideration Federal participation in the construction and operation at great cost of locks and structures to prevent such intrusion, and assures

a free and open passage for the highly important navigation through the channels of the Delta. Based on this aspect of the case, as well as the direct benefits to navigation and flood control on the Sacramento River, I find that the general and Federal benefits from the construction of the Kennett Dam on the plans now proposed by the State warrant a special direct participation of the Federal Government of \$12,000,000 in the cost of this structure" (Staff 9, p. 549). It will be noted that salinity control is directly tied in with navigation in this instance. In 1935, one year later, the Department of Interior stated that control of salinity in the Delta of the two rivers near Sacramento is part of the agricultural maintenance phase of the project (Staff 9, pp. 566-567).

The River and Harbor Act (Reclamation Project Authorization), 1937, provided that the \$12,000,000 mentioned above should, "when appropriated, be available for expenditure in accordance with the said plans by the Secretary of the Interior instead of the Secretary of War: Provided, that the transfer of authority from the Secretary of War to the Secretary of the Interior shall not render the expenditure of this fund reimbursable under the reclamation law...." (Staff 9, p. 568). I fail to understand why this \$12,000,000 is not included in the \$18,083,000 allocation for navigation (Staff 9, p. 576).

The Contra Costa Canal was in operation after 1940 and we can assume that it was supplying water to the agricultural areas and municipal and industrial requirements on



the mainland at and below (west of) Antioch. This left the problem of salinity control to be solved for potential users of water on the mainland east of Antioch and by irrigators on the islands of the Delta and particularly at the lower end where the dredging of channels in 1917-20 had first upset the equilibrium between outflow and tidal inflow. It is significant that no mention of any conduit is made for either agriculture or industry on the mainland east of Antioch. I can only surmise that this was omitted on the assumption that salinity control (not to exceed 100 parts of chlorides per 100,000 parts of water at a point 0.6 mile west of Antioch) would be provided. Plate II of Bulletin 27 shows these upper bay lands, above Antioch, to be classed as industrial and agricultural uplands.

On September 1944, a committee of the Bureau of Reclamation set up a method of charging for alleged benefits to users of water in the Delta. Up to this time, probably in view of the damage done by the dredging and the inclusion of salinity control as a function of navigation, there had been no suggestion of a charge for salinity control.

There are many allusions in Bureau reports after Shasta Dam was built as to how the reimbursement cost, if any, for salinity control should be charged. Following are some examples:

In a letter by Secretary of Interior Krug, dated December 3, 1946, he said that "the Central Valley project has for its major purpose the transfer of Sacramento River water

southward to the San Joaquin Valley where it is needed for irrigation and municipal and industrial water supply. At the same time navigation, flood control and salinity repulsion benefits are accomplished as incidental parts of a well-rounded program of river regulation". He then allocated as non-reimbursable items - navigation at \$18,083,000 and flood control at \$31,444,000. He also made the direct tie between navigation and salinity control when he stated, "The Central Valley project has for its major purpose the transfer of Sacramento River southward to the San Joaquin Valley where it is needed for irrigation and municipal and industrial water supply. At the same time, navigation, flood control and salinity repulsion benefits are accomplished as incidental parts of a well-rounded program of river regulation." Later he stated, "The Central Valley project provides navigation benefits in the Sacramento River, flood control benefits in both the Sacramento and San Joaquin Valleys, and substantial salinity repulsion benefits in the Delta area" (Staff 9, pp. 575-576).

The Report on the Engineering Feasibility of the Central Valley Project, 1947, stated that the functions of salinity repulsion, fish protection and recreation are not specifically mentioned in the legislation but it was concluded that salinity repulsion may be classified as a supplemental irrigation function (Staff 9, p. 581).

Later, the Report states that the estimate of flow at Antioch in order to prevent salinity repulsion ranges from

3300 to 5000 cubic feet per second (Staff 9, p. 586). At still a later discussion in this same report: "it is to be noted that salinity control and fish protection described above in Paragraphs 13 (c) and 13 (f) receive no allocation as project functions because no provision in law exists whereby they could be declared non-reimbursable and means are not available to collect revenues for services in this category". Paragraph 13 (c) referred to above reads "(c) Salinity repulsion - The maintenance of a minimum flow of approximately 3,300 cubic feet per second at Antioch as proposed in operating schedules for Shasta (estimates range from 3,300 to 5,000 cubic feet per second, and no final figure is closely assured) is believed sufficient to prevent salinity intrusion in the Sacramento-San Joaquin delta, thereby preventing such extensive crop damage as has been common in the recent past while at the same time permitting more beneficial use of lands in the affected area". Paragraph 13 (f) refers to recreation and fish protection (Staff 9, p. 586).

It is difficult to reconcile the statement that "no provision in law exists whereby they could be declared non-reimbursable" quoted in the preceding paragraph with statements in the decision of the United States Supreme Court in the so-called Ivanhoe Case (357 US 275, 78 Supreme Court Reporter 1174). This case was decided on June 23, 1958. The following quotations are from that decision with pages as used in the Supreme Court Reporter.

When commenting on the water supply available to the Central Valley Project, the Supreme Court said at pages 1179 and 1180:

"Nature has not regulated the timing of the runoff water, however, and it is estimated that half of the Sierra runoff occurs during the three months of April, May and June. Resulting floods cause great damage, and waste this phenomenal accumulation of water so vital to the valley's rich alluvial soil. The object of the Plan (CVP) is to arrest this flow and regulate its seasonal and year-to-year variations, thereby creating salinity control to avoid the gradual encroachment of ocean water, providing an adequate supply of water for municipal and irrigation purposes, facilitating navigation, and generating power....

"The water supply facilities along the Sacramento River will regulate its flow, store surplus winter runoff for use in the Sacramento Valley, maintain navigation in the channel, protect the Sacramento-San Joaquin Delta from salt intrusion from the Pacific, provide a water supply for the Contra Costa and Delta-Mendota Canals, and generate a great deal of hydroelectric power....

"The power facilities of the project will, when finally completed, have a capacity of near a million kilowatts. Transmission lines, steam plants, and other essential facilities will be constructed so as to obtain the maximum utilization. It is estimated that through the sale of this power the United States will receive reimbursement for over half of its total reimbursable expenditures....

"The over-all allocation of these enormous costs has not been definitely determined. That portion of the costs ultimately allocated to power facilities will be reimbursed at 4% interest but that allocated to irrigation facilities will be reimbursed at no interest. Moreover, the Federal Government will receive no reimbursement for that portion of the cost allocated to numerous aspects of the project, such as navigation, flood control, salinity prevention, fish and wildlife preservation and recreation. The irrigators will, therefore, be chargeable with but a small fraction of the total cost of the project."

At page 1186 the Court made further comment:

"In considering appellee's specific constitutional contentions, it is well to recapitulate. The Central Valley Project is multi-purpose in nature. That portion of the project expense attributable to navigation, flood control, salinity prevention, recreation and fish and wildlife preservation is nonreimbursable. The remainder of the total expense, and the only part that is reimbursable, is divided between two main sources. The first is hydroelectric power which estimates indicate will be chargeable with over 50 percent of the reimbursable expense, plus interest on the part representing electric plants in service. The other is irrigation, which pays the rest without interest charge. In short, the project is a subsidy, the cost of which will never be recovered in full."

Contra Costa County Water Authority Exhibit 30A contains several mentions of a sum amounting to \$5,630,000 for salinity control. The first mention is in response to Question 9 as posed to a committee formed in 1943. This committee was composed of individuals and representatives from Federal and State agencies (Staff 9, p. 593). This question (9) was, "What allocations of costs should be made respectively to navigation, flood control, salinity control and national security?" The answer is quoted in part in CCCWA 30, page 2, that out of an estimated total cost of the project at \$364,511,000 on June 15, 1945, \$5,630,000 was allocated to navigation "for elimination of salt water barrier". Later, "The operation of Shasta Reservoir eliminates the necessity of constructing a barrier to prevent salt water intrusion. Such a barrier would seriously interfere with lower river navigation." This is the same feature for which the Chief of Engineers, War Department, advocated an allotment of \$12,000,000 (Staff 9, p. 545). Mention is then made on page 3 of CCCWA 30A that a "subcommittee report directed attention to the fact that Congress has authorized \$5,630,000 as a Federal contribution to the project because Shasta Reservoir eliminates from consideration the salt water barrier which has been proposed as an alternative salinity repulsion measure". With so many references to navigation coupled with salinity control, it is probable that any allotment for salinity control is lost in the navigation allotment of \$18,083,000 approved and adopted by Secretary of Interior Krug by letter to President Truman, dated December 3, 1946 (Staff 9, p. 576).

The Bureau's asserted justification for a claim of annual benefits amounting to \$1,600,000 for salinity control is contained in Senate Document 113, 1949, 81st Congress (the so-called Blue Book). It is claimed that an annual outflow of 3300 second-feet, equivalent to 2,400,000 acre-feet, must pass Antioch to protect the Sacramento-San Joaquin Delta from salinity intrusion of ocean water. It then states, "Controlled releases of water to the Sacramento-San Joaquin Delta for salinity repulsion will result in increased crop production, make possible a wider choice of crops to be grown, permit double-cropping and benefits now served from delta channels" (USBR 176, p. 78). If these benefits are to result, the quality of water will have to be on a parity with that guaranteed to the Contra Costa Canal and the Delta-Mendota Canal. The report continues with the statement that "the large future diversions which will be required for Central Valley lands could not equitably be made without maintaining salinity control for delta lands." The estimate of an annual benefit of \$1,600,000 for repulsion of salinity is then presented (USBR 176, pp. 61, 78).

The President's Water Resources Policy Commission in 1950 declared that the Delta-Cross Channel furnishes water for irrigation and salinity control (CCCWA 37A, p. 1). In view of the record of water quality in the western portion of the Delta, the users of this water have received no benefits.

Maximum salinity of tidal flows at Antioch for the pre-Shasta period, 1925 through 1943, occurred on September 5

as an average. For the post-Shasta period, 1944 through 1954, the maximum was reached on August 18 as an average. These data would indicate that the growing season on the western portion of the Delta has been shortened by 18 days through the operation of Shasta Dam and the Delta Cross Channel. The same 18 day shortening applies to the dates of maximum salinity in the Delta above Antioch and, probably by coincidence, the dates are identical (Sacramento-San Joaquin Water Supervision Reports). Bureau Exhibit 157 is intended to show the decrease in chloride content of the flow at Antioch during the critical 77-day period June 16 to September 1, after Shasta Reservoir was put in operation in 1944. A study of the basic data will reveal that this so-called improvement is due to releases from Shasta Dam storage in excess of inflow to the reservoir during June. If the total inflow to the Delta during July and August is used for comparison purposes for both pre-Shasta and post-Shasta periods, this so-called improvement will disappear.

Testimony was given at a hearing before a Special Subcommittee on Irrigation and Reclamation on October 29-31, 1951, by witnesses for both the State and the Bureau. A witness for the Bureau testified that "in order to deliver 610 cubic feet per second at the pumps (July 1951), it required 8,000 second-feet of water." He continued, "Now the quantity of water required for salinity repulsion has been estimated both by the United States Bureau of Reclamation and the State at about 4,500 cubic feet per second. The Bureau



has estimated that the Delta consumptive use is also in the neighborhood of about 4,500 second-feet of water" (CCCWA 36A, p. 2). A flow of 4500 second-feet is about 276,750 acre-feet per month. This is the same amount (4500 cfs) as the State Engineer would have passed through the Delta under his proposed Feather River Project as set forth in his May 1951 report.

The Bureau furnished additional data in support of this testimony. The Superintendent of Central Valley Project Operations gave, as his opinion, that "under the conditions prevailing during July 1951 about 610 cubic feet per second were all that could be diverted without increasing the releases from Shasta Reservoir in order to maintain a suitable quality at the points of diversions." He furnished a table which showed that in July 1951, 11,580 cubic feet per second were released at Keswick Dam; 9,270 cubic feet per second were passing Sacramento below the confluence of the American River; and 10,240 cubic feet per second were entering the Delta (Staff 9, p. 741).

The Department of Finance filed Application 5626 on July 30, 1927. Saline control was listed as one of the purposes. Application 9364 was filed by the same Department on August 2, 1938 and included saline control among its purposes. On September 3, 1938, these applications were assigned to the Bureau with certain reservations to protect lands within the watershed of the Sacramento River above Kennett dam site (Staff 2 & USBR 86). The inclusion of

"saline control" as one of the purposes was omitted when the assignment was made (USBR 87). However, Bureau's Exhibit 87A shows these applications were amended in 1951 and among the uses are "To provide irrigation water of suitable quality for the Delta-Mendota and Contra Costa Canals, it is believed that up to 6,000 cfs of direct diversion and/or storage releases may be required to flow into Suisun Bay in order to dispose of the chemical elements that would otherwise accumulate in the irrigation waters flowing in the delta channels of the Sacramento and San Joaquin Rivers." It will be noted that all channels of the Delta are included, and not those which lead only to the Contra Costa and Tracy pumping plants.

A witness for the Bureau testified before the Assembly Interim Committee on Conservation, Planning and Public Works, in March 1952. His testimony was to the effect that the Bureau was able to store for later release from Shasta Reservoir water that formerly ran down the river uncontrolled into the ocean. He pointed out the locations of the lines representing isochlors of 100 parts per 100,000 on a map. These data covered the period 1943 through 1951. This same information appears on USBR Exhibit 154, together with other data. He testified that the same isochlor for the year 1947 reached a little further upstream than the Bureau intended and that "Salinity control, I think I am sure, will be effectuated from here on out to the degree that it has been exercised from 1943 to 1951", as shown on the map. He testified further that the Bureau's releases (from Shasta) will be about 12,000

second-feet to take care of the multiple uses of the project (CCCWA 37A, p. 4 & Table 4, line 4).

A witness for the State at this March 1952 hearing testified, "I think to answer that we first should define what we mean by salinity control. It is generally accepted that the water is satisfactory for irrigation use if its chlorine content does not go over 100 parts per 100,000 which would be 1000 parts per million. And that has been the criteria which we have used as indicating satisfactory salinity control during the past summer (1951). The final figures have not, as yet, been worked out but the line of salinity invasion - maximum line - lay approximately between Collinsville and Antioch, which has been approximately the point we consider satisfactory for salinity control in the Delta." When asked, "That is the point at which the project is planned to control salinity?", he replied, "Yes" (CCCWA 37 A, p. 3).

The Trial Distribution Report for 1954, dated April 1955, contains a "Memorandum of Understanding Relating to a General Approach to Negotiations for Settlement of Water Diversions from the Sacramento River and Sacramento-San Joaquin Delta with the Objective of Avoiding Litigation." After reciting the purpose of the "Understanding", namely, that the "water users and the Federal Government are accordingly attempting to negotiate an adjustment of the various matters" without litigation "so that the Central Valley Project can function in the manner intended without injury to the water users" with the State of California participating in these

negotiations through its State Engineer and its Attorney General, an "Outline of Approach" was adopted by representatives of the Bureau; Attorney General, State of California; State Engineer; and Sacramento Valley Water Users Committee (DWR 19, pp. 44-50).

It was understood by all parties "This general approach shall not in any way prejudice any water rights claimed by any of the parties, nor shall anything contained in this memorandum in any manner affect the powers, duties and responsibilities of the parties hereto as prescribed by law" (DWR 19, p. 47).

For the purposes of the approach to settlement "The Federal Government may store and divert water available not in conflict with the rights of water users to the extent of reasonable requirements for the following purposes: (a) Navigation, (b) Salinity Control, (c) Delta Mendota Canal, (d) Contra Costa Canal and (e) Power" (DWR 19, pp. 47 & 48).

It was agreed that "The legislative formation of a district comprising the area above Sacramento will be sought." It was also agreed that "The riparian owners and appropriators below Sacramento are entitled to the natural flow of the Sacramento River, including accretions thereto to the extent of their present and potential beneficial use, which is the full consumptive use of water required for the irrigable area" (DWR 19, p. 49). "Salinity control in the Delta to the extent to be determined is an obligation of the Federal Government" (DWR 19, pp. 48-49). When the Cooperative Study

Program was undertaken in 1956, "The assumption was made that all of the Delta lowlands, shown on Plate 3 of Volume 1 'Report on 1956 Cooperative Study Program' are riparian to channels of the Delta."

Needless to say, no agreement was reached. While we realize that as a general rule any matters discussed in an attempt by the parties to reach an agreement or compromise are not admissible as evidence, nevertheless, this memorandum is in evidence. The memorandum does have a bearing on the hearing in that it shows the atmosphere that prevailed at the time it was executed. It is also in line with the decision of the United States Supreme Court in the Ivanhoe Case previously cited.

The Regional Director for the Bureau, Mr. C. H. Spencer (Sacramento), addressed a letter, dated July 10, 1957, to the Director of the Department of Water Resources, in which he outlined the procedure of the Bureau for the future. He claimed the Bureau was not obligated legally to control salinity to a certain standard at a point near Antioch. He considered that "the obligations of the Central Valley Project are satisfied when a satisfactory quality of water is provided at the intakes to the Contra Costa and Tracy pumping plants" (USBR 154, p. 3).

Mr. Spencer stated that under his conception of the Bureau's obligation as regards salinity control, its past operation under this precept has protected 95% of the Delta against incursions of highly saline water. He attached a

diagram to his letter which he claimed would demonstrate 3,000,000 acre-feet of fresh water during a critical 77-day period would have to flow into Suisun Bay if the last 20,000 acres are to receive water. Mr. Spencer then made the realistic suggestion that "if it is considered desirable to provide this 20,000 acre area with fresh water--or to furnish municipal and industrial water of good quality to nearby areas, I am confident it can be done at far less cost in precious water supplies" (USBR 154, p. 4).

I can assume Mr. Spencer means fresh water to be that of the maximum chlorinity which is used in the Contra Costa Canal contract (250 ppm of chlorides), or to be that which will not exceed an annual average of 450 parts per million of total dissolved solids as provided by Item (d) of the Amended Exchange Contract for the Delta-Mendota Canal (USBR 82).

A map which is also attached to his letter shows that water having maximum annual chlorides of 100 parts per 100,000 remained below the irrigated portion of Sherman Island during 1945, 1946, 1948, 1951, 1952 and 1958 in the regular operation of the project for the 14-year period 1944 through 1957. His letter, however, opens the way for agreement on a method by which water of acceptable quality can be furnished the 20,000 acres at far less cost than in precious water supplies (USBR 194).

Mr. Gerald H. Jones testified to the cost of carrying out an alternative for Sherman Island along the lines

suggested in the letter introduced as USBR Exhibit 154. Mr. Jones made a study of the irrigation and drainage needs of the portion of Sherman Island that is being irrigated (upstream from Mayberry Slough). He made an estimate of the cost of syphon diversions at Emmaton and opposite Jersey Point and the canals leading from the diversion points to serve the needs of the irrigators who at present are being served through their individual pump facilities along both the Sacramento and San Joaquin River sides of the island. He estimated that the delivery of water having a chlorinity of not to exceed 100 parts per 100,000 at high tide at these diversion points would require only 1800 cfs of outflow from the Delta.

Mr. Jones pointed out that amounts of diversions by syphons would be greatest at high tides. In his Exhibit SRDWA 86, he presents a tabulation showing the various outflows from the Delta that would be required to provide a certain salinity at Three Mile Slough, Emmaton, Mayberry Slough and at a point 0.6 mile west of Antioch for both high tide and the mean tidal cycle surface zone. An outflow of 4500 cfs for salinity control, as used by both the State Engineer and a Bureau witness in 1951 (CCCWA 36A, p. 2), would provide a mean tidal cycle surface zone salinity of 560 parts of chloride per million parts of water at Antioch, according to his tabulation. If a high tide salinity of 1000 parts of chloride per million is to be provided; 5200 cfs will be required at Antioch, 2750 cfs at Mayberry Slough and 1800 cfs at Emmaton.

The estimated capital cost of the required pumping facilities and canals was \$150,000. Additional costs, such as power costs for pumping and drainage, were estimated at \$15,000 per year. The saving in outflow by making diversions at Emmaton and opposite Jersey Point would be 2700 cfs over the amount used by the State Engineer and a Bureau witness in 1951; that is, 4500 cfs.

Following are my suggestions for terms and conditions to solve the salinity control problem on the Delta. The State is included in this discussion because I believe it eventually will have to bear part of any burden imposed on water released from storage.

1. If the users of water in the Delta are to be required to pay the Bureau for firming-up of irrigation water, the quality of this water should be equivalent to that furnished other contracting parties. A chlorinity of 250 parts per million (ppm) is guaranteed at the Contra Costa Canal and an annual average of not to exceed 450 ppm of total dissolved solids is the quality guaranteed for the Delta-Mendota Canal by the Amended Exchange Agreement.

A provision that the contracting parties would not have to pay if the water exceeded a chlorinity of 250 ppm would be meaningless as it would leave the Delta interests at the mercy of the Bureau and the State. I believe that water with a chlorinity of not to exceed 250 ppm could be called "fresh water" for the purposes of this discussion although water with such chlorinity would be considered only "fair"



in the Government's own classification of irrigation water.

If water were to be used for double-cropping in the Delta, as suggested in Blue Book, page 78, its quality should not exceed 250 parts of chlorides per 1,000,000 of water river-side (9e Contracts) at the point of diversion. Mr. C. H. Spencer, Regional Director, Region 2, Sacramento, stated in writing (USBR 154) that in order to furnish fresh water to the entire Delta, a release of 3,000,000 acre-feet from Shasta or Folsom during the critical 77-day period from June 16 to September 1 would be required. I believe that such a release for the limited area to be served would not be in the public interest if an alternative plan can be worked out.

2. It is my opinion that the requirement for a chlorinity of not to exceed 100 parts per 100,000 (1000 ppm) at a point 0.6 mile west of Antioch has been the objective of the Bureau and the State since Bulletin 27 was published in 1931 and continued up to the time of Mr. Spencer's letter of July 10, 1957 (USBR 154). Water of this quality 0.6 mile below Antioch would furnish water fit for domestic purposes to Delta lands at a point near Emmaton and Jersey Island and would require an outflow of from 3300 cfs to 5000 cfs (DWR 5, p. 237).

Bureau's Exhibit 154 (Mr. Spencer's letter - 1957) opens the door for negotiations among the Bureau, State and affected parties for a substitute plan which will eliminate such costly flows to the Delta as 3,000,000 acre-feet in the period June 16 to September 1. If the parties can agree on

the maintenance of a flow of water having a quality not exceeding 1000 ppm of chlorides at a north and south line passing through Emmaton, testimony shows that the expenditure of \$150,000 in revamping the water facilities on Sherman Island and an annual operating cost of \$15,000 would satisfy those users. No testimony was offered on the cost of similar facilities on Jersey Island and the mainland of Contra Costa County. Such an agreement would require from 1400 cfs to 1800 cfs (depending on the tidal phase) for salinity control, and result in a saving of from 1900 cfs to 3400 cfs of valuable water. The value to the Bureau and State in furtherance of their plans of the water thus conserved should more than offset any expenditures required to perfect such conservation.

The retention of jurisdiction in this feature will enable the Board to impose terms and conditions on the State for reimbursement to the Bureau at a ratio agreeable to both parties or at a ratio that the Board believes just for any money the Bureau expends in conserving water as suggested above, if and when the State seeks to divert water from any reservoir in the watershed of the Sacramento River or from the Delta when the natural inflow is not sufficient to maintain the desired salinity control.

The Bureau should maintain a quality of water at a point 0.6 mile below Antioch of not to exceed 1000 ppm of chlorides until some agreement, acceptable to the State and local interests, can be negotiated for any conservation plan requiring less water. The Board should maintain jurisdiction in this matter until such an agreement is reached.

## Coordination of Federal - State Projects

The following data are presented to illustrate how the plans of the Bureau and the State have expanded since 1951. They also show there is a duplication of areas to be served. The solution of the problem presented by these conflicts lies largely in continuing jurisdiction by the Board.

The "Report on Feasibility of Feather River Project", May, 1951 (CCCWA 38) shows that with the construction of a dam providing 3,500,000 acre-feet of storage on the Feather River at Oroville, water to serve the needs of the Santa Clara Valley, the Upper San Joaquin Valley and Southern California would be supplied. When operated in conjunction with the Shasta and Folsom Dams of the Bureau, it would also serve the Bureau's Central Valley Project to the following extent:

"1. Riparian and appropriative rights along the Sacramento River from Shasta Reservoir to Sacramento.

"2. Maintenance of flow of 5,000 second feet at Knights Landing for navigation.

"3. Consumptive uses and evaporation in the Sacramento-San Joaquin Delta.

"4. A supply to the Contra Costa Canal of 55,000 acre-feet per year.

"5. A supply to the Delta Uplands of 80,000 acre-feet per year.

"6. Requirements under the Exchange Agreement.

"7. Salinity control of Antioch (4,500 second feet into Suisun Bay).

"Use was made of estimated return flows for meeting requirements downstream from Knights Landing.

"After meeting all of the foregoing requirements, the study showed that there would have been an additional firm yield from Shasta Reservoir under an irrigation schedule of 550,000 acre-feet per year and a firm irrigation yield from Folsom of 975,000 acre-feet per year" (CCCWA 38, p. 18).

The Feather River Service Area comprising 322,200 acres (gross) would be served with Feather River water, with return flows contributing to the Delta (CCCWA 38, pp. 22 & 23). "The study shows that with the available excess water in the Delta, supplemented by releases from Oroville Reservoir, it was possible to obtain a continuous flow for diversion of 3,930 cubic feet without deficiency, or about 2,845,000 acre-feet annually over the 27-year period of operation" (CCCWA 38, p. 22). This is the water that would be available for use in the Upper San Joaquin Valley and exportation to the Santa Clara Valley and Southern California. When Bureau witnesses were questioned by a Board member whether the items numbered 1 through 7 (CCCWA 38, p. 18) did not represent the aims of the Bureau at that time (1951) there was no negative response.

The Bureau presented its most recent plans for the Central Valley by Exhibit USBR 164. The water supply used in making this study consisted of the Trinity River importations,

Sacramento River, Shasta Reservoir unit and the American River unit of the Central Valley Project. The Board had granted permits to the United States previous to this hearing on the Trinity, American and San Joaquin Rivers. The entire flow of the Feather River was included as a tributary of the Sacramento River. When the attorney for the Bureau was asked if this plan as proposed would interfere with the State's Feather River Project of the State Water Plan, he stated that it would. The State's attorney then suggested that the hearing might be recessed while the State and Bureau attempted to work out a solution of this problem. The Bureau's attorney agreed to the suggestion and a recess was taken on November 4, 1959. The Bureau and Protestants were asked by the Board at that time to attempt to reach a solution of their differences.

When the Board reconvened the hearing on April 19, 1960, the representatives of the State and Bureau stated they had arrived at an agreement, as to how the unappropriated water reaching the Delta would be divided between the Bureau and State which was finalized on May 16, 1960 (DWR 77).

The agreement between the State and the United States provides for a division of the water on the basis of the water yield to the United States pursuant to its applications on the Trinity, American and Sacramento-San Joaquin Delta under applications and permits, being 8,300,000 acre-feet per year, and those of the State on its Feather River and Delta Diversion projects as outlined in applications, being 5,260,000 acre-feet per year. The agreement states that in

event of a shortage the available water shall be divided between the two parties on the ratio of 8,300,000 to 5,260,000 (DWR 77, p. 6).

The annual diversion requirements of the United States are set forth in the Agreement (DWR 77) on page 7 as follows:

1. Sacramento River and bypass rivers 3,000,000 acre-feet
2. Delta Uplands 400,000 acre-feet
3. Sacramento Canals, Cow Creek and Yolo-Zamora Units 740,000 acre-feet
4. Folsom Service Area 910,000 acre-feet
5. Amended Exchange Contract 11r-11144, Delta-Mendota Canal losses and service along Fresno Slough 1,070,000 acre-feet
6. Delta-Mendota Canal 645,000 acre-feet
7. Contra Costa Canal 195,000 acre-feet
8. Shasta County 65,000 acre-feet
9. Additional irrigation from Delta 735,000 acre-feet
10. Additional municipal and industrial from Delta 540,000 acre-feet

Testimony was presented that the proposed East Side Canal would receive its water supply from one or more of the above items.

The State (Department) claims an annual diversion requirement of 5,260,000 acre-feet which includes 1,250,000 acre-feet allocated to the proposed Federal San Luis ~~service~~ area. This 1,250,000 acre-feet shall be transferred to the Federal Central Valley Project if the United States constructs and operates works to deliver water to the proposed Federal

San Luis service area. Congress approved the San Luis Project on June 3, 1960, and the people of the State of California approved the bond issue for the State Water Plan on November 8, 1960, while the hearing was in progress.

The agreement also states "In addition to the annual diversion requirements described above, the State and Federal projects will meet certain requirements for navigation, fish conservation, outflow from the Delta and water service through direct diversion from the Feather River, in the Upper Feather River Basin and to the Delta Lowlands." It will be noted that there is no direct reference to salinity control unless it is included in the "outflows from the Delta". It will also be noted that the uses set forth in the above quotation are included in vested rights under the County of Origin Law, rights under the Watershed Protection Law, or are nonreimbursible items under Federal Reclamation Law. In the absence of particular reference to liability for salinity control, the Board can only conclude that it is included as above quoted.

At the time the Director of the Department of Water Resources of the State testified at the hearing he was asked if any agreement had been reached with the United States as to how any allocation of water for salinity control would be allocated. He stated that this phase of the problem would have to be worked out when the operational agreement between the United States and the State was negotiated.

Section 12934 of the Water Code gives a description of the State Water Facilities to be financed through sale of State Water Resources Development Bonds. The amount to be diverted beyond the Tehachapi Mountains will be conveyed by an aqueduct having a capacity of 2,500 cubic feet per second. If the aqueduct were operated to capacity for one year it would deliver 1,810,000 acre-feet. According to the Agreement of May 16, 1960, the Department's annual diversion requirements is 5,260,000 acre-feet. The facilities outlined under Section 12934 of the Water Code, in addition to the San Joaquin-Southern California Aqueduct, include the North Bay Aqueduct, South Bay Aqueduct and the Pacheco Tunnel-Santa Clara Valley Aqueduct. The last three units overlap the Federal Central Valley Project service area. The amount allocated to the San Joaquin Valley, Southern California and the Santa Clara Valley under the Feather River Project Report was only 2,845,000 acre-feet per year.

During the course of the hearing, the Bureau presented an exhibit which showed the ultimate results it would accomplish by means of its Trinity, Shasta and American River facilities. The Board has permitted the Bureau to extend the service area of the Trinity River diversion facilities to include all the service areas of the original Trinity, Shasta, Folsom and Friant Dam facilities and additional areas around Merced, Westland I. D., Friant-Kern Canal and other small areas that had been omitted when the maps accompanying the original



applications for the four facilities mentioned above were prepared. Under this decision, Trinity River water may be used to firm up the supplies of the Sacramento River (Shasta Dam), American River (Folsom Dam) and the San Joaquin River (Friant Dam).

The variances between the Bureau's Central Valley Project and the Department's Feather River Project of 1951 and the plans as presented at the hearing, involving no more water than was available in 1951 (except for the Trinity River diversion), poses a problem that cannot be solved by the Board. All it can do is maintain continuing jurisdiction until the Department receives its permits for the State Water Plan and has arrived at an operational agreement with the Bureau as proposed in the testimony of the Director of the Department.

## WATERSHED PROTECTION

What is presented under this heading is submitted to show that the Watershed Protection Law is not nearly as burdensome to the Bureau as its counsel contended during the hearing. The year 1943 was one of median runoff for the period 1921-1954, inclusive. It was also the last year of natural conditions on the Sacramento River prior to the commencement of storage behind Shasta Dam although 5,000 acre-feet were stored in July and released later in the season. The addition of 5,000 acre-feet to the discharges at downstream gaging points during July would permit their use with reasonable accuracy in a hydrological study under natural conditions along the Sacramento River and into the Delta.

A study of the hydrological data before Shasta Dam began to store water shows that the months of July and August were the months of minimum runoff from the mountains and the months of maximum diversion of water when it was available. Such a study also shows that the reach of the Sacramento River from Red Bluff to the entrance of Colusa Drain above Knights Landing was the critical one. The largest diversions occur in this reach. The return flows from applied irrigation; runoff from mountain and foothill streams; rainfall going into ground water storage; and local bank storage (water that percolates from the river at high stages) and its later return to the river or drains, are all contributing factors to the water supply for this reach.

Diversion from the Sacramento River between Red Bluff and the entrance of Colusa Drain during July and August 1943 was the greatest in history up to that year, except for minor differences of less than 3,000 acre-feet for the various sections of the reach. Such exceptions were two in number when the maximum diversions were in July 1942.

Table 6 (page 65) illustrates the disposition of water in July and August of 1943 for the reach between Red Bluff and the Colusa Drain entry. Table 7 (page 66) indicates the acreage irrigated between Red Bluff and Knights Landing, during 1943 and 1954.

The return flow from the Glenn-Colusa Irrigation District reaches Colusa Drain and is rediverted for further use on lands distant from the Sacramento River, which in turn provides return flow. The balance of the water from Colusa Drain is either turned down the Yolo By-Pass for users with rights on that channel or is returned to the river at Knights Landing and is not available for use in the reach under discussion.

It will be noted that claimed rights to divert water from the river exceed the actual diversions in these two months. A further study also shows the increased diversions from this reach of the river from 1944-1954, inclusive, were possible only because of releases of stored water from Shasta Reservoir during every August and in 6 years during July.

Diversions during July and August of 1954 for the reach of the Sacramento River between Red Bluff and entry of

TABLE 6

FLOWS, DIVERSIONS, AND CLAIMED RIGHTS  
FROM SACRAMENTO RIVER  
JULY AND AUGUST, 1943  
(Thousands of acre-feet)

Station	July			August		
	Flow (1)	Diverted (2)	Claimed Rights (3)	Flow (1)	Diverted (2)	Claimed Rights (3)
Shasta Dam	270			234		
Red Bluff	288(4)			244		
Butte City	217(4)	119	241	156	119	219
Colusa	208(4)	11	37	149	12	33
Wilkins Slough (5)	160(4)	68	112	103	69	102
Colusa Drain	148(4)	30	46	94	29	42
Knights Landing	161(4)			116		
Verona	259(4)			175		
Sacramento(6)	304(4)			175		

- NOTES: (1) USBR 100, Tables 3 through 10  
(2) USBR 100, Tables 83 through 86 and Staff 6  
(3) USBR 108  
(4) 5000 acre-feet added for storage in Shasta Reservoir, USBR 100, Table 40  
(5) Staff 6  
(6) Below mouth of American River

TABLE 7

AREA IRRIGATED BETWEEN  
RED BLUFF AND KNIGHTS LANDING  
(Acres)

Reach	1943			1954		
	Rice	Other	Total	Rice	Other	Total
Knights Landing to Wilkins Slough	9,299	4,594	13,893	14,631	14,449	29,080
Wilkins Slough to Colusa	35,777	29,580	65,357	40,093	34,667	74,760
Colusa to Butte City	4,275	4,765	9,040	19,644	10,712	30,356
Butte City to Red Bluff	55,316	62,663	117,979	84,198	38,114	122,312
TOTAL	104,667	101,602	206,269	158,566	97,942	256,508

NOTE: All acreages were taken from Water Supervision Reports (Staff 6).

Colusa Drain were the greatest of record to that year. These increased diversions were possible only because of releases of stored water from Shasta Reservoir. Table 8 (page 68 ) illustrates the disposal of water during these months has been prepared similar to that for 1943.

The diversions shown in Table 8 for July and August 1954, were only possible in the amounts shown because of releases from storage at Shasta Dam. The tabulation shows that the claimed pre-1954 rights exceeded the actual diversions even in this year. If the diverters between Red Bluff and Knights Landing had to rely on the flow of the Sacramento River (if Shasta Dam had not been built), their diversions would have been a great deal less in July and August.

The year 1941, during which the discharge of the Sacramento River (July plus August) was the greatest of record for the period 1922 through 1954, was also the only year which would have permitted diversions in the full amount of the claimed pre-1954 rights between Red Bluff and Knights Landing. The problem would then become one of available land on which to use the water. The Report of Analysis on "Trial Water Distribution 1954" (DWR 19) contains a map of 8 sheets showing the land irrigated in the Sacramento Valley for the year 1954. An examination of this map shows that there are large acreages which are not irrigated with water either diverted from the Sacramento River or return flows. These acreages could be irrigated only from wells or other tributary streams.

TABLE 8

FLOWS, DIVERSIONS, AND CLAIMED RIGHTS  
FROM SACRAMENTO RIVER  
JULY AND AUGUST, 1954  
(Thousands of acre-feet)

Station	July			August,		
	Flow (1)	Diverted (2)	Claimed Rights (3)	Flow (1)	Diverted (2)	Claimed Rights (3)
Inflow, Shasta Reservoir	207			199		
Release, Shasta Reservoir	503			499		
Red Bluff	706			706		
Butte City	539	178	241	539	163	219
Colusa	522	32	37	535	29	33
Wilkins Slough (4)	424	102	112	457	95	102
Colusa Drain	431	44	46	479	39	42
Knights Landing	438			523		
Verona	493			593		
Sacramento (5)	498			568		

NOTES: (1) USBR 100, Tables 3 through 10

(2) USBR 100, Tables 83 through 86 and Staff 6

(3) USBR 108

(4) Staff 6

(5) Below mouth of American River

There are frequent references to the underground water in the Sacramento Valley. Bulletin No. 21 (1929) at page 76 describes the El Camino Irrigation District, which was supplied entirely with water pumped from the underground supply. Bulletin No. 26 (1931) at page 81 states, "about 203,000 acres, or 28% of the irrigated lands in the Sacramento Valley and adjacent foothills in 1929 were served by pumping from ground water". Appendices "F and C" of Bulletin 26 explain the ground water resources of the ground water in the Sacramento Valley. Table F-1 of Appendix "F" shows the estimated ground water capacity to be 3,019,000 acre-feet in a zone 35 feet thick.

It should be apparent, in the light of the evidence introduced at the hearing, that the problem of claimed rights and their amounts is of no concern to the Board, once the pertinency of the Watershed Protection Law is established including a provision that the Sacramento Valley and Delta lands are to be guaranteed water by contract before stored water from Shasta Dam is exported to the San Joaquin Valley. The Board has no jurisdiction at this time to determine the amount of any party's right to use water. Furthermore, the Board has no jurisdiction over the use of the underground water basin underlying the Sacramento Valley. This provides the basis for establishing the need for applying watershed protection to stored water. It also shows that the Project operators would not be impaired by application of the Watershed Protection Law.



Signed at Sacramento, California, this 9th day of  
February, 1961.

/s/ W. P. Rowe  
W. P. Rowe, Member