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STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

PUBLICATIONS OF THE
DIVISION OF WATER RESOURCES
EDWARD HYATT, State Engineer

SACRAMENTO-SAN JOAQUIN WATER SUPERVISOR'S REPORT FOR YEAR 1931

By
HARLOWE M. STAFFORD
Water Supervisor

Under the supervision of
HAROLD CONKLING
Deputy State Engineer

AUGUST, 1932

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ACKNOWLEDGMENT

In the conduct of the investigations of the Sacramento-San Joaquin Water Supervisor, much valuable assistance has been rendered by many individuals and public and private agencies.

Land owners and water users and the executives, engineers, managers, and water superintendents of the various water organizations throughout the territory covered by this work have cooperated fully in furnishing the many and varied data requested. In the Delta, particularly, many land owners have contributed the time of their employees for taking salinity samples without cost to the State and in connection with the special investigation of losses due to salinity, have furnished at considerable time and expense, a great mass of detailed information.

Valuable cooperation extended by Federal agencies has included that of the Water Resources Branch of the Geological Survey, U. S. Department of Interior; the Division of Irrigation of the Bureau of Agricultural Engineering, U. S. Department of Agriculture; and the Second District Engineer Office, Pacific Division, Corps of Army Engineers, U. S. War Department.

The State Division of Highways has cooperated in the expeditious and efficient testing of salinity samples in its testing laboratory.

ORGANIZATION

Walter E. Garrison - - - - - - - - - - - - Director of Public Works
Edward Hyatt - State Engineer

- - 0 - -

Harold Conkling - - - - - - - - - - Deputy in charge of Water Rights

Harlowe M. Stafford
Sacramento-San Joaquin Water Supervisor

Principal Assistant

Martin H. Blote - - - - - - - - - - - - - - Assistant Water Supervisor

Assistants

Frederick E. Anderson Fred Paget James M. Brockway

Assistants on Special Investigation of Losses Due to Water Shortage and Salinity in 1931

A. H. Hubbard A. M. Wells

Special Feather River Water Master, 1931

W. A. Laflin

ADVISORY COMMITTEE

PERMANENT COMMITTEE OF THE SACRAMENTO-SAN JOAQUIN RIVER PROBLEMS CONFERENCE

The successful prosecution of the work of the Sacramento-San Joaquin Water Supervisor may be attributed in no small measure to the backing, advice, and continued interest and cooperation of the Permanent Committee of the Sacramento-San Joaquin River Problems Conference.

This Committee, representing the water users and other interests involved, was appointed by the First Sacramento-San Joaquin River Problems Conference in January, 1924, and has continued with particular activity in the succeeding years of low water supply. In the record dry season of 1931, the necessity and value of an organization of this character was emphatically demonstrated by the facility and dispatch with which the Committee met the difficulties of that season's water shortage. The present personnel of the Committee is as follows:

Herbert E. White, Chairman, Sacramento

E. L. Adams, Chico
A. E. Anderson, San Francisco
Alden Anderson, Sacramento
G. A. Atherton, Stockton
P. M. Downing, San Francisco
William Durbrow, Grass Valley
Manly S. Harris, San Francisco
W. I. Hechtman, Sherman Island
Warren H. McBryde, San Francisco
R. V. Meikle, Turlock
Jesse Poundstone, Grimes
F. T. Robson, Vina

CHAPTER I

INTRODUCTION

The purpose of this report is to outline the conservation measures and stream flow administration made necessary by the record dry season of 1931 and to make of record the measurements made and data collected through the office of the Sacramento-San Joaquin Water Supervisor during this season.

Origin and History of Work

This work was inaugurated in 1924 through the efforts of the first Sacramento-San Joaquin River Problems Conference and its Permanent Committee working with the former Division of Water Rights. A complete description of the origin, history and conduct of this work will be found in the 1924 and 1926 Biennial Reports of the former Division of Water Rights, in Bulletin Number 4 of the same Division, and in Bulletin Number 23 of the Division of Water Resources. The latter bulletin brings together all data and measurements obtained by the Water Supervisor in the five year period, 1924 to 1928, inclusive. The reports for subsequent individual years are mimeographed as the present report, with the plan to again bring all data together in a printed bulletin at the end of the second five year period.

Objectives and Scope

Briefly, the Water Supervisor work may be described as a

measure of relief in the difficulties attendant upon water supply conditions and the use of water throughout the Sacramento-San Joaquin territory. The situation, as outlined in detail in previous reports, involves the major problem of satisfying the water requirements for irrigation in both the Up-river areas and the Delta Region, for the control of salinity in the Delta and Upper Bay area and for navigation above Sacramento when frequently each one of these requirements has exceeded the available Summer flow in the rivers. The solution lies in conservation; by storage as soon as this can be accomplished but also by the careful use and equitable distribution of the existing water supply to those entitled to receive it. Such distribution may be based upon an adjudication of water rights or upon a schedule determined by mutual consent of all interests. To form the basis for either, it is required that there be available, the fundamental facts relating to the past and present diversions and uses of water, the water supply, return flow and all pertinent hydrographic data. In the absence of an adjudication in the Sacramento-San Joaquin area, and looking to the needed conservation to be effected by the equitable distribution of water under decree or mutual agreement, the Water Supervisor work embraces, then, the investigations and measurements necessary to complete the record of basic data required. In the more extreme seasons of water shortage such as 1924, 1926 and 1931, the conduct of this work has provided also the organization of the Division of Water Resources which, working through the Permanent Advisory Committee of the various interests concerned, has been able to effect the temporary administration of the stream flow under mutual agreement and to enforce the measures of waste prevention that have been instrumental in success-

fully tiding over the critical situation of these seasons without serious conflict or loss.

The engineering investigations, measurements and collection of records, etc., have comprised: measurements and records of the diversions of water from the Sacramento, Feather, Yuba, American, Merced, Tuolumne, Stanislaus, and San Joaquin rivers within the valley floor and above the Delta; stream flow measurements throughout the territory, largely in cooperation with the Water Resources Branch of the U. S. Geological Survey; measurements and records of waters returned to the Sacramento and San Joaquin Rivers; studies of the consumptive use of water in the Sacramento-San Joaquin Delta in cooperation with the Division of Irrigation of the Bureau of Agricultural Engineering, U. S. Department of Agriculture; an annual census of irrigated acreages and crops under all diversions recorded and throughout the Delta; and observations and investigation of the advance and retreat of salinity in the Delta channels and Upper Bays. As a special activity in 1931, an intensive field and office investigation was carried on to determine the extent of and to evaluate the losses due to the water shortage and resulting salinity in the Delta in that season.

Organization

The regular organization has included the Water Supervisor, Assistant Water Supervisor, two Assistant Hydraulic Engineers and Engineering Aids. Under the immediate direction of Martin H. Blote, Assistant Water Supervisor, Engineers Fred Anderson, James Brockway, and Fred Paget have been responsible for the major portion of the field work. Brockway resigned on August 1st to take other employment

and Paget, who succeeded him, has been responsible for the work in the Sacramento River territory from the mouth of the Feather River to Redding. Anderson has been responsible for the work on the Sacramento River below the mouth of the Feather River and on the Feather, Yuba, and American Rivers, for a portion of the census of irrigated crops in the Delta and for the work in the Delta uplands. The San Joaquin return water measurements have been conducted jointly by Anderson and Paget.

In the special investigation of losses in the Sacramento-San Joaquin Delta due to salinity, A. H. Hubbard was field engineer from July to the middle of October and the subsequent field and office work was completed by A. M. Wells.

In the special Feather River Water Master Service required in 1931, Anderson started the field work on July 23d and turned it over to W. A. Laflin on August 1st. Laflin continued as Feather River Water Master until September 12th.

In continuation of the cooperative Delta investigation, Major O. V. P. Stout has been in charge of this work under the direction of W. W. McLaughlin, Chief of the Irrigation Division, Bureau of Agricultural Engineering, U. S. Department of Agriculture.

CHAPTER II

ADMINISTRATION AND SPECIAL CONSERVATION FEATURES OF 1931

A comparison of stream flow and water supply conditions from 1924 to 1931, the period in which the work of the Water Supervisor has been conducted, is shown in Table 1.

TABLE 1

COMPARATIVE STREAM FLOW 1924 TO 1931

Year	Run-off to San Francisco Bay in per cent of Normal*	Minimum Flow in Second-feet			
		Sacramento River at			San Joaquin River Near Vernalis
		Red Bluff	Colusa	Sacramento	
1924	28	2810	1470	705	391
1925	83	3240	1870	2760	660
1926	57	2980	1030	1330	565
1927	114	3580	1960	3420	1290
1928	80	3400	1960	2510	840
1929	42	3060	1550	2300	565
1930	63	2980	1680	2350	645
1931	29	2480	820	Zero	200

*Normal taken as 40-year mean (1889-1929) of natural run-off at foothill stations of major tributaries.

It will be noted that the minimum flow conditions in 1931 were even more serious than in 1924 although the total seasonal run-off of the major streams in 1931 was practically the same as that in 1924. This was largely due to the greater rice acreage in 1931. In 1924 there

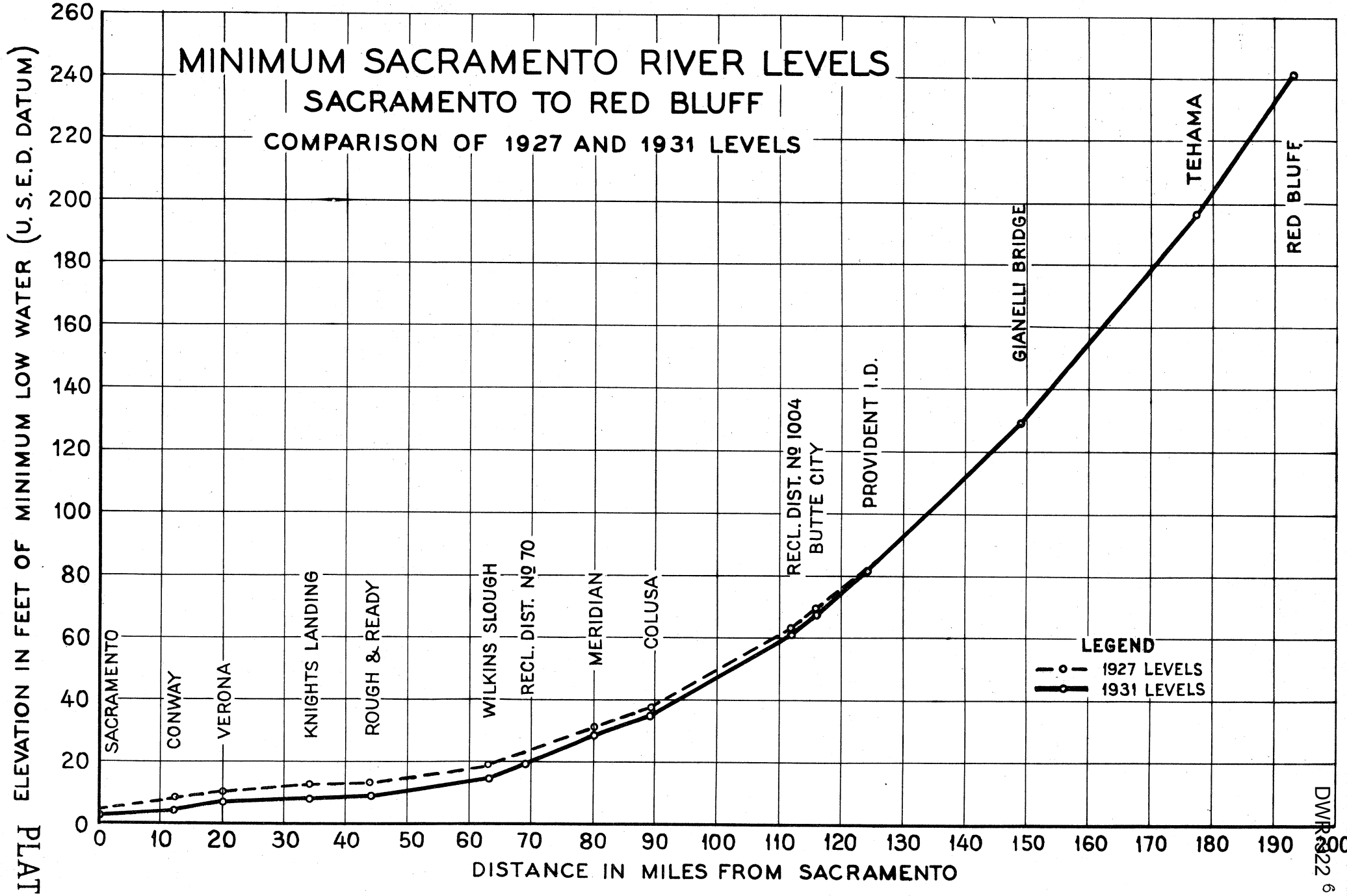

PLATE 1

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were 32,800 acres of rice under irrigation from the Sacramento River above Colusa and 88,500 acres from the river and its tributaries above Sacramento. In 1931 the corresponding acreages were 43,500 above Colusa and 126,500 above Sacramento.

Early Action

By the middle of March, 1931, it was clearly evident that another season as critical as that of 1924, if not more so, was to be anticipated. Early plans were made, therefore, for a program, similar to that of 1924, under which conservation and waste prevention measures might be enforced and a control exercised over diversions and use of water to the greatest extent possible.

On March 26th the Permanent Committee of the Sacramento-San Joaquin River Problems Conference met at Sacramento with representatives of the Division of Water Resources and the U. S. War Department to consider what steps might be taken. It was agreed that the Water Supervisor should proceed much the same as in 1924 and that the first most effective step would probably lie in an endeavor to bring about a curtailment of all plantings such as rice which would demand such large quantities of water.

Request by Permanent Committee for Curtailment of Plantings

Pursuant to this plan the following letter was sent out to all water users in the Sacramento-San Joaquin territory:

March 26, 1931

To Water Users in the Sacramento-San Joaquin Territory:

Your undersigned Committee in cooperation with the State Department of Public Works, Colonel Walter E. Garrison, Director, has met today to consider the water

situation confronting us in the coming season and to take the action indicated to be necessary.

A forecast of the 1931 water supply and the situation to be expected was presented to the Committee by the State Engineer. Barring storms of unusual magnitude and duration in the next few weeks, the Summer stream flow is forecast to approach closely that of 1924. With such low flow the water supply will be insufficient to care for the anticipated acreage, to prevent salinity encroachment into the Delta approaching in extent that of 1924, and to prevent serious impairment of navigation above Sacramento. It was shown also that present storage in reservoirs is very low.

After careful consideration of data gathered by the State Engineer's office, this Committee is impelled to warn the water users of these conditions only less severe than those of 1924. The necessity will exist for the greatest possible conservation of water. In 1924 this was effected by water users on the advice of this Committee acting with the State Division of Water Resources, and the splendid cooperation on the part of all interests resulted in a minimum of loss, and an acceptance by the U. S. War Department of local efforts in the interest of navigation, to the extent that no drastic action was taken by the Federal Government. Faced by a recurrence of low water conditions, similar cooperation and effort should, in the opinion of the Committee, be put into effect immediately. Edward Hyatt, State Engineer, advises that his office, through Harlowe M. Stafford, Water Supervisor, stands ready to work with the Committee and water users to prevent waste and save water in every possible way, and further, is prepared, if necessary, to place in effect a schedule of diversions or other such means which may be agreed upon for water administration.

In considering how best to meet the situation the needs of the Delta must be taken into account along with those of the valleys, as must the authority of the United States in the interest of navigation.

The most effective conservation measure possible at this time is limitation of acreages to be irrigated. Plans for crop plantings are being made at this time and in some cases planting has been started. You are urged to consider the situation most carefully, particularly in the case of extensive plantings which will demand large amounts of water in July and August.

Through the efforts of the water users themselves, represented by this Committee, previous dry seasons have

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been successfully passed with a minimum of friction and a maximum benefit to all interests, and your full cooperation is most earnestly urged to again accomplish this in the season at hand.

Very truly yours,

Permanent Committee of the Sacramento-San Joaquin River Problems Conference.

Through arrangements made by Mr. E. L. Adams, President of the Rice Growers Association of California, and Permanent Committee member, this letter was also enclosed with a statement of the water situation sent out by the Rice Association to its entire mailing list.

As the result of further action at the March 26th meeting, other letters warning of the impending water shortage were sent out by the Division of Water Resources and by the District Engineer of the U. S. War Department as follows:

Letter to Junior Permittees of the Division of Water Resources

April 1, 1931

To Permittees under Junior Priorities
on Sacramento and San Joaquin Rivers
and Tributaries on Valley Floor:

All permits for use of water from streams in the valley area of the Sacramento-San Joaquin River system issued since May 9, 1919, contain the following clause:

> "As there is a possibility that there will not be sufficient water in _____ river during the latter part of the irrigation season to satisfy all requirements, this permit is issued subject to the express condition that the use hereunder may be regulated by the Division of Water Resources during such periods of water scarcity to the end that such use will not interfere with rights under prior applications."

Your attention is called to the fact that your permit was issued subsequent to the above date.

Estimates of discharge of the Sacramento-San Joaquin River system for July and August of the coming summer indicate that there will be a considerable deficiency even with heavy late season rains. In the case of a water right which depends on a permit issued subsequent to the above date, cognizance should be taken of the risk to be incurred in planting crops requiring large amounts of water during those two months.

If it becomes necessary, in order to comply with the water law, to regulate use, the latest priority would be the first to suffer and so on in order.

This letter is being sent as a result of a meeting of the Permanent Committee of the Sacramento-San Joaquin River Problems Conference which recently sent warnings of the impending shortage to all water users.

Very truly yours,

(Signed) Harold Conkling
Deputy in charge of Water Rights.

Warning from District Engineer, U. S. War Department

March 31, 1931

To Water Users in the Sacramento Valley:

In view of the abnormally low stage expected in the Sacramento River during the coming Summer months, it is desired to bring to your attention the interests of the War Department with regard to navigation. As you doubtless know, the Department is charged by law with the maintenance of the navigability of the Sacramento River (among others), and is empowered to enforce restrictions on any use of the water that would interfere with the requirements of navigation.

The War Department would be very reluctant to take action with a view to stopping diversions for irrigation, thereby adding to the difficulties that the natural water shortage will impose upon agriculturists. However, unless prompt action be taken by those who divert water from the river, to reduce such diversions to the minimum actually necessary, and to stop the water wastage that is known now to exist, it is possible that the War Department may have to take action to reduce diversions for irrigation, in order that the interests of navigation may be protected.

It is understood that the Department of Public Works of the State of California is cooperating with the Permanent Committee of the Sacramento-San Joaquin River Problems Conference, to effect the greatest possible conservation of water. Similar action during the low water season of 1924 produced very satisfactory results; and it is earnestly hoped that those who divert water for irrigation will give wholehearted support to the efforts of the above mentioned agencies, in order that the limited quantity of water may be used in the best interests of all concerned. Such cooperation may obviate the necessity of drastic action by the War Department.

Yours very truly,

(Signed) J. R. D. Matheson
Major, Corps of Engineers
District Engineer.

Second Meeting of Permanent Committee

At the second meeting of the Permanent Committee with State and War Department representatives, held at Sacramento on April 13th, a canvass of the results from these letters indicated that a sincere effort was being made by the water users to comply with the recommendations made and that many projects were effecting substantial cuts in their rice acreage. Pursuant to action at this meeting the following letter was sent to water users by the Permanent Committee:

Credit Allowance for Acreage Reductions

April 15, 1931

To Sacramento-San Joaquin Water Users:

On April 13th this Committee held its second meeting of the present season to canvass the results of recommendations sent to the water users after its first meeting, to receive from the State Engineer the latest information and forecast of 1931 water supply conditions, and to consider further steps to meet the situation.

The enclosed data taken from the "Monthly Bulletin of Snow Survey and Precipitation Data and Seasonal

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Forecast" of the State Division of Water Resources, presents the serious situation to be expected throughout the State and indicates a shortage even greater than was anticipated at the date of the Committee's first meeting.

As a result of the Committee's first letter, a number of replies have been received indicating that action is being taken pursuant to the Committee's recommendation for a reduction in irrigated acreages and it is felt that action of this character should be given the highest commendation. Further, the Committee feels that those water users endeavoring to help the situation at this time through a bonafide reduction in acreage should be given every consideration, when, at the time of extreme shortage later in the season, reduction of diversions by the State Division of Water Resources through the Water Supervisor, may become necessary. With this in mind the Committee adopted the following resolution -

"Resolved that it is the sentiment of this Committee that where, as a measure of cooperation in meeting the water situation, a water user at this time voluntarily reduces his irrigated acreage and furnishes proof of such reduction to the Committee, such water user be given full credit for his action, when, later in the season, it is found necessary to effect a reduction in diversions."

Very truly yours,

Permanent Committee of the Sacramento-San Joaquin River Problems Conference.

In spite of every step taken, the available stream flow continued to decrease at an alarming rate and on May 28th the Committee and State and Federal representatives met again at Sacramento to take positive action for relief. From the Water Supervisor's report of stream flow, diversions and return flow conditions, it was apparent that a further and more drastic campaign of waste prevention offered the most effective course to be pursued. The Water Supervisor was instructed to perfect a cooperative arrangement with the larger projects whereby each through a specially designated conservation officer

would be held responsible to the Water Supervisor and a representative of the U. S. Engineer office, for all waste prevention and conservation measures. The Committee sent the following letter to all of the major projects above Sacramento:

Organization for Conservation and Waste Prevention

June 1, 1931

Gentlemen:

At the May 28th meeting of this Committee with officials of the State Division of Water Resources and U. S. War Department, Corps of Engineers, the present water situation was critically reviewed. The facts shown are as follows:

River Discharge:

Sacramento River at Red Bluff - - - -	3300 Sec.Ft.
Sacramento River at Butte City - - -	2060 Sec.Ft.
Sacramento River at Colusa - - - - -	1870 Sec.Ft.
Sacramento River at Knights Landing -	1000 Sec.Ft.
Feather River at Nicolaus - - - - - -	760 Sec.Ft.
Sacramento River at Verona - - - - -	1600 Sec.Ft.
American River at Sacramento - - - -	950 Sec.Ft.
Sacramento River at Sacramento - - -	2300 Sec.Ft.
San Joaquin River near Vernalis - - -	400 Sec.Ft.
Combined flow of Sacramento and San Joaquin Rivers to Delta - - - - - -	2700 Sec.Ft.

which is below the flow in 1924 at the corresponding time.

There is a present draft by major projects only on the river from Red Bluff to Sacramento of 3900 second-feet. This is being diverted for approximately 75,000 acres of rice and 68,000 acres of general crops or a total of 143,000 acres. The rice acreage being irrigated from the river and tributaries above Sacramento is approximately 26 per cent greater than the 1924 acreage and above Colusa it is 34 per cent greater.

Water levels are now such on the section of river between Colusa and Knights Landing that a drop of very little more will cause the intakes of two or more of the largest pumping plants to be out of water. A comparison of present draft, acreage irrigated, and waste and return waters for four major Up-River districts shows the following:

District	River Draft of Major Pumping Plants Sec.Ft.	Acreage Under Major Diversions			Waste and Return Water	
		Rice	Genl.	Total	Second feet	Point of Measurement
Recl. Dist.2047 including Glenn-Colusa, Jacinto, Provident, Princeton-Codora-Glenn, Compton-Delevan, and Maxwell Irrigation Districts	1900	42700	24300	67000	850	Colusa "Trough" at Colusa-Williams Highway
Recl. Dist. 70	112	----	6800	6800	32	District 70 Drain
Recl. Dist. 108	385	11000	3500	14500	100	District 108 Drain at Rough and Ready Bend
Recl. Dist.1500 Sutter Basin	617	7400	12000	19400	0	Dist.1500 Drain

This indicates that there is waste of water which can and must be prevented. The large discharge of return water and waste in the Colusa Trough which joins the river at Knights Landing is "by-passing" a section of river between that point and a considerable distance above Colusa; a section where, as above noted, the precarious water levels require the utmost possible flow.

Taking all facts together, it is indicated that not only low levels but an actual shortage of water for Up-River acreage (without consideration of the Delta requirements and the salinity problem) is impending.

The situation demands a decided action for conservation and prevention of waste and this can only be accomplished through the active cooperation of all water users. It is felt that the larger Districts must assume the responsibility for waste prevention within their Districts and that in their field organization the necessary provision for inspectors, water masters, etc., for this purpose, should be made. It is therefore requested that you immediately designate a Conservation Officer who shall patrol your district to stop wastage and shall be your representative to cooperate with the State Water Supervisor and Federal officials.

The rule to be followed by the Water Supervisor of

the State Division of Water Resources, is to cut river diversions by the amount of wastage under them.

Will you please notify the Water Supervisor when you have designated your Conservation Officer and within a short time arrangements will be made for the representative of the War Department and the Water Supervisor to meet him for an inspection of your project and to assist in any way possible in your conservation campaign.

Very truly yours,

PERMANENT COMMITTEE OF THE SACRAMENTO-SAN JOAQUIN RIVER PROBLEMS CONFERENCE

HERBERT E. WHITE
Chairman

A similar letter appropriate to the situation of the smaller projects and individual diverters of water was sent to all of these. This letter did not request the appointment of a Conservation Officer but placed the responsibility and requirement for waste prevention upon the smaller projects and arranged for the contact with the Water Supervisor in the conservation campaign.

In order to bring the necessity for waste prevention to all of the individual water users under the larger projects and Districts, a copy of the Permanent Committee's letter to the project was sent to each user accompanied by the following letter from the Water Supervisor:

Diversion Cuts in Accordance with Waste

June 3, 1931

To all Water Users Under Large Project and District Irrigation Systems of the Sacramento River:

Your attention is called to the enclosed letter recently sent to your project by the Permanent Committee of the Sacramento-San Joaquin River Problems Conference. You will note that the water situation is

extremely grave and it is imperative that the utmost conservation of water be practiced if present crop plantings are to be matured and damage and conflict averted.

To effect this conservation the regulation has been established that where waste shall be found to occur under any project the diversion of such project shall be reduced by the amount of such waste.

On the larger projects where effective conservation can result only from the combined effort of the individual water users, provision is made for a Conservation Officer on each project to cooperate and work with the Water Supervisor in the inspection and prevention of waste.

Pursuant to the enclosed letter, the project from which you receive your supply of water, has designated its Conservation Officer and will place inspectors in the field to insure a careful use of water.

The exertion of every effort upon your part to SAVE WATER and the reporting of waste by others to your Conservation Officer or to this office, in order that it may be stopped, will insure that the supply of your project and hence that of your individual diversion will not be reduced for waste of water.

Very truly yours,

HARLOWE M. STAFFORD
Water Supervisor

Following up these letters and the appointment of the various conservation officers, contact was made with the latter by a representative of the U. S. Engineer Office and the Water Supervisor and on each of the major projects on the Sacramento River above Sacramento a detailed inspection was made of the use of water, the amount of drainage, seepage or waste and the methods of control. These inspections were continued by the Water Supervisor and his staff throughout the critical period of the season and close contact was maintained at all times between the Conservation Officers and the Water Super-

visor's office. It was found that the men appointed to act for the various projects were, in practically every instance, more than willing to cooperate to cut down waste and spill in order that the river diversions might be correspondingly reduced. The backing of the State and Federal agencies to assist them in the enforcement of rules and regulations for waste prevention already laid down was particularly welcomed and it was at the request of a number of the Conservation Officers that headgate warning signs were printed and furnished to them. Over the signature of the Water Supervisor, these signs were captioned "SAVE WATER" and read, "The amount of water taken out of the Sacramento River by this project will be reduced for waste of water by individuals. If you want a supply of water through this gate all season, regulate the flow so that there will be no waste."

Waste Eliminated

It was but a short time after these activities had been under way that there was a very marked drop in the flow of the drains and return water channels and a further inspection showed that on every large project all controllable waste, particularly the spill from the tailgates in the rice fields, had been practically eliminated. This was reflected in diversion reductions which, in the aggregate, resulted in a considerably increased flow in the river.

With controllable waste and spill taken care of there still remained the considerable drainage flow due to seepage. To control this loss and prevent excessive seepage from the rice fields, a number of the larger projects put into effect a plan of blocking the drains and holding the water table as high as possible without causing injury.

This undoubtedly permitted a considerable reduction in the amount of water required to be diverted from the river. On other projects numerous booster pumping plants were installed on the drains to re-use the seepage flow.

Accomplishment

At the close of the season, faced with the facts that the Delta had experienced a salinity encroachment higher than that of 1924, that for a short time there was no net downstream flow in the Sacramento River at Sacramento and that navigation above Sacramento was not possible for practically the entire season, it might seem that little was accomplished by the strenuous efforts put forth. When viewed, however, from the standpoint of what the situation might have been without these efforts, with no recognition by the water users of the need for conservation and no concerted action for waste prevention, the results are more encouraging. In the evidence by the water users of their desire to cooperate and to put forth every possible effort to conserve water the War Department was constrained to waive severe action in the protection of navigation with which it is charged and was supported in assuming a course which took cognizance of the needs of irrigation. Without doubt the measures taken to maintain the river levels and flow above Sacramento were instrumental in preserving a considerable acreage of crops under irrigation from the river in this territory. With respect to the Delta area, however, the relief possible within the limits of the control exercised was small and the experience of the 1931 season points very forcefully to the conclusion that if, in another such season, any greater flow is to reach the Delta, the

measures of control must go beyond those of waste prevention and embrace the actual administration of diversions in accordance with the most equitable and workable schedule that can be derived from the many years of records and data now available. With mutual agreement a requirement for operation under such a schedule and the elimination of late appropriators probably an inevitable result in such a season as that of 1931, the difficulties in the way of its realization are of no small magnitude. However, outside of increased water supplies through storage, the solution appears to lie in this direction and the possibility of a situation which would force the issue is not to be ignored.

THE FEATHER RIVER SITUATION

Early in July, 1931, the flow of the Feather River below Yuba City diminished very seriously and the larger irrigation pumping plants located on the lower stretches of the river began to experience a shortage of water. On July 10th the flow entirely ceased at the Nicolaus Bridge gaging station and at the plants of Feather River Water Company, Garden Highway Mutual Water Company and Pollock, a short distance above Nicolaus, and the plants of Sutter Basin Company near the mouth of the river, diversions were reduced to the intermittent pumping of pools supplied only by seepage. It was apparent that something would have to be done immediately to increase the river flow if a considerable area of orchards and field crops were to be saved.

Sacramento and Oroville Meetings

An investigation of conditions was made by the Water Supervisor's office and after many preliminary conferences between the various water users and the Division of Water Resources, two meetings

conducted by the State Engineer, one at Sacramento on July 21st and the other at Oroville on July 22d, resulted in relief action. These meetings were attended by representatives of the larger water users on the Feather River below Marysville, by representatives of the Sutter Butte Canal Company, Richvale Irrigation District, Western Canal Company, Pacific Gas and Electric Company and at the Oroville meeting, by a representative of the State Railroad Commission. It was apparent from the facts presented that if sufficient water in addition to the natural flow (claimed by Sutter Butte Canal Company and Richvale Irrigation District) were to pass the Sutter Butte Canal Company's diversion dam a short distance below Oroville, it would require not only voluntary cuts on the part of the two large canal companies but additional storage releases by the Pacific Gas and Electric Company, owner of the Almanor and Bucks Reservoirs on the North Fork of the Feather River. It was shown that the releases from Almanor were already of an amount to keep the Caribou power plant running continuously at full capacity. However, as a result of the Oroville meeting, the power company agreed to extend further aid and an additional release of stored water was made from Bucks Reservoir. This, with the temporary cuts of Western and Sutter Butte-Richvale canals, resulted in a flow which carried the water to a point below Nicolaus Bridge and supplied all pumping plants except those of Sutter Basin Company a short distance above the mouth of the river.

Provision for Water Master

At both the Sacramento and Oroville meetings the need was

stressed for a State Water Master to insure the proper distribution of the available flow in the river and to effect such savings as might be possible through a schedule of rotation or other regulation of this nature. In fact, the additional release of storage by the Power Company was made contingent upon the placing of control of diversions in the hands of a State Water Master. An agreement providing for a Water Master for the 1931 season was drawn up and presented to the water users at the Sacramento meeting and the signatures were practically completed at the Oroville meeting. The water master began work under the direction of the Sacramento-San Joaquin Water Supervisor on July 23d. Immediate arrangements were made with Pacific Gas and Electric Company and Sutter Butte Canal Company for daily telephone reports to insure the rapid transmission of natural flow determinations. and the immediate check and regulation accordingly. The water master called upon all water users and arranged for and placed in effect a schedule of rotation of diversions wherever possible.

Additional Storage Releases

The records show that subsequent to the Oroville meeting and the initiation of the work of the Water Master, a maximum flow of 189 second-feet passed Sutter Butte diversion dam on July 24th. The increased flow was of too short duration, however, to carry the water through to the lowest pumping plants. The flow at Nicolaus picked up from zero to 36 second-feet on July 27th but very quickly dropped off again and the lowest point of established flow was only a short distance below Nicolaus. It appeared that everything poss-

ible was being done by the Water Master in the way of conservation of the existing flow and hence that if the Sutter Basin Company pumps were to be reached, an additional storage release would be required, preferably an initially large one to force the water downstream quickly. The Sutter Basin Company presented the situation to the Pacific Gas and Electric Company and requested an additional storage release. Upon assurance from the Division of Water Resources that the Water Master would maintain a careful check and close regulation of any releases to insure that the additional water would be permitted to reach the lower pumping plants, the Pacific Gas and Electric Company agreed to a large additional release of water from Lake Almanor and this was started on July 30th. It was necessary to by-pass the Caribou Power Plant with this water as the previous release was already operating this plant to capacity.

Results Obtained

According to the records the storage release started on July 30th resulted in an increased flow in the river at Oroville from July 31st to August 4th amounting to 1800 acre-feet or a mean additional flow of 180 second-feet for five days. This release passed the Sutter Butte diversion dam, reached Nicolaus on August 2d, and increased to a maximum flow of 192 second-feet at the latter point on August 3d. It reached the lowest pumping plants on the river but through control by temporary sand dams, very little of the flow was permitted to waste into the Sacramento River. Subsequently an average weekly flow of not less than 45 second-feet was maintained at Nicolaus and for the week ending September 11th the average flow had

increased to 316 second-feet due to the reduction of upper diversion requirements as the season advanced.

Water Right Determination a Probable Outcome

With the closing of the Water Master work on September 12th, the water users expressed an entire satisfaction with the results accomplished and it appeared that the timely cooperation of all interests concerned had been most successful in preventing serious damage from water shortage to a considerable area of valuable irrigated lands. As an outcome of the 1931 situation, it also appeared that some action might be expected leading to an ultimate adjudication or determination of the water rights below Oroville. A committee of the water users is now giving consideration to the best procedure to bring about such a determination and it appears that this may take the form of a Court Reference to the Division of Water Resources as Referee.

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CHAPTER III

MEASUREMENTS OF STREAM FLOW

During the irrigation season of 1931, stream flow measurements and records were obtained through cooperation with the Water Resources Branch of the U. S. Geological Survey for stations on the Sacramento River at Kennett, Red Bluff, Butte City, Colusa, Wilkins Slough, Knights Landing, and Verona; on the Feather River at Nicolaus; on the American River at H Street Bridge, Sacramento; on the Mokelumne River at Woodbridge and Thornton, and on the San Joaquin River near Newman and Vernalis. The station on the Sacramento River at Wilkins Slough which is between Colusa and Knights Landing, was newly established in 1931 to provide a closer definition of the return water in this stretch of the river. The station on the Mokelumne River at Thornton was discontinued at the end of May as conditions here were not entirely satisfactory for gaging and the flow as recorded at the Woodbridge station is little different from that at Thornton.

Supplementing the above cooperative stations, the Water Supervisor has maintained stations on Upper Butte Creek, on Lower Butte Creek and Slough, and, in connection with the San Joaquin return water measurements (See Chapter V), stations as follows: Stanislaus River at Orange Blossom Bridge and at Elliot Ranch, Tuolumne River at Roberts Ferry Bridge and at Tuolumne City, Merced River at Yosemite Valley Railroad Crossing and at Hills Ferry Road Bridge (near mouth), Dry Creek at Old Waterford Bridge and at Basso Ranch (near Modesto), and San Joaquin River at San Luis Island and at Grayson (Laird Slough). Many additional stations maintained on

By-Pass and Drainage channels for the measurement of return water are listed in Chapter V.

The stations at Kennett, Red Bluff, Verona, Woodbridge, Vernalis and Newman, are maintained throughout the year but the records are given in this report for the irrigation season only.

Sacramento River at Sacramento

The record of the flow of the Sacramento River at Sacramento as given in this and previous reports, does not represent actual measurements at a station below the City of Sacramento Intake. Because of tidal action, a gaging station at this point is not feasible. The daily discharge record as given has been computed by using the Verona record and making due allowance for the measured inflow and draft between that station and Sacramento. In this computation it is not practicable and no attempt has been made to allow for the time required for the flow to travel from Verona to Sacramento and to make the various deductions and additions enroute at the exact time that the given Verona flow would have passed the respective points of inflow or draft. During the Summer period the velocities between Verona and Sacramento are low and a given flow may require a day's time or more to travel this distance. Under these conditions, the computed flow at Sacramento may differ somewhat from what would have been found if the actual flow could have been measured. Contributing to this difference also there are the accretions or losses which cannot be measured. In the upper sections of the river the invisible accretions or losses between two points are susceptible of computation as the remaining quantity required to satisfy the equation when the

flow at the upper and lower points and all definite intermediate inflows and drafts are known. With no actual measurement of the flow at Sacramento, the invisible accretions or losses between Verona and Sacramento cannot be thus defined and hence they are unaccounted for in the computed flow at Sacramento. From the data presented subsequently in Chapter V, it would appear that some return flow might be expected in the Verona-Sacramento section but, as indicated in the tabulation of return water (Table 50), no figure for it has been given (except for the measured drains) because it could not be derived without a record of the actual flow at Sacramento.

Tidal Cycle Stream Flow Measurements

In July and August a number of tidal cycle measurements of the flow of the Sacramento River at Sacramento were made. During a complete cycle of tidal phases, normally a period of about twenty-five hours, current meter measurements of the flow were made at intervals of approximately one hour. The measurements were then plotted against tide and time and the net discharge for the tidal cycle was determined graphically. Table 2 gives the data for these tidal cycle measurements and Plate 2 shows the variation of discharge with tide and illustrates the method of computation for the two tidal cycles of July 22d and 23d.

The periods of the tidal cycle for which the measurements are given in Table 2 do not coincide with the corresponding daily periods for which the discharge at Sacramento is computed from the Verona record (See Table 11), and for other reasons previously explained, some difference between the net discharge as derived by

tidal cycle measurement and as computed would be expected and was found. The difference may probably be taken as an appoximation of the seepage return water in the Verona-Sacramento section provided that the derivation of the computed flow without allowance for the Verona-Sacramento time interval has not given results at too great variance from what the actual flow less seepage return would have been. It will be noted that as computed, there was a negative daily discharge at Sacramento for a considerable period in the latter half of July, indicating a net tidal flow upstream to supply an upstream irrigation draft. The minimum flow shown by the tidal cycle measurements was a positive or downstream flow of 41 second-feet for the cycle of July 22-23d. A reliable estimate for the seepage return in the Verona-Sacramento section could doubtless be derived from a comparison of the measured and computed figures for a total monthly flow, but this would require that the tidal cycle measurements, which are costly, be continued throughout an entire month.

Upstream Flow at Sacramento

On Plate 2 it will be noted that at the time of the extreme low flow at Sacramento there was, at high tide, a maximum upstream discharge of 4000 second-feet, and for several hours twice a day during this period, there was a very marked upstream flow. Floats were placed in the river to show the extent of the upstream travel and Plate 3 shows the considerable distance traveled by a float placed in the river at the Riverside sewer sump of the City of Sacramento on July 16th.

Distribution of Flow to Delta Channels

As reported in Bulletin 27 - "Variation and Control of Salin-

ity in Sacramento-San Joaquin Delta and Upper San Francisco Bay" - a number of tidal cycle measurements were made in 1929 and 1930 in connection with the investigation for that bulletin, to establish as closely as possible the distribution of Sacramento River flow to the various Delta channels at various stages of the river at Sacramento. The data of Bulletin 27 show that for the tidal and channel conditions and the division of inflow between the Sacramento and San Joaquin River systems which existed throughout the period of the measurements, a very definite relation was established between the flow at Sacramento and its distribution to the Delta channels. It was noted, however, that a change in the established relation might be anticipated should the relative inflow of the Sacramento and San Joaquin River systems be considerably different or should there occur a marked change in tidal and channel conditions as the result of subsequent reclamation or dredging operations.

In the work of the 1931 season, through a cooperation with the U. S. Engineer Office, Second District, an opportunity was afforded to make several measurements as a partial check of the relation established by the 1929-30 measurements. Simultaneous tidal cycle measurements of flow were made on Georgiana Slough and on the main river channel below the head of Georgiana Slough, and it was endeavored to make the measurements at stages of the flow at Sacramento not covered by the 1929-30 measurements in order to more completely define as well as to check the curve derived from the latter measurements. The results are shown in Table 3.

When these measurements are plotted on the curve of Bulletin 27 showing the relation between the flow of the Sacramento River at

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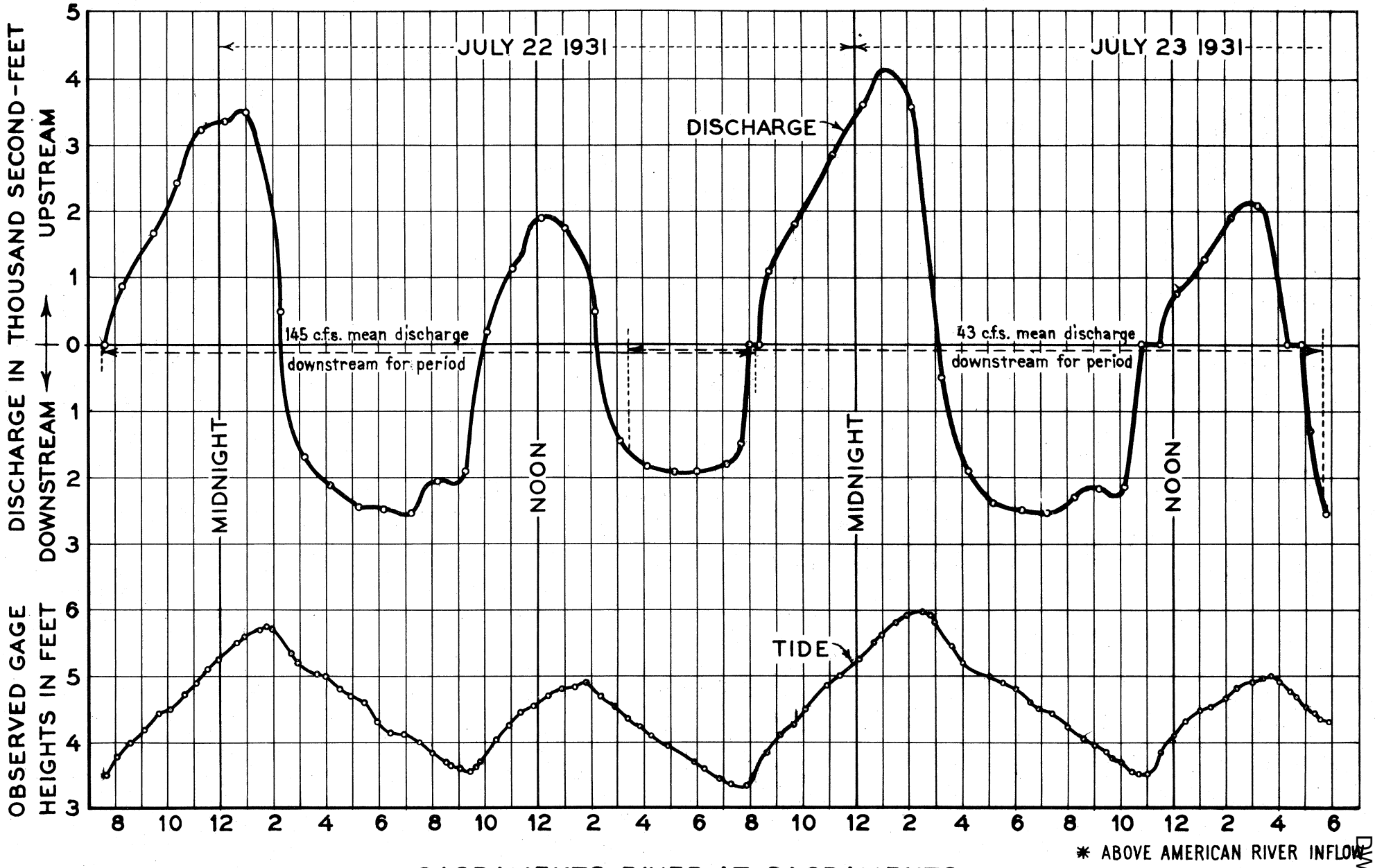
Sacramento and the percentage of this flow passing through Georgiana Slough, it would appear that some change in conditions may have occurred under which, for a given flow at Sacramento, the proportional flow through Georgiana Slough is now smaller; or in other words, that a proportion of the flow passing Walnut Grove, greater than that shown in 1929, is now continuing down the main river channel. Since the 1929-30 measurements were made, considerable dredging work has been done by the U. S. War Department in the Sacramento River channel from Rio Vista up to the triple junction of Steamboat Slough, Cache Slough and the main river channel, and also up into the main river channel toward Isleton and it is not improbable that the changed tidal and channel conditions resulting from this work may have been responsible for the change in the relation which the 1931 measurements would indicate. However, the number of the latter measurements was probably not sufficient to warrant a definite or final conclusion that a change has occurred in the division of flow at the haed of Georgiana Slough.

TABLE 2

TIDAL CYCLE MEASUREMENTS OF THE SACRAMENTO RIVER AT SACRAMENTO, JULY AND AUGUST, 1931

Cycle Number	Period of Measurements				Duration of Cycle		Measured Discharge Sec. feet	American River inflow Sec. feet	City of Sacto Diversions Sec. feet	Net Flow Below City of Sacto. Intake Sec. feet
	From		To							
	Time	Date	Time	Date	Hour	Mins				
1	9:20 P	7-9	9:55 P	7-10	24	35	450	177	56	571
2	9:55 P	7-10	10:50 P	7-11	24	55	202	126	55	273
3	7:05 P	7-11	9:40 P	7-12	26	35	145	136	48	233
4	9:20 P	7-9	9:40 P	7-12	72	20	218	148	53	313
5	10:20 A	7-15	9:35 A	7-16	23	15	227	124	48	303
6	12:40 P	7-20	1:07 P	7-21	24	27	335	74	50	359
7	12:50 A	7-21	2:20 A	7-22	25	30	158	62	50	170
8	2:20 A	7-22	3:25 A	7-23	25	5	41	81	52	70
9	12:40 P	7-20	5:40 P	7-23	77	--	215	75	51	239
10	8:30 A	8-12	9:25 A	8-13	24	55	510	---	---	510

NOTE: Measurements 1 to 9 inclusive, were made at a section located approximately 1000 feet above the mouth of the American River. Number 10 was made at a section located 600 feet below the I Street Bridge.



* ABOVE AMERICAN RIVER INFLOW

SACRAMENTO RIVER AT SACRAMENTO *

NET FLOW AND VARIATION OF DISCHARGE WITH TIDE

AS SHOWN BY

MEASUREMENTS THROUGHOUT COMPLETE TIDAL CYCLES DURING PERIOD OF LOW FLOW

PLATE 2

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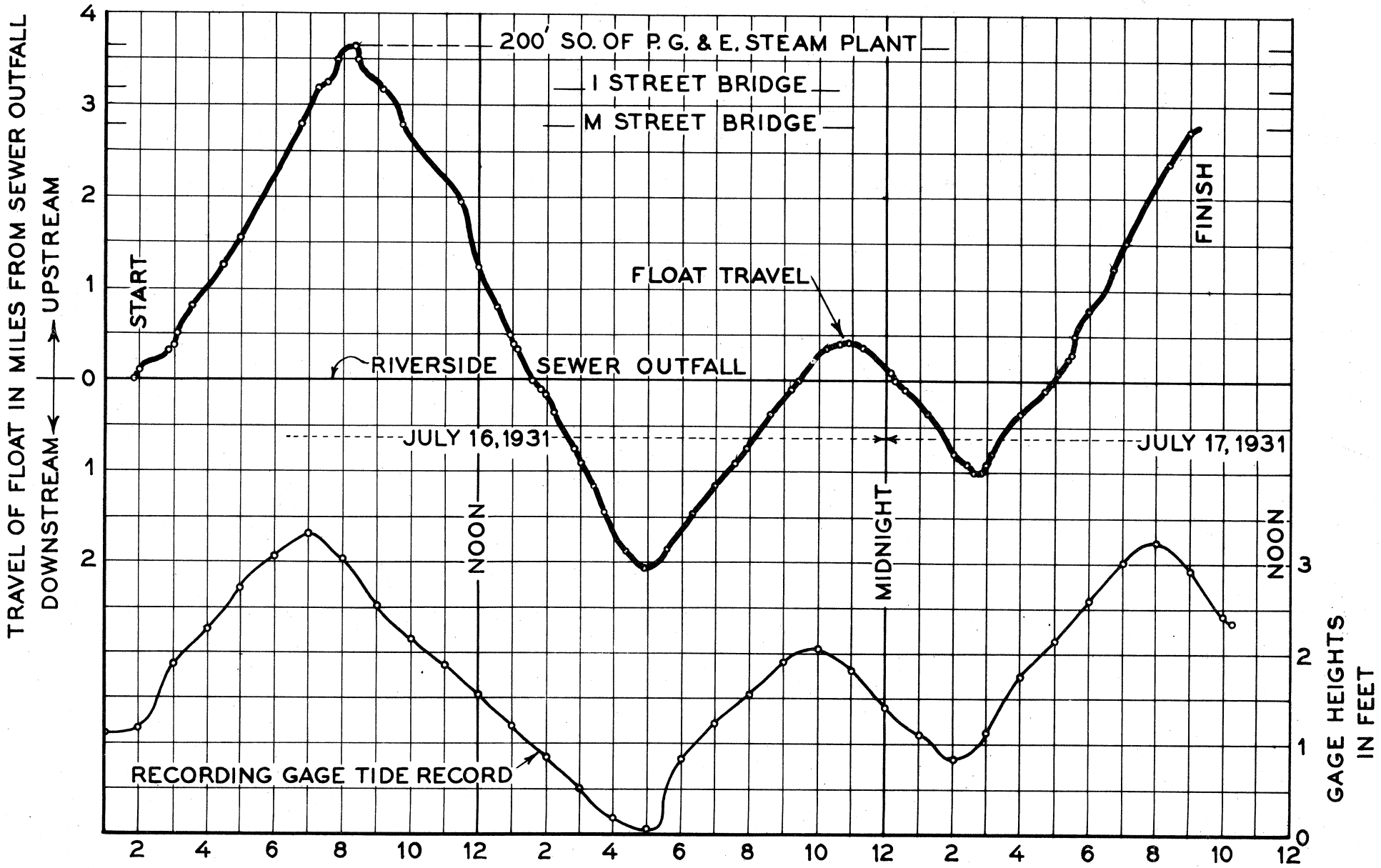

SACRAMENTO RIVER AT SACRAMENTO

CHANGE IN DIRECTION OF FLOW WITH TIDE

AS SHOWN BY

FLOAT TRAVEL DURING PERIOD OF ZERO NET RIVER DISCHARGE

PLATE 3

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TABLE 3

DISTRIBUTION OF SACRAMENTO RIVER FLOW TO DELTA CHANNELS AS SHOWN BY TIDAL CYCLE MEASUREMENTS OF GEORGIANA SLOUGH AND SACRAMENTO RIVER BELOW THE HEAD OF GEORGIANA SLOUGH, 1931

Cycle Number	Period of Measurements				Duration of Cycle		Net Discharge Second-feet		Corresponding Flow at Sacramento Second-feet
	From		To				Georgiana Slough *	Sacto. River Below Head of Georgiana Slough **	
	Time	Date	Time	Date	Hour	Min.			
1	8:55 A	May 20	10:00 A	May 21	25	05		1330	4200
2	8:55 A	May 20	9:50 A	May 21	24	55	1220		4200
3	8:45 A	May 23	9:35 A	May 24	24	50		1090	3400
4	8:45 A	May 23	9:35 A	May 24	24	50	990		3400
5	8:30 P	May 23	9:10 P	May 24	24	40		885	3100
6	8:30 P	May 23	9:10 P	May 24	24	40	885		3100
7	11:55 A	June 5	10:05 A	June 6	22	10		527	2500
8	11:55 A	June 5	10:05 A	June 6	22	10	1150		2500

* Toward San Joaquin River.
** Toward Rio Vista.

TABLE 4

DISCHARGE OF SACRAMENTO RIVER AT KENNETT

Day	Daily Discharge in Second-feet							
	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	3990	4590	3710	2880	2720	2570	2520	2520
2	3850	4590	3710	2880	2720	2570	2520	2520
3	3850	4590	3710	2880	2670	2570	2520	2520
4	3850	4280	3580	2820	2670	2520	2520	2620
5	3850	4280	3450	2770	2670	2520	2570	2570
6	3710	4280	3330	2720	2670	2570	2520	2520
7	3710	4280	3330	2720	2670	2570	2520	2620
8	3580	4130	3210	2770	2620	2570	2570	2670
9	3850	4130	3210	2770	2620	2570	2570	2670
10	3710	4130	3210	2770	2620	2520	2620	2720
11	8800	4130	3100	2770	2620	2520	2570	2720
12	13300	3990	3100	2770	2620	2470	2570	2670
13	9880	4280	3100	2770	2570	2520	2570	2670
14	7760	3990	3100	2720	2570	2520	2570	2670
15	6370	3990	3210	2990	2570	2570	2620	2670
16	5800	3990	3330	3850	2570	2520	2620	2670
17	5800	3990	3210	3330	2570	2520	2620	2670
18	9810	3990	3100	3100	2570	2520	2620	2670
19	9000	3990	2990	2990	2620	2520	2620	2620
20	7960	3850	2990	2990	2620	2520	2620	2670
21	7160	3850	2990	2990	2620	2520	2570	2670
22	6760	3710	2990	2990	2570	2470	2570	3580
23	6370	3850	2990	2880	2570	2470	2620	3990
24	5990	3580	2990	2880	2570	2520	2620	3330
25	5620	3450	2990	2820	2570	2520	2620	3330
26	5260	3450	2990	2770	2570	2520	2570	3450
27	5090	3450	2990	2770	2570	2520	2470	3210
28	4920	3580	2990	2770	2570	2520	2520	2990
29	4750	3580	2940	2820	2620	2520	2620	2880
30	4590	3710	2940	2770	2570	2520	2570	2820
31	4590		2880		2620	2520		2880
Mean	5920	3990	3170	2890	2610	2530	2570	2830
Ac.Ft. for Month	364000	237000	195000	172000	160000	156000	153000	174000

NOTE: This is a permanent station of the Water Resources Branch of the U. S. Geological Survey established at Kennett in 1925. This station is maintained throughout the year, but the record is given here for the period of the irrigation season only.

TABLE 5

DISCHARGE OF SACRAMENTO RIVER NEAR RED BLUFF

Day	Daily Discharge in Second-feet							
	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	5430	5430	4200	3150	2980	2640	2640	2720
2	5210	5650	4200	3150	2900	2640	2640	2720
3	5100	5430	4200	3150	2810	2640	2640	2640
4	5000	5320	4100	3060	2810	2640	2640	2720
5	5000	5210	4010	2980	2810	2560	2640	2810
6	4900	5100	3920	2980	2900	2560	2720	2720
7	4790	5000	3830	2980	2810	2560	2720	2720
8	4690	5000	3660	2980	2810	2560	2640	2810
9	4690	4900	3660	2980	2720	2560	2720	2900
10	5000	4690	3580	2980	2720	2560	2720	2980
11	6120	4690	3580	2980	2720	2560	2720	2980
12	15300	4790	3490	2980	2720	2560	2640	2980
13	13700	5100	3490	2900	2720	2480	2640	2980
14	10200	5100	3490	2980	2640	2560	2640	2980
15	8300	4790	3580	3400	2640	2560	2640	2980
16	7160	4690	3660	4790	2720	2560	2640	2980
17	6890	4690	3660	4790	2720	2560	2640	2980
18	9360	4690	3580	3920	2720	2560	2640	2980
19	13700	4590	3320	3660	2720	2560	2640	2980
20	10900	4390	3320	3580	2720	2560	2640	2980
21	9540	4390	3320	3490	2640	2640	2640	2980
22	8910	4300	3320	3400	2640	2640	2640	3400
23	8300	4390	3240	3240	2640	2560	2640	4900
24	7710	4590	3240	3150	2640	2560	2720	4590
25	7160	4200	3490	3060	2640	2640	2720	4100
26	6890	4100	3580	2980	2640	2640	2810	4490
27	6630	4100	3400	2980	2640	2560	2720	3920
28	6370	4100	3320	2980	2640	2640	2720	3740
29	6120	4100	3320	2980	2640	2640	2720	3660
30	5880	4200	3240	2900	2640	2640	2810	3580
31	5650		3150		2640	2640		3490
Mean	7440	4720	3590	3250	2720	2590	2680	3240
Ac.Ft. for Month	457000	281000	221000	193000	167000	159000	159000	199000

NOTE: This is a permanent station of the Water Resources Branch of the U. S. Geological Survey located near the site of the proposed Iron Canyon Dam: Mile 198.6 above Sacramento. This station is maintained throughout the year, but the record is given here for the period of the irrigation season only.

TABLE 6

DISCHARGE OF SACRAMENTO RIVER AT BUTTE CITY

Day	Daily Discharge in Second-feet					
	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	2690	1810	1560	1100	1400	2430
2	2760	1750	1510	1130	1400	2430
3	2760	1690	1480	1130	1440	2360
4	2690	1640	1450	1140	1500	2360
5	2560	1640	1420	1150	1550	2360
6	2500	1580	1390	1120	1560	2360
7	2430	1580	1370	1130	1640	2360
8	2430	1580	1330	1140	1750	2360
9	2300	1580	1300	1160	1810	2430
10	2240	1560	1260	1160	1870	2500
11	2170	1550	1230	1150	2050	2560
12	2050	1580	1190	1140	2110	2560
13	1990	1580	1160	1080	2110	2620
14	1990	1570	1120	1080	2110	2690
15	1930	1690	1100	1100	2110	2690
16	1930	1930	1080	1160	2240	2760
17	1990	2690	1090	1180	2300	2760
18	2050	3230	1100	1200	2300	2820
19	1990	2760	1090	1230	2300	2820
20	1870	2430	1110	1220	2300	2880
21	1810	2360	1120	1220	2360	2820
22	1750	2300	1130	1250	2300	2820
23	1750	2110	1110	1260	2300	2950
24	1690	2050	1080	1250	2300	4040
25	1870	1930	1070	1230	2360	4200
26	1930	1870	1060	1230	2360	3900
27	2110	1750	1060	1250	2360	4200
28	2050	1690	1080	1240	2360	3900
29	1990	1580	1080	1260	2300	3670
30	1930	1560	1070	1330	2300	3600
31	1870		1110	1370		3520
Mean	2130	1890	1200	1190	2040	2930
Ac.Ft. for Month	131000	112000	73800	73200	121000	180000

NOTE: Gagings taken near Butte City Bridge, Mile 115.8 above Sacramento. Station maintained by Water Resources Branch of the U. S. Geological Survey under cooperative agreement.

TABLE 7

DISCHARGE OF SACRAMENTO RIVER AT COLUSA

Day	Daily Discharge in Second-feet					
	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	2620	1660	1320	952	1260	2490
2	2540	1600	1290	925	1230	2490
3	2620	1500	1260	952	1260	2410
4	2540	1470	1230	952	1290	2410
5	2460	1470	1230	1010	1400	2410
6	2300	1440	1200	1000	1430	2410
7	2220	1410	1140	972	1430	2410
8	2300	1380	1090	1000	1540	2410
9	2220	1380	1040	1000	1680	2410
10	2060	1350	952	1000	1740	2490
11	1990	1350	925	1000	1930	2570
12	1850	1380	925	972	2050	2660
13	1850	1410	925	945	2090	2660
14	1780	1380	870	918	2090	2660
15	1740	1470	870	918	2130	2750
16	1740	1600	845	972	2130	2750
17	1850	2050	870	1000	2290	2750
18	1920	3130	845	1030	2330	2840
19	1920	2770	870	1060	2330	2930
20	1780	2360	898	1080	2410	2930
21	1800	2200	898	1110	2410	2930
22	1660	2120	870	1080	2410	2840
23	1530	2120	870	1110	2410	2840
24	1500	1910	845	1110	2330	3820
25	1560	1740	820	1060	2410	4700
26	1770	1630	845	1060	2410	4400
27	1910	1530	870	1060	2410	4400
28	1910	1470	845	1080	2410	4400
29	1910	1410	845	1110	2330	4000
30	1840	1320	845	1170	2410	3800
31	1770		898	1200		3600
Mean	1980	1700	969	1030	2000	3020
Ac.Ft. for Month	122000	101000	59600	63300	119000	186000

NOTE: Gagings taken near Colusa Bridge, Mile 89.4 above Sacramento. Station maintained by Water Resources Branch of the U. S. Geological Survey under cooperative agreement.

TABLE 8

DISCHARGE OF SACRAMENTO R. BELOW WILKINS SLOUGH

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		1610	898	476	56	778	2430
2		1520	733	452	148	812	2520
3		1540	632	446	172	760	2430
4		1600	597	366	150	812	2380
5		1460	564	321	188	882	2380
6		1380	542	361	227	1000	2380
7		1380	537	285	227	970	2430
8		1600	525	226	195	1080	2380
9		1410	499	226	224	1210	2380
10		1230	490	176	254	1320	2430
11		1050	411	66	254	1400	2480
12		918	395	65	251	1560	2520
13		845	405	126	254	1760	2560
14		843	427	86	233	1840	2610
15		768	496	86	224	1890	2660
16	2650	742	801	148	287	1980	2660
17	2340	833	830	140	326	2070	2700
18	2100	1090	1270	107	350	2160	2750
19	1960	1210	2140	77	347	2200	2800
20	1820	1110	1940	126	362	2250	2900
21	1720	895	1540	110	416	2300	2900
22	1730	667	1490	86	470	2340	2850
23	1900	539	1380	66	452	2340	2800
24	1800	479	1370	93	485	2340	2950
25	1700	602	1140	66	464	2340	3780
26	1840	675	943	104	470	2380	4050
27	1860	804	781	135	485	2380	3940
28	1660	989	679	169	515	2430	4050
29	1580	957	627	26	560	2430	3880
30	1550	992	517	40	638	2380	3660
31		914		42	708		3560
Mean	*1880	1050	854	171	335	1750	2880
Ac.Ft. for Month	*56000	64800	50800	10500	20600	104000	177000

NOTE: Station newly established August 1, 1931 at Mile 62.9, a short distance below Wilkins Slough Pumping Plant of Reclamation District 108. Maintained by Water Resources Branch of U. S. Geological Survey under cooperative agreement.

Discharge prior to August 1st is computed from gage height record at Tisdale plant of Sutter Mutual Water Company (Mile 63.75 L) and rating curve based upon measurements at new station and Tisdale Plant gage heights.

* 15 days.

TABLE 9

DISCHARGE OF SACRAMENTO RIVER AT KNIGHTS LANDING

Day	Daily Discharge in Second-feet					
	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	2200	1750	778	302	1180	2590
2	2200	1610	708	320	1280	2650
3	2150	1430	672	350	1280	2650
4	2260	1300	620	430	1280	2650
5	2370	1200	568	430	1280	2530
6	2150	1140	550	460	1400	2470
7	2000	1100	505	505	1450	2410
8	2150	1060	445	520	1500	2410
9	2200	995	403	550	1550	2470
10	2050	955	378	585	1750	2530
11	1750	875	345	585	1910	2530
12	1480	855	308	602	2080	2530
13	1300	855	300	602	2300	2590
14	1340	875	318	638	2350	2590
15	1250	975	320	602	2410	2650
16	1300	1120	302	585	2470	2710
17	1340	1250	300	590	2590	2770
18	1700	1560	292	642	2650	2830
19	1950	2200	272	678	2710	2770
20	2000	2480	265	678	2710	2770
21	1660	2200	270	695	2710	2770
22	1300	2050	270	755	2710	2770
23	1040	1900	260	835	2650	2770
24	915	1800	258	835	2650	3070
25	995	1560	298	875	2650	3850
26	1120	1380	330	875	2650	4100
27	1560	1200	385	895	2650	3980
28	2100	1060	380	935	2650	4100
29	2260	1020	358	980	2650	3980
30	2000	895	310	1050	2530	3730
31	1900		295	1120		3610
Mean	1740	1360	389	661	2150	2930
Ac.Ft. for Month	107000	80900	23900	40600	128000	180000

NOTE: Gagings are taken at the Railroad Bridge at Knights Landing at Mile 34.0 above Sacramento and therefore include the water entering the river from the Back Borrow Pit of Reclamation Districts 787 and 108. Station maintained by Water Resources Branch of the U. S. Geological Survey under cooperative agreement.

TABLE 10

DISCHARGE OF SACRAMENTO RIVER AT VERONA

Day	Daily Discharge in Second-feet							
	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	11800	9680	4370	2550	1060	345	1550	3600
2	11500	9320	4230	2280	950	407	1670	3720
3	10900	9320	4370	2020	905	473	1720	3840
4	10600	9140	4510	1830	846	603	1630	3720
5	10200	8620	4510	1650	811	579	1670	3600
6	9860	8110	4090	1560	755	579	1850	3480
7	9680	7600	3680	1520	707	615	1940	3300
8	9500	7280	3950	1480	616	603	1980	3350
9	9140	7120	3950	1400	532	628	2080	3540
10	8790	6800	3550	1320	507	674	2280	3650
11	9140	6480	3100	1180	448	648	2570	3570
12	10400	6000	2610	1240	394	701	2950	3420
13	14300	6000	2440	1230	377	757	3220	3380
14	17600	5680	2440	1220	399	799	3360	3360
15	18600	5530	2380	1360	399	771	3500	3480
16	17200	5230	2440	1560	377	743	3500	3720
17	15500	4790	2500	1780	360	736	3710	3840
18	14500	4510	2910	2280	328	834	3780	3720
19	17000	4370	3420	3290	311	883	3920	3600
20	21300	4230	3290	3420	306	876	3920	3600
21	22400	4090	2610	2910	317	876	3850	3480
22	21100	3950	2070	2670	322	965	3850	3600
23	19300	3950	1740	2550	304	1120	3710	3720
24	18000	4230	1600	2440	304	1120	3780	4640
25	16500	4510	1700	2070	345	1190	3710	6260
26	14900	4230	1830	1780	385	1150	3780	6260
27	13700	4230	2730	1560	418	1150	3780	6110
28	12800	4230	3680	1360	462	1270	3780	6260
29	12000	4370	3680	1400	429	1350	3640	5960
30	11100	4370	3030	1240	375	1350	3430	5510
31	10200		2790		345	1430		5210
Mean	13900	5930	3100	1870	497	846	3000	4150
Ac.Ft. for Month	855000	353000	191000	111000	30600	52000	179000	255000

NOTE: This station is located at Mile 19.6 above Sacramento below the junction of the Feather with Sacramento River. It is just above the mouth of "Cross Canal", main drain of Reclamation District 1001, and is only a short distance above the upstream limit of the tide effect. Station maintained by Water Resources Branch of the U. S. Geological Survey under cooperative agreement.

TABLE 11

DISCHARGE OF SACRAMENTO RIVER AT SACRAMENTO

Day	Daily Discharge in Second-feet							
	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	12800	11400	7010	2900	841	-3	1310	3670
2	12500	11500	6800	2490	698	106	1430	3790
3	11800	11600	6920	2180	702	162	1530	3920
4	11600	11200	7010	1930	692	286	1410	3850
5	11400	10500	6990	1700	610	230	1440	3690
6	11100	10100	6520	1590	503	206	1670	3570
7	10700	10100	6130	1560	409	237	1800	3360
8	10500	10100	6220	1560	348	219	1840	3420
9	10000	9570	5470	1420	221	268	2010	3590
10	9630	9070	5010	1310	209	319	2300	3760
11	10200	8870	4450	1170	78	250	2610	3660
12	13600	8270	3950	1180	61	345	2940	3520
13	16600	7970	3770	1130	51	373	3220	3460
14	19400	7530	3690	1080	58	369	3360	3450
15	20200	7090	3960	1220	25	402	3510	3580
16	18700	6710	3710	1490	8	369	3520	3760
17	17100	6590	3820	3750	-25	343	3750	3860
18	18100	6650	4100	4070	-79	455	3810	3760
19	24900	6740	4520	4490	-63	492	3970	3630
20	25800	6630	4010	4130	-91	480	3990	3710
21	26000	6400	3040	3350	-131	492	3910	3560
22	24800	6500	2530	2950	-112	600	3940	3660
23	22500	6460	2230	2710	-121	754	3780	3790
24	20900	6370	2080	2500	-111	735	3840	5010
25	19200	6230	2160	2090	-69	799	3800	6970
26	17100	5900	3460	1740	15	782	3890	6820
27	15600	7170	4500	1450	50	737	3910	6800
28	14400	7520	4670	1220	115	929	3890	6790
29	13500	7740	4380	1250	26	1010	3710	6360
30	12500	7490	3550	1100	46	1020	3490	5820
31	11500		3310		-7	1130		5520
Mean	16000	8200	4520	2080	160	480	2990	4330
Ac.Ft. for Month	981000	488000	278000	124000	9830	29500	178000	266000

NOTE: This represents the flow past Sacramento (below the City of Sacramento intake) to the Delta. The discharges of this table have been computed by adding to the measured Verona discharges the measured inflow of return water and American River and subtracting therefrom the measured diversions between Verona and Sacramento. A gaging station is not maintained at Sacramento because of tidal action.

TABLE 13

DISCHARGE OF FEATHER RIVER AT NICOLAUS

Day	Daily Discharge in Second-feet					
	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	2040	569	91	0	174	796
2	2000	498	72	81	199	844
3	2040	441	49	192	195	932
4	1950	378	52	120	199	1010
5	1720	317	62	84	204	868
6	1520	288	36	49	208	653
7	1360	275	32	50	252	590
8	1360	239	9.5	57	318	724
9	1270	223	9	54	329	948
10	1180	223	1.4	33	406	1000
11	1090	223	0	32	490	772
12	1000	197	0	43	590	632
13	910	182	0	47	611	604
14	820	170	0	46	732	576
15	885	193	0	54	716	764
16	950	223	0	76	724	988
17	885	250	0	78	780	1020
18	852	561	0	57	812	932
19	820	547	0	46	844	796
20	748	460	0	47	844	639
21	564	404	0	66	730	611
22	514	369	0	94	611	844
23	470	300	0.5	125	646	1020
24	481	246	0	130	700	2700
25	508	227	0.7	154	740	2800
26	569	208	0	132	780	1940
27	1580	164	36	130	820	2080
28	1720	197	13	127	700	1900
29	1260	201	0.7	103	590	1620
30	950	136	3.6	113	597	1400
31	736		2.6	135		1280
Mean	1120	297	15.2	82.4	551	1110
Ac.Ft. for Month	68900	17700	935	5070	32800	68200
Monthly Diversions Below Nicolaus	2458	3008	1002	2568	520	1
Discharge to Sacto. River Acre-feet	66400	14700	0	2500	32300	68200

NOTE: Station moved in 1931 to Mile 9.3 above mouth of river and 0.1 mile below Nicolaus Bridge. Maintained by Water Resources Branch of U. S. Geological Survey under cooperative agreement.

TABLE 11

DISCHARGE OF SACRAMENTO RIVER AT SACRAMENTO

Day	Daily Discharge in Second-feet							
	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	12800	11400	7010	2900	841	-3	1310	3670
2	12500	11500	6800	2490	698	106	1430	3790
3	11800	11600	6920	2180	702	162	1530	3920
4	11600	11200	7010	1930	692	286	1410	3850
5	11400	10500	6990	1700	610	230	1440	3690
6	11100	10100	6520	1590	503	206	1670	3570
7	10700	10100	6130	1560	409	237	1800	3360
8	10500	10100	6220	1560	348	219	1840	3420
9	10000	9570	5470	1420	221	268	2010	3590
10	9630	9070	5010	1310	209	319	2300	3760
11	10200	8870	4450	1170	78	250	2610	3660
12	13600	8270	3950	1180	61	345	2940	3520
13	16600	7970	3770	1130	51	373	3220	3460
14	19400	7530	3690	1080	58	369	3360	3450
15	20200	7090	3960	1220	25	402	3510	3580
16	18700	6710	3710	1490	8	369	3520	3760
17	17100	6590	3820	3750	-25	343	3750	3860
18	18100	6650	4100	4070	-79	455	3810	3760
19	24900	6740	4520	4490	-63	492	3970	3630
20	25800	6630	4010	4130	-91	480	3990	3710
21	26000	6400	3040	3350	-131	492	3910	3560
22	24800	6500	2530	2950	-112	600	3940	3660
23	22500	6460	2230	2710	-121	754	3780	3790
24	20900	6370	2080	2500	-111	735	3840	5010
25	19200	6230	2160	2090	-69	799	3800	6970
26	17100	5900	3460	1740	15	782	3890	6820
27	15600	7170	4500	1450	50	737	3910	6800
28	14400	7520	4670	1220	115	929	3890	6790
29	13500	7740	4380	1250	26	1010	3710	6360
30	12500	7490	3550	1100	46	1020	3490	5820
31	11500		3310		-7	1130		5520
Mean	16000	8200	4520	2080	160	480	2990	4330
Ac.Ft. for Month	981000	488000	278000	124000	9830	29500	178000	266000

NOTE: This represents the flow past Sacramento (below the City of Sacramento intake) to the Delta. The discharges of this table have been computed by adding to the measured Verona discharges the measured inflow of return water and American River and subtracting therefrom the measured diversions between Verona and Sacramento. A gaging station is not maintained at Sacramento because of tidal action.

TABLE 12

DISCHARGE OF BUTTE CREEK NEAR EAST SIDE HIGHWAY

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		10					22
2		9					21
3		7					20
4		6					20
5		4					20
6		3					20
7		1					20
8		1					20
9		2					20
10		2					19
11		2					18
12		2					17
13		2					15
14		2					13
15	31*	2					12
16	31	2					10
17	31	2					8
18	30	3					6
19	28	3				4	4
20	27	3				12	3
21	25	3				16	1
22	24	3				22	1
23	22	3				22	1
24	21	3				22	1
25	19	3				22	2
26	18	3				23	3
27	16	3				23	4
28	15	3				23	6
29	13	3				23	8
30	12	3				23	10
31		3					12
Mean	**22.6	3.3				7.8	11.5
Ac.Ft. for Month	**720	200				466	708

NOTE: This record is estimated from current meter measurements and occasional staff gage readings. Station is located at bridge one mile west of the East Side Highway.

* Beginning of record for season.

** 16 days.

TABLE 13

DISCHARGE OF FEATHER RIVER AT NICOLAUS

Day	Daily Discharge in Second-feet					
	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	2040	569	91	0	174	796
2	2000	498	72	81	199	844
3	2040	441	49	192	195	932
4	1950	378	52	120	199	1010
5	1720	317	62	84	204	868
6	1520	288	36	49	208	653
7	1360	275	32	50	252	590
8	1360	239	9.5	57	318	724
9	1270	223	9	54	329	948
10	1180	223	1.4	33	406	1000
11	1090	223	0	32	490	772
12	1000	197	0	43	590	632
13	910	182	0	47	611	604
14	820	170	0	46	732	576
15	885	193	0	54	716	764
16	950	223	0	76	724	988
17	885	250	0	78	780	1020
18	852	561	0	57	812	932
19	820	547	0	46	844	796
20	748	460	0	47	844	639
21	564	404	0	66	730	611
22	514	369	0	94	611	844
23	470	300	0.5	125	646	1020
24	481	246	0	130	700	2700
25	508	227	0.7	154	740	2800
26	569	208	0	132	780	1940
27	1580	164	36	130	820	2080
28	1720	197	13	127	700	1900
29	1260	201	0.7	103	590	1620
30	950	136	3.6	113	597	1400
31	736		2.6	135		1280
Mean	1120	297	15.2	82.4	551	1110
Ac.Ft. for Month	68900	17700	935	5070	32800	68200
Monthly Diversions Below Nicolaus	2458	3008	1002	2568	520	1
Discharge to Sacto. River Acre-feet	66400	14700	0	2500	32300	68200

NOTE: Station moved in 1931 to Mile 9.3 above mouth of river and 0.1 mile below Nicolaus Bridge. Maintained by Water Resources Branch of U. S. Geological Survey under cooperative agreement.

TABLE 14

DISCHARGE OF AMERICAN RIVER AT SACRAMENTO

Day	Daily Discharge in Second-feet					
	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	3120	780	204	63	52	123
2	3070	670	186	85	47	117
3	3020	620	241	78	44	126
4	2980	546	230	84	40	127
5	2940	468	198	62	46	130
6	2900	468	182	62	50	136
7	2860	493	142	59	49	120
8	2610	519	189	57	64	128
9	1970	434	164	50	74	113
10	1840	418	177	50	82	141
11	1830	402	126	59	102	143
12	1840	350	138	74	90	125
13	1790	343	157	32	99	143
14	1740	287	137	34	85	149
15	2080	274	122	48	72	154
16	1770	269	127	48	73	98
17	1650	2320	133	34	76	72
18	1510	2130	110	56	81	78
19	1430	1580	90	41	88	74
20	1140	1060	87	37	103	106
21	921	811	62	50	109	115
22	921	670	81	50	122	92
23	943	546	84	50	110	96
24	866	476	71	60	117	409
25	877	395	80	70	109	747
26	2060	350	85	85	137	602
27	2220	308	90	60	150	722
28	1440	280	56	61	130	555
29	1130	246	28	56	120	425
30	943	226	60	54	108	337
31	943		52	54		337
Mean	1850	625	125	56.9	87.6	221
Ac.Ft. for Month	114000	37200	7690	3500	5210	13600
Monthly Diversions Below Gaging Station	61	26	44	45	28	18
Discharge to Sacto. River Acre-feet	114000	37200	7650	3460	5180	13600

NOTE: Gagings at "H" Street Bridge, 6.0 miles above mouth. Station maintained by Water Resources Branch of the U. S. Geological Survey under cooperative agreement.

TABLE 15

DISCHARGE OF MOKELUMNE RIVER AT WOODBRIDGE

Day	Daily Discharge in Second-feet							
	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	124	7	9.5	10	6.5	471	188	4.1
2	120	7	9	10	6.5	245	5.5	2.5
3	106	7	9	10	6.5	303	3.9	2.5
4	104	7	10	10	6.5	322	3.7	2.6
5	106	7	9.5	10	6.5	334	4.3	2.6
6	108	7	10	10	6.5	315	4.3	2.6
7	106	7	10	10	7	436	4.5	2.5
8	110	7	10	11	7	511	4.5	2.5
9	107	6	10	11	7	348	4.6	2.4
10	105	5	11	11	7	251	4.6	2.5
11	83	5	10	11	6	315	4.6	2.6
12	32	5.5	10	11	4.3	356	4.3	2.8
13	11	5.5	10	11	4.1	191	4.1	2.8
14	9.5	6	11	11	3.4	96	3.9	2.8
15	12	6.5	14	12	3.4	132	3.9	3.0
16	13	7	15	12	3.4	149	3.6	2.8
17	14	6.5	15	12	3.6	270	3.6	3.0
18	16	6.5	16	12	3.9	315	3.6	2.8
19	57	6	16	12	4.6	338	3.6	2.8
20	26	6.5	16	13	7	330	3.4	2.8
21	36	6.5	15	14	7	330	3.4	2.6
22	34	6.5	14	15	5.5	330	3.6	2.5
23	30	6.5	12	15	5	338	3.6	2.4
24	27	6.5	8	15	80	338	3.6	2.4
25	26	6.5	9	14	275	322	3.6	2.4
26	20	7.5	10	15	307	330	3.7	2.6
27	10	13	10	10	318	315	3.6	6
28	6.5	9.5	10	7	307	315	3.2	10
29	6	10	10	6.5	296	308	3.0	10
30	6	10	10	6.5	296	315	2.6	10
31	6		10		285	322		9.5
Mean	50.9	7.02	11.3	11.3	73.9	309	10.0	3.7
Ac.Ft. for Month	3130	418	695	672	4540	19000	595	228

NOTE: Gaging station located just below Woodbridge Irrigation District's Dam at Woodbridge. Station maintained by Water Resources Branch of the U. S. Geological Survey throughout the year, but the record is given here for the period of the irrigation season only.

TABLE 16

DISCHARGE OF MOKELUMNE RIVER AT THORNTON

Day	Daily Discharge in Second-Ft. Mar.	Apr.	May
1	114	14	16
2	117	14	15
3	108	14	14
4	106	14	16
5	108	13	16
6	110	13	15
7	109	12	16
8	108	13	16
9	110	14	16
10	106	12	16
11	110	8.5	17
12	66	9.5	14
13	34	10	15
14	25	10	16
15	22	12	16
16	22	13	17
17	21	13	17
18	23	12	18
19	39	12	18
20	41	9	18
21	32	11	15
22	41	12	17
23	36	11	17
24	33	12	15
25	32	12	14
26	28	12	14
27	25	18	15
28	18	18	15
29	16	18	15
30	16	14	15
31	14		15
Mean	57.7	12.7	15.8
Ac.Ft. for Month	3550	756	972

Station discontinued May 31, 1931.

NOTE: This station is located near Thornton at the lowest point on the river which is above tidal effect. Station maintained by Water Resources Branch of the U. S. Geological Survey.

TABLE 17

DISCHARGE OF SAN JOAQUIN RIVER NEAR NEWMAN

Day	Daily Discharge in Second-feet							
	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	465	165	107	146	77	30	54	65
2	448	173	112	152	70	46	48	67
3	430	175	105	136	74	48	48	62
4	398	169	107	121	65	48	50	64
5	357	160	101	112	58	43	48	65
6	337	160	100	109	65	48	54	64
7	320	146	96	119	59	46	59	64
8	304	132	103	130	58	48	60	64
9	298	121	118	127	48	48	58	62
10	304	112	110	118	30	48	60	62
11	324	103	103	118	36	47	65	69
12	327	105	101	114	47	47	64	74
13	304	116	105	114	56	47	60	74
14	286	125	107	112	58	46	67	74
15	280	121	93	118	58	46	62	76
16	271	109	103	119	67	46	60	76
17	260	112	116	116	67	53	59	77
18	251	105	105	116	62	50	34	77
19	243	100	100	118	64	39	37	76
20	237	100	96	116	74	26	43	77
21	227	103	101	107	72	22	44	77
22	227	89	96	112	67	29	48	76
23	217	91	100	132	62	36	37	79
24	202	96	118	118	64	41	40	79
25	200	94	156	101	58	40	43	79
26	195	110	160	101	56	33	41	81
27	192	119	156	91	62	28	48	79
28	186	127	160	89	58	39	54	82
29	182	119	160	84	59	44	56	81
30	177	109	139	88	48	44	59	77
31	167		136		32	53		74
Mean	278	122	115	115	59.1	42.2	52.0	72.7
Ac.Ft. for Month	17100	7260	7070	6840	3630	2590	3090	4470

NOTE: This station is at Mile 47.0 above Durham Ferry Bridge and is below the inflow of the Merced River. It is a permanent station of the Water Resources Branch of the U. S. Geological Survey. This station is maintained throughout the year, but the record is given here for the irrigation season only.

TABLE 18

DISCHARGE OF SAN JOAQUIN RIVER NEAR GRAYSON*

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		126	161	89	33	27	32
2		122	161	97	34	24	32
3		124	152	77	36	24	32
4		130	91	60	37	24	32
5		120	97	62	38	25	32
6		118	132	56	38	28	32
7		103	101	51	38	29	56
8		87	99	39	36	30	126
9		99	87	36	33	28	126
10		124	93	37	31	30	124
11		138	93	35	30	30	122
12		134	89	35	30	30	120
13		134	81	32	29	30	122
14		178	91	33	28	30	128
15		168	103	30	28	30	132
16		182	99	31	28	30	136
17		192	93	31	28	30	136
18		190	91	28	27	30	136
19		187	89	28	27	30	138
20		184	101	30	26	30	138
21		181	105	32	24	30	138
22	54**	178	107	34	24	30	140
23	56	154	107	35	24	30	140
24	62	134	113	36	24	30	140
25	68	159	111	33	24	30	140
26	62	215	87	32	24	30	140
27	71	236	83	31	24	31	142
28	97	232	73	32	25	31	142
29	109	232	64	32	25	32	144
30	105	213	69	32	26	32	144
31		169		35	27		146
Mean	***76	159	101	41.3	29.3	29.2	113
Ac.Ft. for Month	***1360	9800	6000	2540	1800	1740	6920

NOTE: Discharge obtained from current meter measurements and recording gage record.

* Station is at Laird Slough Bridge.
** Beginning of record for season.
*** 9 days.

TABLE 19

DISCHARGE OF SAN JOAQUIN RIVER NEAR VERNALIS

Day	Daily Discharge in Second-feet							
	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	1510	534	376	448	298	214	275	355
2	1510	514	376	441	307	220	268	337
3	1450	498	376	424	301	238	270	337
4	1300	498	385	388	282	242	290	343
5	1160	498	373	385	278	235	301	361
6	1060	486	361	406	280	242	304	367
7	1030	466	349	406	270	252	298	370
8	1030	438	340	392	255	238	268	427
9	1030	413	343	402	235	225	288	462
10	980	396	370	379	210	242	285	483
11	955	396	382	370	228	230	270	490
12	930	402	382	370	240	214	295	480
13	892	382	410	373	235	210	325	469
14	840	376	444	392	218	200	343	466
15	790	373	486	420	208	202	337	472
16	765	370	472	448	200	230	343	466
17	750	364	458	427	216	216	343	462
18	740	340	483	399	210	218	340	472
19	740	316	490	388	222	218	352	476
20	735	319	466	406	220	202	355	472
21	720	319	472	434	206	212	349	480
22	710	310	444	434	214	214	337	506
23	685	304	438	406	210	248	343	544
24	656	298	441	379	202	275	337	552
25	647	307	522	379	206	238	337	575
26	638	319	562	352	214	222	331	588
27	629	346	588	340	216	222	346	593
28	602	358	584	337	202	212	355	593
29	598	367	566	334	208	218	346	602
30	611	370	530	307	210	235	355	602
31	606		486		208	275		602
Mean	881	389	444	392	233	228	320	478
Ac.Ft. for Month	54200	23100	27300	23300	14300	14000	19000	29400

NOTE: Gaging station located at Durham Ferry Bridge below the junction of Stanislaus and San Joaquin Rivers. Station maintained by Water Resources Branch of the U. S. Geological Survey under co-operative agreement.

TABLE 20

DISCHARGE OF MERCED RIVER AT YOSEMITE VALLEY RAILROAD CROSSING

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		7.0	10	10	6.8	3.0	.6
2		7.0	10	10	10	2.0	.7
3		14.2	10	11	11	2.0	.6
4		17.8	8.1	11	11	2.0	.7
5		13.0	8.1	11	11	1.8	.6
6		4.4	10	10	11	1.4	.7
7		8.7	11	11	6.8	1.0	.8
8		8.1	15	17	6.8	.8	.8
9		8.1	15	12	7.1	.8	.8
10		8.1	15	12	7.4	.8	.8
11		10	15	12	7.7	.8	.8
12		11	15	11	8.0	.8	.8
13		11	15	11	8.3	.8	.8
14		11	15	11	8.6	.8	.8
15		15	15	13	8.9	.8	.8
16		14	14	17	9.2	.8	.8
17		14	14	17	9.5	.8	.8
18		13	14	14	9.8	.8	.8
19		15	14	13	10	.8	.8
20		15	14	13	10	.8	.8
21		15	14	12	11	.8	.8
22		15	14	11	11	.8	.8
23		18	13	11	11	.8	.8
24		15	11	8.0	11	.8	.8
25	*10	18	11	6.8	11	.8	.8
26	9.8	20	11	6.2	8.9	.8	1.2
27	9.8	15	11	6.8	6.8	.8	.7
28	8.4	15	11	7.6	5.4	.8	.5
29	7.0	15	11	6.8	4.0	.8	.7
30	7.4	14	11	7.6	4.0	.8	.5
31		11		11	4.0		.5
Mean	**8.7	12.8	12.5	11.0	8.6	1.1	0.7
Ac.Ft. for Month	**104	786	744	678	530	63	46

NOTE: Discharge obtained from current meter measurements and daily gage readings.

* Beginning of record for season.

** 6 days.

TABLE 21

DISCHARGE OF MERCED RIVER NEAR MOUTH*

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		61	140	61	37	43	76
2		72	151	56	43	38	74
3		61	121	57	39	43	67
4		70	99	59	39	40	69
5		56	94	56	39	41	74
6		59	94	52	41	43	72
7		56	109	52	43	47	74
8		61	118	52	47	50	72
9		84	106	35	47	47	72
10		82	96	31	54	56	79
11		61	106	43	59	62	86
12		59	89	50	38	50	91
13		72	91	59	48	62	91
14		72	99	54	39	58	91
15		61	109	45	35	50	91
16		74	109	68	47	58	91
17		74	96	57	43	43	94
18		74	102	52	39	21	91
19		79	109	54	31	17	96
20		70	96	59	24	38	96
21		68	91	57	23	38	99
22		54	112	52	17	38	99
23		74	134	50	31	32	99
24		96	89	47	27	34	96
25	68**	161	86	47	28	32	102
26	96	147	89	52	27	29	99
27	84	147	72	50	25	52	102
28	90	158	65	52	25	58	104
29	72	161	65	50	31	58	104
30	56	124	63	35	35	62	99
31		124		27	47		94
Mean	***77.7	86.2	100	50.7	37.1	44.7	88.5
Ac.Ft. for Month	***925	5300	5950	3120	2280	2660	5440

NOTE: Discharge obtained from current meter measurements and daily gage readings.

* Station is 1.1 mile above mouth at bridge on Hills Ferry Road.

** Beginning of record for season.

*** 6 days.

TABLE 22

DISCHARGE OF DRY CREEK NEAR OLD WATERFORD BRIDGE

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		8.1	16	11	3.7	1.4	5.9
2		8.3	14	9.6	4.0	1.4	6.8
3		9.1	14	6.3	4.5	1.3	7.6
4		9.9	13	2.9	5.0	1.3	7.6
5		11	12	2.7	5.1	1.3	7.6
6		12	12	2.6	5.3	1.3	7.6
7		11	12	2.4	5.4	1.3	7.6
8		11	11	2.3	5.6	1.3	7.7
9		11	10	2.1	5.7	1.3	7.7
10		11	9.9	2.0	5.9	1.3	7.7
11		10	9.3	1.8	6.0	1.3	7.7
12		10	8.7	1.7	6.5	1.4	7.7
13		9.8	8.1	1.5	7.0	1.7	7.7
14		9.5	7.5	1.4	7.6	2.0	7.7
15		9.1	6.9	1.2	6.8	2.3	7.7
16		8.8	6.4	1.1	5.9	2.6	7.7
17		8.5	5.9	1.8	5.0	2.8	7.7
18		6.8	5.4	2.1	4.1	3.1	7.6
19		5.4	4.9	2.4	3.2	3.0	7.5
20		4.2	4.4	2.7	2.3	2.8	7.4
21		3.0	3.9	3.0	2.1	2.5	7.3
22		2.8	3.7	3.3	1.8	2.2	7.2
23		7.3	3.5	2.2	1.5	1.9	7.1
24		12	3.1	2.2	1.5	2.0	7.0
25	*6.3	16	2.7	2.2	1.5	2.1	7.0
26	6.5	20	2.3	2.2	1.5	2.2	7.1
27	6.7	24	4.6	2.2	1.5	2.3	7.2
28	7.0	28	6.9	2.5	1.4	3.2	7.3
29	7.3	24	8.1	2.8	1.4	4.1	7.4
30	7.7	21	9.5	3.1	1.4	5.0	7.5
31		18		3.4	1.4		7.6
Mean	**6.9	11.6	8.0	2.9	3.9	2.1	7.4
Ac.Ft. for Month	**82	715	475	180	241	126	456

NOTE: Discharge record obtained from occasional current meter measurements and gage readings made at several day intervals.

* Beginning of record for season.

** 6 days.

TABLE 23

DISCHARGE OF DRY CREEK NEAR MODESTO

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		28	33	25	24	22	21
2		29	33	25	23	21	21
3		30	33	24	23	21	21
4		30	31	25	23	21	21
5		29	31	25	23	21	21
6		23	30	23	23	21	21
7		23	30	23	24	20	21
8		24	31	22	24	20	21
9		30	31	23	24	20	21
10		31	30	24	23	20	21
11		30	27	24	24	20	21
12		33	27	25	24	19	21
13		34	28	25	24	19	22
14		33	30	25	25	19	22
15		30	28	25	25	19	22
16		32	28	25	21	19	23
17		34	28	25	21	19	23
18		33	27	24	21	19	23
19		26	30	24	21	19	23
20		29	33	23	21	21	23
21		23	28	23	21	21	23
22		23	27	22	22	21	23
23		23	23	23	21	21	23
24	23*	24	24	22	22	21	33
25	23	25	23	22	21	21	33
26	23	33	22	23	20	21	33
27	23	34	23	24	20	21	33
28	29	35	23	24	21	21	27
29	29	38	22	24	21	21	26
30	29	36	23	23	21	21	25
31		34		23	21		23
Mean	**25.6	29.6	27.9	23.7	22.0	20.3	23.7
Ac.Ft. for Month	**354	1820	1660	1460	1350	1210	1460

NOTE: Record obtained from current meter measurements and daily gage readings. Measurements made at a point about two miles above mouth. No spill from Modesto Irrigation District to Dry Creek below gaging station.

* Beginning of record for season.
** 7 days.

TABLE 24

DISCHARGE OF TUOLUMNE RIVER AT ROBERTS FERRY BRIDGE

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		28	38	29	26	30	25
2		28	38	30	29	29	88
3		28	38	30	27	28	124
4		28	38	32	27	28	110
5		28	38	34	27	29	130
6		26	38	34	29	28	175
7		22	38	34	29	28	189
8		21	38	32	29	28	175
9		21	38	30	27	28	189
10		21	37	32	29	29	189
11		20	37	30	29	26	189
12		20	37	32	30	29	155
13		21	40	33	29	29	175
14		22	40	32	30	29	189
15		21	38	34	30	29	155
16		20	40	34	30	29	175
17		20	40	34	29	29	149
18		18	38	32	32	29	139
19		18	35	30	37	29	175
20		18	35	30	44	29	189
21		18	37	32	44	29	189
22		38	35	34	40	29	189
23		38	37	34	39	29	185
24		41	37	32	35	26	180
25	34*	48	41	35	29	25	175
26	30	46	38	35	25	24	155
27	30	45	34	29	27	24	189
28	29	43	31	29	27	24	189
29	26	41	31	26	28	23	175
30	26	40	31	26	29	23	155
31		38		25	29		155
Mean	**29.1	28.6	37.0	31.4	30.7	27.6	162
Ac.Ft. for Month	**348	1760	2200	1930	1890	1640	9960

NOTE: Discharge obtained from current meter measurements and recording gage record.

* Beginning of record for season.

** 6 days.

TABLE 25

DISCHARGE OF TUOLUMNE RIVER AT TUOLUMNE CITY*

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		267	269	255	249	261	263
2		267	267	257	251	251	261
3		269	267	257	253	251	257
4		273	269	257	253	253	273
5		271	269	255	251	253	277
6		273	267	259	255	255	279
7		273	267	259	255	253	300
8		275	267	261	253	249	317
9		273	265	259	253	253	329
10		271	263	259	255	255	322
11		269	263	257	253	255	329
12		267	263	259	251	255	327
13		275	263	259	251	255	328
14		277	263	255	255	255	322
15		275	267	255	253	263	327
16		273	273	255	255	267	327
17		275	273	257	253	267	317
18		277	273	255	249	266	315
19		269	271	257	243	266	312
20		263	271	257	247	266	310
21		263	277	257	255	266	322
22		265	277	257	259	265	334
23	271**	263	271	255	263	265	337
24	273	265	267	249	261	265	339
25	275	283	265	249	257	265	342
26	277	280	261	249	255	264	358
27	277	279	259	249	253	264	339
28	273	279	259	247	255	264	344
29	273	277	263	249	257	264	352
30	269	275	257	247	261	263	341
31		273		247	263		329
Mean	***273	272	267	255	254	260	317
Ac.Ft. for Month	***4340	16700	15900	15700	15600	15500	19500
Monthly Diversions Below Gaging Station		181	206	208	194	150	30
Discharge to San Joaquin R. Acre-feet		16500	15700	15500	15400	15400	19500

NOTE: Discharge obtained from current meter measurements and recording gage record.

* Station is 3.35 miles above mouth.

** Beginning of record for season.

*** 8 days.

TABLE 26

DISCHARGE OF STANISLAUS RIVER AT ORANGE BLOSSOM BRIDGE

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		32	32	32	32	25	25
2		32	32	32	32	25	25
3		32	32	32	25	25	25
4		32	32	32	25	25	25
5		32	32	32	25	25	25
6		32	32	32	25	25	25
7		32	32	32	25	25	25
8		32	32	32	25	25	25
9		32	32	32	25	25	25
10		32	32	32	25	25	25
11		32	32	32	25	25	25
12		32	32	32	25	25	25
13		32	32	32	25	25	25
14		32	32	32	25	25	25
15		32	32	32	25	25	25
16		32	32	32	25	25	25
17		32	32	32	25	25	25
18		32	32	32	25	25	25
19		32	32	32	25	25	25
20		32	32	32	25	25	25
21		32	32	32	25	25	25
22		32	32	32	25	25	25
23		32	32	32	25	25	25
24	32*	32	32	32	25	25	25
25	32	32	32	32	25	25	25
26	32	32	26	32	25	25	25
27	32	32	32	32	25	25	25
28	32	32	32	32	25	25	25
29	32	32	32	32	25	25	25
30	32	32	32	32	25	25	25
31		32		32	25		25
Mean	**32.0	32.0	31.8	32.0	25.4	25.0	25.0
Ac.Ft. for Month	**444	1970	1890	1970	1560	1490	1540

NOTE: Discharge obtained from current meter measurements and recording gage record.

* Beginning of record for season.
** 7 days.

TABLE 27

DISCHARGE OF STANISLAUS RIVER AT ELLIOT RANCH*

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		192	154	127	114	115	127
2		183	148	133	117	121	127
3		185	135	134	125	120	126
4		175	127	136	128	126	117
5		173	141	140	124	126	117
6		165	143	136	132	128	117
7		164	143	124	137	129	111
8		165	131	118	129	120	115
9		175	138	113	136	121	122
10		190	137	96	132	113	120
11		156	137	117	108	112	133
12		181	133	134	115	113	133
13		176	131	130	116	122	129
14		188	134	122	87	118	136
15		202	146	111	93	116	137
16		203	154	121	96	119	139
17		188	156	132	99	120	136
18		205	153	125	106	120	139
19		192	154	127	93	115	138
20		178	159	96	81	117	137
21		175	157	90	95	117	138
22		168	157	116	98	115	139
23	126**	167	153	114	118	126	145
24	127	170	133	117	123	119	147
25	122	173	136	126	98	129	146
26	151	176	133	139	90	129	145
27	175	179	131	136	97	133	143
28	185	182	130	129	96	135	140
29	186	185	133	126	100	117	136
30	186	176	128	122	112	125	135
31		165		120	120		134
Mean	***157	179	142	123	110	121	132
Ac.Ft. for Month	***2490	11000	8420	7550	6770	7210	8140

NOTE: Discharge obtained from current meter measurements and recording gage record.

* Station is 5.2 miles above mouth.

** Beginning of record for season.

*** 8 days.

CHAPTER IV

MEASUREMENTS OF DIVERSIONS

Measurements and records of diversions in 1931 have included those from the Sacramento River and its tributaries within the valley floor, those to the Delta Uplands from Cache Slough, Old San Joaquin River, Tom Paine Slough, and San Joaquin River, and those on the Stanislaus, Tuolumne, Merced, and San Joaquin Rivers and Dry Creek as obtained in connection with the return water measurements (See Chapter V). This report records a total of 544 diversions, segregated to the various sources as follows: Sacramento River 259, Colusa Trough 14, Back Borrow Pit (carrying drainage water from Colusa Basin along the back levees of Reclamation Districts 108 and 787) 8, Lower Butte Creek and Butte Slough 20, By-pass and Drainage Channels 26, Feather River 41, Yuba River 9, AmericanRiver 30, diversions to Delta Uplands from Cache Slough 1, from Old San Joaquin River 12, from Tom Paine Slough 8, and from San Joaquin River (below Vernalis gaging station) 33, San Joaquin River (above Vernalis Gage) 19, Stanislaus River 11, Tuolumne River 11, Dry Creek 7, and Merced River 35.

All of these diversions except five are accomplished by pumping. The five exceptions are gravity diversions, two on the Yuba River, two on the Feather River and one on the Sacramento River, and the records for these are obtained by means of canal ratings. In the case of the pumping diversions there are a few instances where the records are obtained by means of canal ratings but in the main the records are obtained from the relation established between electric

power consumption and pump discharge. This is possible due to the fact that practically all of the pumping plants are electrically operated. All pump operators keep daily operation records on blanks furnished by the Water Supervisor. These records are collected monthly by the field engineers at the same time that the readings of the electric meters are recorded. The relation between power input and water pumped is determined from current meter measurements of the discharge. At the larger pumping plants, several measurements are made during each season. At the smaller plants a sufficient number of measurements are made initially to determine the rating and thereafter at intervals sufficient to show any changes which may occur in the rating. With the daily operation records available it has been possible to compile from the monthly diversions as computed from the power record, a daily diversion record for each plant. In this report and the tables of this chapter, the records of monthly diversions only are given. The daily diversion records have been compiled as a supplemental report, however, and this is on file and available for reference in the office of the Division of Water Resources.

A summary of the 1931 diversions throughout the Sacramento-San Joaquin territory is shown in Table 28. A segregation is made to show the relative diversions from the various river sources. For each segregation the table shows also the acreage irrigated and the computed seasonal gross duty of water. The total 1931 diversions above Sacramento from the Sacramento River and its tributaries on the Valley floor amounted to 1,956,900 acre-feet. This water was diverted for 126,500 acres of rice and 202,800 acres of general crops or for a total of 329,300 acres, giving a seasonal gross unit diversion of 5.9 acre-feet

per acre. The diversions under the higher lifts to the Delta Uplands and the pumping diversions of the San Joaquin River and its tributaries amounted to 293,000 acre-feet. These were for 102,500 acres including only 500 acres of rice, giving a seasonal gross unit diversion of 2.9 acre-feet per acre. It should be noted that the total figures for the San Joaquin River and tributaries do not include the major gravity diversions by the canals of Miller and Lux nor those of Oakdale, South San Joaquin, Modesto, Turlock, Waterford and Merced Irrigation Districts, as these diversions are not within the scope of the measurements. Table 28 shows the data also for the Sacramento-San Joaquin Delta but it is to be noted that the Delta figures represent the consumptive use of water (see derivation, Chapter VI). They are, therefore, not comparable to the figures for the up-river areas which are for gross diversions and take no account of return water.

TABLE 28

DIVERSIONS, ACREAGE IRRIGATED AND GROSS SEASONAL DUTY OF WATER IN THE SACRAMENTO-SAN JOAQUIN AREA, 1931

Source	Seasonal Diversions Acre-feet	Acreage Irrigated			Gross Seasonal Duty of Water Ac.Feet per Acre
		Rice	General	Total	
Sacramento River, Redding to Sacramento	1335300	73894	141505	215399	6.2
Feather River below Oroville	464100	41359	40454	81813	5.7
Yuba River on Valley Floor	63300	2950	4823	7773	8.1
American River below Fairoaks	5600		2694	2694	2.1
By-Pass and Drainage Channels (Including Lower Butte Creek and Slough)	88600	8327	13317*	21644	4.1
Total above Sacramento	1956900	126530	202793	329323	5.9
Delta Uplands from Cache Slough, Old River, Tom Paine Slough and San Joaquin River	149800		60265	60265	2.5
San Joaquin River from Merced River to Vernalis Gaging Station	106000	500	34894	35394	3.0
Merced River below Snelling	19500		3623	3623	5.4
Tuolumne River below Roberts Ferry Bridge, and Dry Creek	3800		965	965	3.9
Stanislaus River below Orange Blossom Bridge	13900		2261	2261	6.1
Total Delta Uplands and Pumping Diversions of San Joaquin River and Tributaries **	293000	500	102008	102508	2.9
Sacramento-San Joaquin Delta ***	*** 1167400		*** 446310	*** 446310	*** 2.6

* Includes 4805 Gun Club Acreage.

** Note that major gravity diversions by canals of Oakdale, South San Joaquin, Modesto, Turlock, Waterford, and Merced Irrigation Districts and Miller and Lux are not included within the scope of these measurements.

*** The figures for the Delta represent the consumptive use of water (See Chapter VI) and are not comparable to the Gross Diversion figures of the Up-River areas which take no account of return water. The Delta acreage given is the total consumptive area including water surfaces, aquatic growths, weeds, etc. The total irrigated crop area was 343,355 acres.

TABLE 29

SUMMARY OF SACRAMENTO RIVER DIVERSIONS (ACRE-FEET)

River Section	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Totals
Redding to Red Bluff	1388	19278	21599	21121	21642	21926	21566	15023	143543
Red Bluff to Butte City	9502	83268	110128	91596	105271	92878	43005	18015	553663
Butte City to Colusa	3797	14700	19836	17800	19499	12324	3790	1438	93184
Colusa to Wilkins Slough	10967	65847	59976	54014	52097	45055	20640	4641	313237
Wilkins Sl. to Knights Ldg.	1146	15142	14701	14516	11173	8228	3854	2206	70966
Knights Landing to Verona	607	4371	3978	3964	4014	3020	1021	531	21506
Verona to Sacramento	2792	20326	26938	24147	28380	25920	7946	2718	139167
Totals	30199	222932	257156	227158	242076	209351	101822	44572	1335266

TABLE 30

SACRAMENTO RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GENERAL	RICE
CITY OF SACRAMENTO	0.8 L	3-20" 1-18"	1807	2293	2566	2504	3128	2937	2388	2084	19707	MUNICIPAL	
— AMERICAN RIVER —	MILE 1.1 LEFT					SEE TABLE 14							
— BACK BORROW PIT R.D. 1000 —	MILE 1.3 LEFT					SEE TABLE 66							
E. FOURNESS	1.45 R	1-8"	1	39	23	12	55	15	12	2	159	75	
C. W. JONES	2.05 L	1-8"			110		78	94	14		296	137	
— RECL. DIST. 1000 DRAIN —	MILE 2.1 LEFT					SEE TABLE 65							
FRANK CHRISTOPHEL	2.4 L	1-5"	8	7	10	20	21	10	12	2	90	34	
H. M. SWALLEY	2.45 L	1-5"		17	14	17	3	9	4		64	35	
ALBERT ELKUS	2.9 L	1-5"				9	8	12	4		33	20	
HAYWARD REED	3.55 R	1-16"	421	294	521	296	293	69	73		1967	360	
W. E. M. BEARDSLEE	3.75 R	1-5"		20	26	28	11	2	1		88	44	
W. I. ELLIOTT	4.0 R	1-8"			59	53	40	12			164	134	
REESE AND GREER	4.65 R	1-7"		19	12	34	32	66	45	9	(1) 217	247	
HARBINSON BROS.	5.05 R	1-14"			155	141	24	52	27	54	(2) 453	87	
J. W. RODDAN AND SONS	5.25 R	1-8"		155	150	95	91	72	26	16	605	177	
C. H. MERKELEY ESTATE (MERKELEY BROS.)	5.3 R	1-8"			14	13	26				53	60	
A. CASSELMAN	5.5 R	1-6"(3)		6	19						25	35	
K. L. LOVDAL	5.7 R	1-10"			NO	DIVERSION							
J. E. BANDY	6.0 R	1-6"		50	5	33	34	18	4	1	145	50	
RIVERSIDE MUTUAL WATER COMPANY	6.10 L	2-18"	33	1224	1532	1502	1732	1490	658		8171	2623	
O. A. WHITE	6.4 R	1-6"				1	25	19	30	9	84	80	
A. MARTY	7.0 R	1-4"			NO	DIVERSION							
CALIFORNIA BANK AND TRUST COMPANY	7.5 L	1-8"		18	20	28	30	34			130	100	
F. L. MARTIN & A. B. CARTER (F. J. STAHL)	7.8 L	1-10"		24	76	19	79	39			237	80	
A. MARTY	7.9 R	1-8"		18	30	10	13	7	23	18	119	(4) 151	
M. E. AND R. F. BENNETT	7.9 L	1-10"	16		19	161	40	27	107	7	377	82	
M. MARTY	8.3 R	1-10"		227	24		12	140	95	28	526	(5)	
JULIUS BLAUTH	8.5 R	1-6"(6)			20	79					99	85	
H. WALDECK	8.7 R	1-6"		21.2	20.4	30.3	31.0	26.6	25.1	5.5	160.1	42	
T. T. C. GREGORY	8.95 R	1-18"		873	402	31	329	428	520	276	2859	1050	
A. A. SOUSA	9.15 R	1-2"			NO	DIVERSION							
A. A. SOUSA	9.20 R	1-6"			NO	DIVERSION						(7) 130	
A. A. SOUSA	9.35 R	1-14"		165	242	240	343	468	271	47	(8) 1776	(8) 420	

* MILEAGE ALONG RIVER ABOVE SOUTHERN PACIFIC BRIDGE, SACRAMENTO.
(1) AN ADDITIONAL UNDETERMINED AMOUNT OF WATER WAS RECEIVED FROM HARBINSON PLANT AT MILE 5.05 RIGHT.
(2) AN UNDETERMINED PORTION OF THIS WATER WAS SUPPLIED TO REESE AND GREER LANDS TO THE SOUTH. (SEE MILE 4.65 RIGHT).
(3) REPLACED FORMER 5" UNIT ON MAY 23, 1931.
(4) THIS IS THE TOTAL ACREAGE IRRIGATED BY THIS PLANT AND PLANT AT MILE 8.3 RIGHT. ADDITIONAL ACREAGE FORMERLY IRRIGATED FROM THE RIVER IS NOW SUPPLIED BY WELLS.
(5) SEE PLANT AT MILE 7.9 RIGHT.
(6) 5" UNIT REMOVED IN 1930 AND REPLACED BY THIS UNIT IN 1931.
(7) THIS ACREAGE IRRIGATED FROM THE SOUSA PLANT AT MILE 9.35 RIGHT.
(8) 130 ACRES ADDITIONAL ON OLD MERKELEY PLACE, MILE 9.20 RIGHT WERE IRRIGATED FROM THIS DIVERSION.

TABLE 30 (CONTINUED)

SACRAMENTO RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE
R. G. PEARSON AND P. S. DRIVER	9.80 L	1-14"		155	192	202	205	81			835	230	
CARL CASSELMAN	9.9 R	1-12"		35	98	91	55	114	80		473	131	
F. W. KIESEL	10.25 L	1-14"	60	161	182	144	389	332	168	40	1476	232	
REESE ESTATE (LOUIS ASHWANDAN)	10.75 R	1-12"		49	128	92	135	142	10	90	646	82	
R. F. FIDDYMENT AND E. J. CAHILL	10.75 L	1-12"		27	37	94	32	104	12	7	313	(1)210	
A. L. WHITE	11.6 L	1-10"		33	35	23	1	52	6		150	60	
CONAWAY RANCH	12.0 R	4-36"		6390	9611	7765	8997	8264	972		41999	670	4380
THOMAS O'CONNOR	12.5 R	1-12"		27	12	32	16	37	32		156	53	
JULIUS HAUSER	13.1 R	1-12"			NO	DIVERSION							
H. E. FRANKS	13.25 R	1-10"		15	18	16	50	19	9	2	129	20	
ELKHORN MUTUAL WATER COMPANY	14.1 L	1-24" 1-20"		1100	1716	2416	2475	2784	1019		11510	2690	
CALIFORNIA LANDS INCORPORATED	15.15 R	1-10"		70	151	137	160	209	161	21	909	180	
HARRY W. HALL (2)	15.7 L	1-6"			NO	DIVERSION							
CENTRAL MUTUAL WATER COMPANY	16.0 L	2-38"	203	3215	3805	3893	4842	3789	762		(3)20509	1491	3076
FRANK FISHER AND HENRY RICH (HERSHEY PLANT)	16.27 R	1-20"		354	743	764	749	502			(4) 3112	190	280
H. T. SILVIUS	16.4 R	1-6"			NO	DIVERSION							
W. B. BEACH	16.62 R	1-6"		22			70				93	(5)	
THOS. J. COX ESTATE	16.7 R	1-16"			NO	DIVERSION						(6)75	
FRANK FISHER AND HENRY RICH (MULL PLANT)	17.75 R	1-20"			527		226				753	290	
A. LINGGI	18.45 L	1-12"			122	53	115	68	87		445	150	
RICKENBACKER BROS. (7)	18.7 L	1-8"				21	19				40	45	
FRANK FISHER AND HENRY RICH (HOOVER PLANT)	18.95 R	1-18"			NO	DIVERSION							
NORTHERN MUTUAL WATER COMPANY	19.6 L	1-36"	243	3203	3492	3047	3366	3376	289		17016 (8)	3745 (8)	1117 (8)

* MILEAGE ALONG RIVER ABOVE SOUTHERN PACIFIC BRIDGE, SACRAMENTO.

(1) FIDDYMENT 95 ACRES AND CAHILL 115 ACRES.

(2) FORMERLY LISTED AS M. O. RUSS.

(3) THIS PLANT PUMPS WATER TO THE IRRIGATION CANAL BOTH FROM A DRAIN CANAL OF DISTRICT 1000 AND FROM THE SACRAMENTO RIVER. THE DIVERSIONS LISTED ARE THOSE FROM THE RIVER ONLY. THE WATER OBTAINED FROM THE DRAIN CANAL WAS AS FOLLOWS: (ACRE-FEET) JUNE 39, JULY 691, AUGUST 1303, SEPTEMBER 522, TOTAL 2555.

(4) A PORTION OF THE DIVERSION BY THIS PLANT AND THAT AT MILE 22.5 WAS BY-PASSED TO THE EAST BORROW PIT OF THE YOLO BY-PASS TO FURNISH PART OF THE WATER DIVERTED TO BY-PASS LANDS (SEE "YOLO BY-PASS DIVERSIONS - FISHER AND RICH").

(5) 75 ACRES ADDITIONAL ON ADJOINING BEACH AND COX LANDS WERE IRRIGATED FROM THIS PLANT. (SEE MILE 16.7 RIGHT).

(6) THIS ACREAGE WAS IRRIGATED FROM PLANT AT MILE 16.62 RIGHT.

(7) THIS PLANT WAS INSTALLED IN 1929 BUT WAS NOT LISTED IN THE 1929 OR 1930 REPORTS. THERE WERE NO DIVERSIONS IN 1929 OR 1930.

(8) CROSS CANAL, THE MAIN DRAIN BETWEEN R.D.1000 AND 1001 JOINS THE RIVER AT MILE 19.6 L. AT THE MOUTH OF THIS DRAIN NATOMAS NORTHERN MUTUAL WATER CO. MAINTAINS, DURING THE IRRIGATION SEASON, A BOOSTER PUMP SUPPLYING WATER FROM THE RIVER TO THE DRAIN. THE WATER IS RETAINED IN THE DRAIN BY A MOVABLE DAM AT ITS MOUTH. WHEN THE RIVER FALLS LOWER THAN THE CREST OF THIS DAM THE GATES ARE CLOSED AND THE BOOSTER PUMP STARTED. THERE ARE PUMPING PLANTS ALONG THE SOUTH BANK OF CROSS CANAL, BUT ONLY ONE, AT MILE 4.0 FROM THE MOUTH, WAS OPERATED IN 1931 AND THE ACREAGE SHOWN WAS IRRIGATED FROM THIS PLANT. FROM MARCH 28 UNTIL APRIL 9, INCLUSIVE, WATER WAS AVAILABLE IN CROSS CANAL WITHOUT PUMPING AT BOOSTER PLANT. THE DIVERSIONS HERE SHOWN ARE THOSE FOR THE PLANT AT MILE 4.0 ON CROSS CANAL FROM MARCH 28 TO APRIL 9 AND FOR THE BOOSTER PLANT FOR THE REMAINDER OF THE SEASON. THE WATER PUMPED THROUGH THE PLANT AT MILE 4.0 WAS AS FOLLOWS: (ACRE-FEET) MARCH 243, APRIL 2695, MAY 3663, JUNE 3168, JULY 3270, AUGUST 3027, SEPTEMBER 418, TOTAL 16484.

TABLE 30 (CONTINUED)

SACRAMENTO RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE
— VERONA GAGING STATION —	MILE 19.65					SEE TABLE 10							
— FEATHER RIVER —	MILE 20.9 LEFT					SEE TABLE 13							
— SACRAMENTO SLOUGH —	MILE 21.2 LEFT					SEE TABLE 61							
J. H. BERGHAUSER	21.7 R	1-15"		NO	DIVERSION								
FRANK FISHER AND HENRY RICH (KELLER PLANT)	22.5 R	1-22"		1007	1707	1691	1520	1444	294		(1)7663	900	200
HERSHEY ESTATE	26.95 R	1-18"				36	457	60			(2) 553	372	
MORSE INGLIN	28.2 R	1-6"	1	29	25	5	27	19	14	3	123	28	
KENDALL ESTATE (3)	29.7 R	1-8"		NO	DIVERSION								
P. L. TRAGANZA AND K. RUSSELL	29.75 R	1-8"		5.0	6.3	6.2	3.4	1.2	3.4	3.1	28.6	8	
LAURA FREITAS	29.9 L	1-12"		33	54	66	47	8	2		210	86	
LEO GIOVANETTI	30.2 L	1-3"		3.1	1.9	5.0	5.8	3.2	2.4	0.7	22.1	(4)14	
CHARLES GHISELLI	30.25 L			PLANT REMOVED									
M. S. LESLIE (5)	30.45 L	1-2"		.8	2.3	1.6	2.4	.3			7.4	(6)20	
KENDALL RANCH (LOWER)	30.6 R	1-7"		NO	DIVERSION								
FLOYD ANDERSON (7)	30.7 R	1-6"			5.0	5.0	5.6	5.6	2.5	3.6	27.3	14	
M. S. LESLIE (9)	30.75 L	1-3"(10)		1.8	2.0	0.9	2.0	0.1			6.8	(8)	
J. G. GOULART (7)	30.9 L	1-8"(11)			61	75	19				155	75	
A. C. HUSTON (J. A. SIMMONS)	31.5 R	1-12"		8	20	5	17	7	3		60	26	
M. ALONSO	31.8 L	1-6"(12)			12	5	4	6	5	2	34	35	
KENDALL RANCH	32.0 R	1-10" 1-18"		NO	DIVERSION								
SUTTER MUTUAL WATER COMPANY (PORTUGUESE BEND)	32.0 L	2-24"	606	3159	1704	1491	1414	1022	507	421	10324	(13)	(13)
COLLIER BROS.	32.5 R	1-10"		59	117	67	77	16	17	5	358	97	
GEORGE STAM	33.2 L	1-20"			91	314	272	375	130		1182	400	
EMMA SNOWBALL (LEO WETZEL) (7)	33.5 R	1-12"			151	128	102				381	140	
J. G. KNOX AND FRED LEISER	33.75 L	1-12"		65	19	62	39	53	41	93	372	(14)202	

* MILEAGE ALONG RIVER ABOVE SOUTHERN PACIFIC BRIDGE, SACRAMENTO.
(1) SEE FOOTNOTE FOR PLANT AT MILE 16.27 RIGHT.
(2) DIVERSION FROM THE RIVER TO GRAYS BEND (OLD CHANNEL NOW CUT OFF). BY MEANS OF A BOOSTER PLANT THIS WATER PLUS SEEPAGE IN GRAYS BEND WAS DIVERTED TO THE AREA IRRIGATED, AS FOLLOWS: (ACRE-FEET) MARCH 0, APRIL 144, MAY 479, JUNE 458, JULY 545, AUGUST 71, SEPTEMBER 0, TOTAL 1697.
(3) FORMERLY FRED TRAGANZA.
(4) INCLUDES 6 ACRES IRRIGATED FOR P. N. ASHLEY.
(5) FORMERLY CHARLES GHISELLI.
(6) THIS ACREAGE WAS IRRIGATED JOINTLY BY THIS PLANT AND THE PLANT AT MILE 30.75 LEFT.
(7) NEW INSTALLATION 1931.
(8) SEE PLANT AT MILE 30.45 LEFT.
(9) FORMERLY J. G. GOULART.
(10) 8" UNIT HAS BEEN REMOVED.
(11) PUMP FORMERLY LOCATED AT MILE 30.75 LEFT.
(12) PREVIOUSLY LISTED AS 4" PUMP.
(13) SEE SUTTER MUTUAL WATER COMPANY'S PLANT AT MILE 63.75 LEFT.
(14) KNOX 77½ ACRES, LEISER 124½ ACRES.

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TABLE 30 (CONTINUED)

SACRAMENTO RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GENERAL	RICE
— KNIGHTS LANDING GAGING STATION —	MILE 34.0					SEE TABLE 9							
— COLUSA BASIN DRAINAGE —	MILE 34.15 R					SEE TABLE 60							
MEEK ESTATE	34.2 R	1-10" 2-16"		1427	1810	1499	796	254	64	25	5875	1331	
RIVER FARMS COMPANY (TOWNSITE PLANT)	34.25 R	1-24" 1-26" 1-20"	528	2255	733	1106	1387	316	155	826	7306	1467	
COMMERCIAL INVESTMENT CO. (R. B. BAILEY)	34.85 L	1-12"		216	236	204	140	52	63		911	120 (1)	
FRED VAN LEW	35.2 L	1-12"			NO	DIVERSION						(2) 100	
J. H. SCOTT	35.6 L	1-7"		18	29	14	11			19	91	29	
A. COSTA (A. MORCONI)	35.8 L	1-10"		28	22	7	9	4	4		74	92	
AMEDEO MORONI	36.7 L	1-5"			NO	DIVERSION							
RIVER FARMS COMPANY (GARDEN PUMP)	36.95 R	1-2"	3.0	6.0	4.0	2.8	4.0	3.0	3.0	2.0	27.8	4	
W. W. BOTTIMORE	37.2 L	1-14"			NO	DIVERSION							
L. W. BUNDOCK	37.75 L	1-8"		24	23	29	9				85	122	
ADDIE REEL (3)	38.4 L	1-10"					99				99	75	
CALIFORNIA LANDS, INC. (H.A.KRAMER)	38.8 L	1-10"		21	69	32	27				149	107	
SUTTER BASIN CORPORATION (F. O. EASTMAN) (4)	39.4 L	1-12"			184	8	4	50			246	80	
COMMERCIAL INVESTMENT COMPANY (OTTO BUSHAW)	39.8 L	1-10"			33	3	10	38			84	50	
WM. DUFFEY, JR.	39.9 L	1-6"		13	8	6	19	2			48	29	
SUTTER MUTUAL WATER COMPANY (STATE RANCH BEND)	40.6 L	1-24"	74	2984	2247	1771	1854	1703	225	780	11638	(5)	(5)
BUELL RANCH (M. K. DEAN)	42.2 L	1-6"			41	72	3		1	5	122	40	
SUTTER BASIN CORPORATION (E.BOZZI)	42.3 L	1-8"		46							46	58	
A. KRAMER	43.1 L (6)	1-12"		7	23	10	15	27	17		99	50	
EL DORADO RANCH	43.1 R	1-18"	142	791	278	448	302	683	125	242	3011	704	
RIVER FARMS COMPANY (RECLAMATION DISTRICT 2047 PLANT)	43.1 R	2-50"			NO	DIVERSION							
— RECLAMATION DISTRICT 108 DRAIN —	MILE 44.0 R					SEE TABLE 59							
JOHN CLAUSS (A. R. WAYBUR)	47.3 L	1-14" 1-24"(7)		463	730	1282	943	1039	1099	279	5835	253	195
P. J. HIATT	48.7 L	1-20"	136	1380	1491	1393	1294	1291	898		7883	240	350
P. J. HIATT (3)	49.7 L	1-14"			235	391	411	442	389		1868	50	75

* MILEAGE ALONG RIVER ABOVE SOUTHERN PACIFIC BRIDGE, SACRAMENTO.
(1) 100 ACRES ADDITIONAL WERE IRRIGATED ON VAN LEW LAND. SEE MILE 35.2 LEFT.
(2) IRRIGATED FROM COMMERCIAL INVESTMENT COMPANY PLANT AT MILE 34.85 LEFT.
(3) NEW INSTALLATION 1931.
(4) FORMER LESSEE WAS A. COLLI.
(5) SEE PLANT AT MILE 63.75 LEFT.
(6) MILEAGE CORRECTION. PREVIOUSLY GIVEN AS 42.65 LEFT.
(7) 24 INCH UNIT ADDED IN 1931.

TABLE 30 (CONTINUED)

SACRAMENTO RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE
RECLAMATION DISTRICT 108 (TYNDALL MOUND PLANT)	51.1 R	2-24" 1-36"	65	2332	2159	1635	1201	346			7738	1416	
G. J. STAM	51.2 L	1-24"		748	597	556	852	793	586		4132	210	160
J. F. WHITE	51.5 L	1-8"			7	14	14				35	20	
T. J. CUMMINS RANCH COMPANY	52.0 L	1-16"		49	267	450	363	129	73		1331	320	
G. W. STRETTER (A. R. WAYBUR)	55.1 L	1-20"		356	438	399	79		48	16	1336	501	
RECLAMATION DISTRICT 108 (BOYER BEND PLANT)	56.4 R	1-18" 1-30"	198	947	1282	1598	857	853	65		(1)5800	898	
J. M. MILLER	56.65 R	1-12"		107	58						(2) 165	68	
G. W. STRETTER (A. R. WAYBUR)	56.95 L	1-20"		377	67						444	106	
J. M. KIRKUP	57.5 L	1-16"		29	8	143	9	77	22		288	103	
H. S. FASIG	58.2 L	1-15"		67	279	287	203	1	6		843	220	
J. R. YOUNG	58.9 L	1-16"			6.3						6.3	(3)	
LAMB BROS.	59.8 L	1-12"		49	53	60	20	49			231	168	
RECLAMATION DISTRICT 108 (STEINER BEND PLANT)	59.85 R	1-16" (4)		297	1089	928	152				2466	370	
BLANCHE COULTER BROWN	60.5 L	1-12"		21	44	59	20	41	7		192	85	
SUTTER BASIN CORP. (COLES LANDING)	61.3 L(5)	1-12"		36	94	81					211	100	
JOHN KOLPIEN (6)	61.3 R	1-12"		12	25	23	24	19	4		107	(7)52	
HINES RANCH	62.3 R	1-10"		9	28	5	42	16		8	108	35	
WM. BAKER	62.6 R	1-8"		27	4					4	35	33	
— WILKINS SLOUGH GAGING STATION —	MILE 62.9					SEE TABLE 8							
RECLAMATION DISTRICT 108 (WILKINS SLOUGH PLANT)	63.2 R	5-42"	4383	22501	18801	16683	16247	12289	1759		92663 (8)	5885	1096 (8)
SUTTER MUTUAL WATER COMPANY (TISDALE) & IMPROVEMENT MUTUAL WATER COMPANY	63.75 L	6-42"	4611	28993	25547	24269	22146	22410	13867	3249	145092 (9)	27846 (10)	6471 (10)
LA ROCA MONTE RANCHO COMPANY (11)	64.3 R	1-12"		16	10	17	28	15			86	34	
TISDALE IRRIGATION AND DRAINAGE CO.	64.4 L	1-12"	212	346	407	266	402	345	132	17	2127	1894 (12)	

* MILEAGE ALONG RIVER ABOVE SOUTHERN PACIFIC BRIDGE, SACRAMENTO.
(1) INCLUDES SOME WATER FURNISHED TO J. M. MILLER, MILE 56.65 RIGHT.
(2) ADDITIONAL WATER WAS OBTAINED FROM RECLAMATION DISTRICT 108, BOYER BEND PLANT, MILE 56.4 RIGHT.
(3) NO IRRIGATION. CHECKING PUMP OPERATION.
(4) 14" UNIT HAS BEEN REMOVED.
(5) MILEAGE CORRECTION. PREVIOUSLY GIVEN AS 60.2 LEFT.
(6) LISTED PREVIOUSLY AS A. KOLPIEN.
(7) INCLUDES 25 ACRES ON MACHADO RANCH TO SOUTH.
(8) ADDITIONAL WATER FOR A SMALL PORTION OF THIS ACREAGE LYING ALONG THE BACK BORROW PIT WAS OBTAINED FROM PLANTS ON THAT CHANNEL. SEE "BACK BORROW PIT DIVERSIONS" MILES 13.25 LEFT AND 22.5 LEFT.
(9) INCLUDES WATER DELIVERED TO IMPROVEMENT MUTUAL WATER CO. AS FOLLOWS: (ACRE-FEET) MARCH 520, APRIL 2402, MAY 1569, JUNE 1684, JULY 661, AUGUST 704, SEPTEMBER 322, OCTOBER 0, TOTAL 7862.
(10) THESE FIGURES GIVE THE TOTAL ACREAGE IRRIGATED FROM THE PORTUGUESE BEND, STATE RANCH BEND, AND TISDALE PLANTS AT MILES 32.0 L, 40.6 L, AND 63.75 L, RESPECTIVELY. THE GENERAL CROP FIGURE INCLUDES 2181 ACRES IRRIGATED BY IMPROVEMENT MUTUAL WATER COMPANY (R.D. 1600) ENTIRELY FROM TISDALE PLANT.
(11) FORMERLY CLOMAN LAND AND SHEEP COMPANY.
(12) THIS IS THE TOTAL TISDALE IRRIGATION CO. ACREAGE IRRIGATED FROM THIS PLANT AND THE OTHER COMPANY PLANT (WINSHIP) AT MILE 67.1 L. 122 ACRES ADDITIONAL ON THE DESMOND WINSHIP LANDS WERE IRRIGATED FROM THE PLANT AT MILE 67.1 LEFT. (SEE MILE 67.2 LEFT).

TABLE 30 (CONTINUED)

SACRAMENTO RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE
COLUSA DEVELOPMENT COMPANY (SPRECKLES SUGAR COMPANY)	64.9 R	1-24"		291	395	395	244				1325	400	
M. BETTENCOURT (1)	65.1 R	1-10"		5	14	23	2	21	15		80	34	
D. L. W. HOFFMAN	65.7 L	1-12"		48	11	29	26	47	56	15	232	65	
J. L. BROWNING	66.4 R	1-20"		405	993	659	678	226			2961	(2)1400	
TISDALE IRRIGATION AND DRAINAGE COMPANY (WINSHIP PLANT)	67.1 L	1-20"		479	638	491	1218	1076	439		4341	(3)	
DESMOND A. WINSHIP, ET AL	67.2 L	1-10"			NO	DIVERSION						(4) 122	
MERIDIAN FARMS WATER CO. #6	67.4 L	1-12"		109	166	186	183	140	75		859	(5)	
ENNIS-BROWN COMPANY	67.5 L	2-24"		1638	1315	1191	1259	1395	961		7759	(6)2797	
— RECLAMATION DISTRICT 70 DRAIN —	MILE 68.8 LEFT					SEE	TABLE	58					
MERIDIAN FARMS WATER CO. #5	68.81 L	1-12"		359	392	427	297	431	311		2217	(5)	
J. L. BROWNING	69.0 R	1-24"	74	47	806	325	424	351	14		2041	(7)	
FAXON RANCH	69.2 R	1-18"	20	235	129	172	186	45	18	148	953	625	
— EDDYS FERRY (GRIMES) —	MILE 69.45												
WILBUR JENSEN AND MARY CECIL, ET AL	70.35 R	1-24"			NO	DIVERSION							
HOUCHINS-HOFFMAN-BECKLEY AND RITCHIE (J. M. RITCHIE)	70.4 R	1-20"		218	211	6	226		94		755	244	
MERIDIAN FARMS WATER CO. #4 (GRIMES)	71.1 L	1-24"		1288	1231	1271	1489	1460	1036	121	7896	(5)	
J. W. BROWNING (SPRECKLES SUGAR CO.)	71.9 R	1-12"		174	266	273	180	24			(8) 917	400	
ANTONE STEIDELMEYER	71.9 R	1-12"		122	186	321	104	51	26		(9) 810	100	
E. E. VANN (COFFMAN BROS.)	73.6 R	1-12"	68	186	301	138	254	72	46	25	1090	248	
MERIDIAN FARMS WATER CO. #3 (HDQTS.)	74.8 L	1-20"	21	855	730	427	396	369	184	77	3059	(5)	
J. H. YATES	76.1 L	1-12"		72	39	83	47	49			290	(10)145	
E. V. JACOBS	77.9 L	1-12"		378	221	59					658	300	
SEBIA DAVIS	78.8 R	1-36"	410	1587	1528	1582	1464	1105	201		7877	1500	
C. E. REISCHE	79.0 L	1-10"	92	87	68	92	73	53	28		493	(11) 137	
G. W. WOODS	79.7 L	1-10"		45	44	30	40	34	9		202	(12)127	
— MERIDIAN BRIDGE —	MILE 79.85												

* MILEAGE ALONG RIVER ABOVE SOUTHERN PACIFIC BRIDGE, SACRAMENTO.
(1) PREVIOUSLY LISTED AS OTTO WACKERMAN.
(2) THIS IS THE TOTAL ACREAGE IRRIGATED BY THIS PLANT AND THE PLANT AT MILE 69.0 RIGHT.
(3) SEE PLANT AT MILE 64.4 LEFT.
(4) THIS ACREAGE IRRIGATED FROM TISDALE IRRIGATION AND DRAINAGE COMPANY PLANT AT MILE 67.1 LEFT.
(5) SEE PLANT AT MILE 80.0 LEFT.
(6) ENNIS-BROWN COMPANY 2388 ACRES, ALAMEDA FARMS COMPANY 257 ACRES, AND GEORGE SPRINGER 152 ACRES.
(7) SEE PLANT AT MILE 66.4 RIGHT.
(8) ADDITIONAL WATER WAS RECEIVED FOR THE STEIDELMEYER PLANT AT MILE 71.9 RIGHT.
(9) A PORTION OF THE DIVERSION BY THIS PLANT WAS USED ON THE BROWNING LAND TO THE SOUTH. SEE J. W. BROWNING, MILE 71.9 RIGHT.
(10) INCLUDES 60 ACRES IRRIGATED FOR MERIDIAN FARMS WATER COMPANY (SEE MILE 80.0 LEFT); ALSO 20 ACRES ON ADJOINING LAND TO THE NORTH.
(11) INCLUDES NEIGHBORING ACREAGE. SEGREGATION AS FOLLOWS: REISCHE 62; ROCKHOLT 20; KILGORE 32; STAAS 23.
(12) INCLUDES NEIGHBORING ACREAGE. SEGREGATION AS FOLLOWS: WOODS 52; E. V. JACOBS 35; SUMMY AND BURTIS 40.

TABLE 30 (CONTINUED)

SACRAMENTO RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GENERAL	RICE
MERIDIAN FARMS WATER COMPANY 1 AND 2 (MERIDIAN)	80.0 L	1-24" 1-18"		3028	3206	2652	2522	2301	1116	512	15337	8422 (1)	
GEO. P. AHLF	80.3 R	1-8"			72				24	40	136	50	
M. S. DAVIS	80.9 L	1-5"		20	14	12	10	3	3		62	17	
H. J. WONDERLY AND GEO. F. SPRINGER	81.5 L	1-16"	1	109	403	197	118	40	15	3	886	261	
STEIDELMEYER BROS.	81.9 R	1-16"	100	800	557	446	487	225	81		2696	729	
F. T. REISCHE AND L. J. WOODS	82.5 L	1-12"		44	42	40	132	12	15		285	111	
GEO. W. KIRKPATRICK	83.3 L	1-14"	24	14	12	21	32				103	(2) 75	
P. E. GARMIRE	83.6 L	1-10"			NO	DIVERSION							
— BUTTE SLOUGH —	MILE 84.0 L					SEE TABLE 57							
OAKLAND PRUNE COMPANY	86.1 R	1-12"	40	37	91	24	96			54	342	130	
J. F. PECK	86.6 L	1-18"	132	253	188	46	182				801	(3) 170	
LLOYD SCOGGINS	86.8 L	1-8"	54	51	52		57				214	52	
CAMPBELL-DWYER (LOWER)	86.9 R	1-16"	69	61	106	33	128	24	44	58	523	190	
CAMPBELL-DWYER (UPPER)	87.4 R	1-15"	71	48	60	22	47	55	19	41	363	156	
JACOBSEN AND O'ROURKE	87.6 L	1-10"		45	32	5					82	30	
SWINFORD TRACT IRRIGATION COMPANY	87.7 R	1-12"	123	98	81	107	26	7	21	100	563	145	
EDWARD K. LANGE (4)	88.0 R	1-6"	32		26	18					76	12	
W. D. DE JARNETT (NAGLE & LOCOVITCH)(5)	88.2 L	1-10"	73	46	64	79	69				331	(6) 55	
W. D. DE JARNETT (5)	88.7 L	1-14"	23	41		59	41				164	25	
COLUSA IRRIGATION COMPANY	89.2 R	1-20"	334	423	318	482	525	333	31	181	2627	912	
PHIL B. ARNOLD	89.25 L	1-8"		93	90	150	12	47			392	72	
P. V. BERKEY	89.3 L	1-12"		152	113	206					471	70	
— COLUSA GAGING STATION —	MILE 89.4				SEE	TABLE 7							
T. H. BOGGS AND SISTERS (7)	89.7 L(7)	1-6"		7		12	12	12	5	2	50	40	
T. H. BOGGS AND SISTERS	89.8 L	1-12"			NO	DIVERSION							
ROBERTS DITCH COMPANY	90.7 R	2-20"	476	439	392	510	579	401	182	93	3072	909	
GEO. P. AHLF	92.5 L	1-14"		124	153	116	141	21		76	631	155	
U. W. BROWN	93.0 R	1-12"		91	103	23	91				308	(8) 120	
GEO. P. AHLF	93.0 L	1-6"(9)			12	22	8	22		10	74	40	
I. G. ZUMWALT	93.2 R	1-36" 1-18"			NO	DIVERSION							
TUTTLE LAND COMPANY	94.3 R	1-15" 1-20"	361	509	262	272	489	141	97	112	2243	(10) 905	

* MILEAGE ALONG RIVER ABOVE SOUTHERN PACIFIC BRIDGE, SACRAMENTO.

(1) THIS IS THE TOTAL ACREAGE IRRIGATED FROM THIS PLANT AND THE OTHER COMPANY PLANTS AT MILE 67.4 L, 68.81 L, 71.1 L, AND 74.8 L. 257 AND 60 ACRES ADDITIONAL WERE IRRIGATED FROM THE PLANTS AT MILES 67.5 L AND 76.1 L, RESPECTIVELY. (SEE PLANTS AT THESE LOCATIONS).

(2) INCLUDES 35 ACRES ON ADJOINING PROPERTY OF H. B. TURNER.

(3) INCLUDES 30 ACRES ON ADJOINING LANDS OF MAX REICHEL.

(4) THIS PLANT WAS INSTALLED OCTOBER 21, 1929. NO RECORD OF WATER DIVERTED OR ACREAGE IRRIGATED IN 1930 WAS OBTAINED.

(5) FORMERLY LISTED AS J. B. DE JARNETT.

(6) ACREAGE SEGREGATED AS FOLLOWS: DE JARNETT 20; NAGLE 20; LOCOVITCH 15.

(7) PORTABLE PLANT.

(8) INCLUDES 60 ACRES ON ARNOLD PROPERTY TO THE SOUTH, AND 5 ACRES IRRIGATED FROM TUTTLE LAND COMPANY PLANT AT MILE 94.3 RIGHT.

(9) NEW UNIT INSTALLED IN 1931. A PORTABLE UNIT WAS USED AT THIS LOCATION PREVIOUSLY.

(10) INCLUDES 30 ACRES ON YERXA PROPERTY TO THE NORTH. 5 ACRES ADDITIONAL ON THE U.W. BROWN PLACE WERE SERVED. (SEE MILE 93.0 RIGHT).

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TABLE 30 (CONTINUED)

SACRAMENTO RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GENERAL	RICE
W. E. PINNEY	94.8 R	1-12"		74	46	64	26				210	(1)65	
J. W. BROWNING (C. MEYERS)	95.2 L	1-14"											
		1-20"				395	1082	22			1499	200	
M. E. HICOK (2)	95.5 L	1-5"		5.1	3.6						8.7	16	
A. N. LEWIS	95.6 L	1-20"											
		1-16"	144	60	225		210			109	748	(3)70	
I. G. ZUMWALT	95.7 R	1-12"	184	135	297	102	294		34	210	(4)1256	250	
BRIDGET GRAHAM ESTATE	95.8 L	1-16"											
		1-20"	33		206	14	17				270	95	
I. G. ZUMWALT	96.8 R				PLANT REMOVED								
J. P. AND J. T. O'SULLIVAN	97.7 R	1-12"	63	22	59	67	51	36			298	36	
FRANK BECKLEY	98.0 L	1-6"				25	31	37	7		100	55	
J. L. ERISEY	98.3 R	1-10"		83	9	95	58	101		10	356	48	
R. A. SPERRY (JOE BOGGS) AND COLUSA DEVELOPMENT COMPANY	98.6 L	1-15"	24	18	262	193	11				508	190 (5)	
WM. AND D. BOGGS	98.8 L	1-18"		44	78	64	85	88	41		400	143	
CHENEY SLOUGH IRRIGATION COMPANY	99.0 R	1-36"	798	612	751	582	292	69		58	3162	810	
		2-26"											
TERRILL AND SARTAIN	99.2 L	1-20"	62	612	1171	1170	1099	1125	132	66	5437	(6)240	(6)600
DAVE GEORGE	99.8 L	1-16" (7)			166	103	181	53	40		543	155	
J. W. BROWNING (C. MEYERS)	100.8 L	1-20"			7	550	213				770	100	
A. F. & R. C. WOHLFROM	101.1 R	1-20"	44	177	182	224	56			78	761	130	
J. W. BROWNING (8)	101.9 L				PLANT REMOVED								
MAXWELL IRRIGATION DISTRICT	102.8 R	2-30"											
		2-18"		2161	1603	1557	1740	962	31	89	8143	5	700
		1-36"										(9)	(9)
AMERICAN TRUST COMPANY	103.7 R	1-16"	74	236	430	412	484	358	236	21 (10)	(10) 2441	410	
COMPTON-DELEVAN IRRIGATION DISTRICT (11)	103.8 R	2-24"											
		1-36"			NO DIVERSION							(11)	(11)
E. M. GORDON	103.9 R	1-16"											
		1-20"		13							13	3	
B. F. GOULD	104.8 L	1-26"	481	670	159	487	402	192	88		2479	(12)486	

* MILEAGE ALONG RIVER ABOVE SOUTHERN PACIFIC BRIDGE, SACRAMENTO.
(1) INCLUDES 30 ACRES ON ADJACENT LANDS OF KATE M. MARSH.
(2) NEW INSTALLATION 1931.
(3) ON LANDS OF COLUSA DEVELOPMENT COMPANY IN SECTIONS 9 AND 10, T 16 N, R 1 W.
(4) 60 ACRE-FEET ADDITIONAL DIVERTED EARLY IN NOVEMBER.
(5) ACREAGE DISTRIBUTED AS FOLLOWS: SPERRY 40 AND COLUSA DEVELOPMENT COMPANY 150.
(6) INCLUDES ACREAGES ON ADJOINING LANDS AS FOLLOWS: J. W. BROWNING 80 RICE AND JOE BOGGS 100 GENERAL CROPS.
(7) NEW UNIT REPLACING FORMER 12" PUMP.
(8) FORMERLY BYRON D. BECKWITH.
(9) ADDITIONAL MAXWELL IRRIGATION DISTRICT ACREAGES IRRIGATED FROM COLUSA TROUGH. SEE COLUSA TROUGH DIVERSIONS.
(10) DIVERSION IN OCTOBER WAS FOR GUN CLUB PURPOSES.
(11) SEE PLANT AT MILE 154.8 RIGHT.
(12) DIVIDED AS FOLLOWS: COLUSA DEVELOPMENT COMPANY 200, R. G. STORTON 40, DUNHAM AND GOULD 106, J. S. GOULD 60, B. F. GOULD 80, TOTAL 486.

TABLE 30 (CONTINUED)

SACRAMENTO RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE
THOUSAND ACRE RANCH (H. W. KELLER)	106.0 R	1-14"	167	4	69	155	84			73	552	150	
CALIFORNIA LANDS, INC. (1)	110.0 R	1-12"	50	155	75	149	22	56		112	619	220	
— PRINCETON FERRY —	MILE 112												
RECLAMATION DISTRICT 1004	112.1 L	1-24" 1-30" 1-50"		4209	6687	5069	5732	4841	1458		27996 (2)	799	1813
PRINCETON-CODORA-GLENN IRR.DIST.(3)	112.4 R	3-24"	803	3987	6371	5258	5937	3781	1417	129	(3) 27683	(4)2911	(4)2349
A. J. STONE (STONE AND FAULKNER)	112.6 L	1-10"		23		27	53	6	4		113	105	
BUTTE CITY RANCH (E.E.LENVILLE) (5)	115.4 R	1-6"		30							30	30	
EDWARD L. STEEL (W. L. KING)	115.5 L	1-12"	33	200	57	83	19		18		410	325	
— BUTTE CITY GAGING STATION —	MILE 115.8	(6)				SEE TABLE 6							
— BUTTE CITY BRIDGE —	MILE 115.9												
BUTTE CITY RANCH	115.95R(7)	1-12"			N O	D I V E R S I O N							
ANTHONY RADEMACHER	116.1 L	1-3"(8)		2.6	1.8	1.7	1.3	1.2	0.8	0.7	10.1	3	
CALIFORNIA LANDS, INCORPORATED (9)	117.8 R	1-10"		90	44	191	49			136	510	135	
TOM BALCH (10)	117.9R(11)	1-7"			25				1		26	22	
E. E. DOTY (12)	117.9R(11)	1-6"	2	19	14	6	22	10	14	3	90	40	
J. F. HARBOUR AND E. H. WILEY (WILFRED CARRIERE) (12)	118.4 R	1-4"			1.3						1.3	2	
TOM CROUCH	119.0 L	1-10"		15	16	19	30	17	8	10	115	92	
LOVELACE BROWN (12)	123.7 R	1-6"				20					20	23	
STAATS, KLEWE AND KILLEBREW	123.8 R				P L A N T		R E M O V E D						
PRINCETON-CODORA-GLENN I.D. (13)	123.9 R	3-24"	1714	5126	5858	5626	5765	6180	4701	2430	(13)37400	(13)	(13)
PROVIDENT IRRIGATION DISTRICT (14)	124.2 R	4-42" 1-36"		12188	20103	14539	15685	13552	7045		83112 (14)	720 (16)	6982 (15)
CALIFORNIA LANDS INCORPORATED (17)	124.4 R	1-16"	236	146	56	282	317	244	261		1542	377	

* MILEAGE ALONG RIVER ABOVE SOUTHERN PACIFIC BRIDGE, SACRAMENTO.
(1) FORMERLY ST. JOHNS PARK COMPANY.
(2) A PORTION OF THE DIVERSION BY THIS PLANT WAS USED ON BUTTE CREEK LANDS. SEE BUTTE CREEK DIVERSIONS MILE 3.9 R AND 9.3 R.
(3) SEE PLANT AT MILE 123.9 FOR ADDITIONAL WATER DIVERTED.
(4) THIS IS THE COMBINED ACREAGE FOR BOTH DISTRICT PLANTS AT MILES 112.4 AND 123.9 R. THE RICE FIGURE INCLUDES 550 ACRES SERVED THROUGH PROVIDENT IRRIGATION DISTRICT PLANT AT MILE 124.2 RIGHT.
(5) PLANT INSTALLED FOR ONE IRRIGATION IN APRIL. NO FIELD RECORD. DIVERSION ESTIMATED.
(6) GAGE MOVED DOWNSTREAM TO NEW LOCATION IN 1931.
(7) MILEAGE CORRECTION. PREVIOUSLY GIVEN AS 115.8 RIGHT.
(8) PREVIOUSLY LISTED AS 2½" PUMP.
(9) FORMERLY GEORGE HANSEN.
(10) GASOLINE OPERATED PLANT WHICH HAS BEEN INSTALLED FOR SOME TIME BUT RECORD FOR PREVIOUS YEARS HAS NOT BEEN REPORTED.
(11) PLANT IS ON BEE HIVE BEND AND OPPOSITE THIS MILEAGE ON MAIN CHANNEL OF RIVER.
(12) NEW INSTALLATION 1931.
(13) SEE PLANT AT MILE 112.4 RIGHT FOR ADDITIONAL WATER DIVERTED AND ACREAGE IRRIGATED.
(14) SEE PLANT AT MILE 154.8 FOR ADDITIONAL WATER DIVERTED AND ACREAGE IRRIGATED.
(15) INCLUDES 167 ACRES ABANDONED JUNE 15TH. ADDITIONAL RICE ACREAGES SERVED WERE: 550 FOR PRINCETON-CODORA GLENN IRRIGATION DISTRICT AND 586 FOR GLENN COLUSA IRRIGATION DISTRICT.
(16) INCLUDES 35 ACRES SERVED BY JACINTO IRRIGATION DISTRICT (SEE PLANT AT MILE 154.8 RIGHT).
(17) FORMERLY CALIFORNIA JOINT STOCK LAND BANK.

TABLE 30 (CONTINUED)

SACRAMENTO RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE
C. L. LEONARD (1)	126.3 R	1-12"			NO DIVERSION							(1)	
E. E. CRAMER	129.0 L	1-5"					6	29	1		36	12	
E. E. CRAMER	129.6 L				PLANT REMOVED								
— ORD FERRY —	MILE 130.8												
J. E. SCHARSCH	130.8 R	1-1½"			NO DIVERSION								
PARROTT-PHELAN ESTATE	141.5 L	5-24"			51	774	2348	3891	742	220	(2) 8026	(4) 1915	(3) 892
— OLD CHICO LDG. RR. BRIDGE —	MILE 142.1												
P. M. ROONEY	146.9 L	1-5"			NO DIVERSION								
M. F. ROSE (5)	148.7 R	1-6"		4	5	4	3	3	1		20	(6) 25	
M. F. ROSE (5)	148.9 R	1-6"	8	8	9	8	8	8	8		57	(7)	
— GIANELLA BRIDGE —	MILE 149.5												
HENRY GIANELLA	150.0 L	1-10"		155	67	82	127	68	38		537	148	
JOSEPH GIANELLA	150.0L (8)	1-10"			NO DIVERSION								
SACRAMENTO VALLEY SUGAR COMPANY	151.0 R	1-12" 1-18"		336	1245	286	1202	773	298	100	4240	1320	
A. HOLECEK	152.2 R	1-6"		8	14	14	15	10	10		71	30	
MAAS BROS.	154.6 R	1-5"			1	6	2	2	2		13	15	
GLENN COLUSA IRRIGATION DISTRICT	154.8 R (9)	1-100" 4-72" 2-50" 1-42" 2-30"	7264	59518	76340	63575	71961	62324	26878	13491	381351 (10)	23110	29313 (11)
JACINTO IRRIGATION DISTRICT	154.8R (9)	(12)	267	2664	2128	2210	3272	2418	1948	1352	16259	(13) 4596	
COMPTON-DELEVAN IRRIGATION DISTRICT	154.8R (9)	(12)		2276	2604	2520	2748	1762	76		11986	130	1839
PROVIDENT IRRIGATION DISTRICT (14)	154.8R (9)	(12)		602	1324	1194	1419	1407	606	42	(14) 6594	(14) 105	(14) 556
C. L. LEONARD	154.8R (9)	(12)			86	50	97	75	283	208	799	160	

* MILEAGE ALONG RIVER ABOVE SOUTHERN PACIFIC BRIDGE, SACRAMENTO.

(1) SEE PLANT AT MILE 154.8 RIGHT.

(2) ADDITIONAL WATER RECEIVED BY GRAVITY FROM BUTTE CREEK (ACRE-FEET) MARCH 3150, APRIL 4508, MAY 3063, JUNE 1497, JULY 755, AUGUST 0, SEPTEMBER 1359, OCTOBER 1325, TOTAL 15657.

(3) PHELAN ESTATE — ALL IRRIGATED FROM SACRAMENTO RIVER.

(4) PARROTT INVESTMENT COMPANY — IRRIGATED BOTH FROM SACRAMENTO RIVER AND BUTTE CREEK.

(5) NEW INSTALLATION 1931.

(6) THIS IS THE COMBINED ACREAGE SERVED BY THIS PLANT AND THE PLANT AT MILE 148.9 RIGHT.

(7) SEE PLANT AT MILE 148.7 RIGHT.

(8) PUMP ON NORD SLOUGH OR PINE CREEK LAGOON WHICH JOINS SACRAMENTO RIVER AT MILE 147.0 LEFT. PLANT IS LOCATED THREE MILES UP SLOUGH ON RIGHT BANK OR OPPOSITE MILE 150.0 LEFT, SACRAMENTO RIVER.

(9) THIS IS A COMMON POINT OF DIVERSION FOR THE GLENN-COLUSA, JACINTO, COMPTON-DELEVAN, AND PROVIDENT (PARTIAL) IRRIGATION DISTRICTS, AND C. L. LEONARD. THE DIVERSIONS BY EACH OF THESE AT THIS MILEAGE ARE LISTED SEPARATELY.

(10) THERE WAS NO GRAVITY DIVERSION FROM THE RIVER IN 1931. 420 ACRE-FEET ADDITIONAL WERE DIVERTED FROM STONY CREEK IN MARCH. RIVER DIVERSION IN NOVEMBER WAS 11059 ACRE-FEET.

(11) INCLUDES 586 ACRES SERVED THROUGH PROVIDENT IRRIGATION DISTRICT PLANT AT MILE 124.2 RIGHT. AN ADDITIONAL RICE ACREAGE OF 1343 ACRES WAS IRRIGATED FOR I. G. ZUMWALT (SEE COLUSA TROUGH, MILE 2.2 RIGHT).

(12) SAME PLANT AS THAT OF GLENN-COLUSA IRRIGATION DISTRICT.

(13) 35 ACRES ADDITIONAL WERE IRRIGATED FOR PROVIDENT IRRIGATION DISTRICT. SEE MILE 124.2 RIGHT.

(14) SEE PLANT AT MILE 124.2 RIGHT FOR ADDITIONAL WATER DIVERTED AND ACREAGE IRRIGATED.

TABLE 30 (CONTINUED)

SACRAMENTO RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE
— CORNING-VINA BRIDGE —	MILE 166.5												
A. F. LANDIS	166.7 R	1-3"		1	2	1	3	3	1		11	10	
WM. H. HALL	166.8 R	1-2"			NO DIVERSION								
R. A. FOSTER	168.7 R				PLANT REMOVED								
R. A. FOSTER	169.1 R	1-8"			NO DIVERSION								
HAMMON STOCK RANCHES	169.8 R	1-8"			NO DIVERSION								
HAMMON STOCK RANCHES	170.7 R	1-6"			NO DIVERSION								
HAMMON STOCK RANCHES	171.2 R	1-8"			NO DIVERSION								
HAMMON STOCK RANCHES	174.2 R	1-8"			NO DIVERSION								
— TEHAMA BRIDGE —	MILE 177.5												
E. B. NOBLE	184.5 R	1-14"		101	31	79	114	64	43	10	442	102	
— RED BLUFF BRIDGE —	MILE 193.45												
R. R. HOWELL	193.5 L	1-1½" 1-4"			29	32	31	22	11	4	129	15	
S. E. AYER	193.6 R				PLANT REMOVED								
S. E. AYER	194.1 R	1-6"			8		1				9	10	
G. E. SUTTON	196.2 R	1-6"	1	3	3	5	6	3	1	1	23	19	
J. A. EDWARDS	196.2 L	1-6"			4	16	2				22	(1) 32	
A. W. GIBSON (T. A. CROOK)	196.4 L	1-8"			36	17	11	8			72	(2) 16	
W. E. JOHNSON	196.5 L	1-4"			NO DIVERSION							(3) 3	
J. ERICKSON	196.6 L	1-3" 1-5"	10	5	22	25	22	4	27	7	122	30	
H. P. STICE	197.0 L	1-8"			NO DIVERSION								
FREEMEYER BROS.	197.65L	1-3"				6.9	3.6				10.5	27	
PEARL EDWARDS	197.73L	1-6"				6.2					6.2	10	
— RED BLUFF GAGING STATION (IRON CANYON) —	MILE 198.6					SEE TABLE 5							
— BEND FERRY —	MILE 207												
T. L. BONNETT	209.0 L	1-2½"				4	7	4	2		17	9	
J. F. NUNES	215.5 R	1-7"			NO DIVERSION								
— JELLEYS FERRY —	MILE 215.6												
J. F. NUNES	216.0 R	1-3"			NO DIVERSION								
W. A. HUNAEUS	216.4 L	1-3"				4.3					4.3	6	
HASKINS BROS.	218.0 L	1-5"(4)			17	18	23			2	60	54	
H. W. JOHNSON, JR.	221.0 R	1-10"			24	175	115				314	200	
— BALLS FERRY BRIDGE —	MILE 224.5												
— ANDERSON BRIDGE —	MILE 232.9												
L. C. SMITH AND G. W. GEORGE	233.0 L	1-6" 1-4"					3.3				3.3	4	
WM. MENZEL MEAT COMPANY	240.2 L	1-12"			156	168	125	159	110		718	(5) 110	

* MILEAGE ALONG RIVER ABOVE SOUTHERN PACIFIC BRIDGE, SACRAMENTO.
(1) INCLUDES 2 ACRES ON ADJOINING PROPERTY OF V. M. PETERSON.
(2) 3 ACRES ADDITIONAL IRRIGATED FOR W. E. JOHNSON (SEE MILE 196.5 L).
(3) THIS ACREAGE SERVED BY PLANT AT MILE 196.4 LEFT.
(4) REPLACING FORMER 4" PUMP.
(5) 20 ACRES ADDITIONAL WERE IRRIGATED FOR FITZPATRICK AND DEMPSTER AND J. L. HENDERSON (SEE MILE 240.5 L).

TABLE 30 (CONTINUED)

SACRAMENTO RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE
FITZPATRICK AND DEMPSTER AND J. L. HENDERSON	240.5 L	1-10"			NO	DIVERSION						(1) 20	
M. LEONARDINI ESTATE	241.5 L	1-8"		36	64	35	57	56	31		279	50	
ADAMS BROS.	242.0 R	1-6"			35	77	75	81	36		304	55	
-- REDDING-ALTURAS BRIDGE --	MILE 242.0												
JOHN DIESTELHORST	246.0 R			PLANT ABANDONED. SEE MILE 246.3 RIGHT									
ANDERSON-COTTONWOOD IRRIGATION DIST.	246.0 R	GRAVITY	1388	19178	21192	20588	21167	21550	21325	14991	141379 (2)	14000 (3)	
JOHN DIESTELHORST (4)	246.3 R	1-10"		64	111	52	70	76	62	30	465	30	
TOTALS			30199	222932	257156	227158	242076	209351	101822	14572	1335266	141505	73894

* MILEAGE ALONG RIVER ABOVE SOUTHERN PACIFIC BRIDGE, SACRAMENTO.

(1) IRRIGATED BY PLANT AT MILE 240.2 LEFT.

(2) SOME OF THIS DIVERSION RETURNS TO THE SACRAMENTO RIVER THROUGH THE CREEK CHANNELS BETWEEN REDDING AND SOUTH OF COTTONWOOD AS SEEPAGE AND DIRECT SPILL. OBSERVATIONS OF THIS RETURN FLOW WERE MADE AT VARIOUS TIMES AND ESTIMATED AS FOLLOWS: (ACRE-FEET) MAY 4200, JUNE 2400, JULY 1200, AUGUST 700, SEPTEMBER 500, OCTOBER 1200, TOTAL 10200.

(3) OF THIS AMOUNT THE REPORTED CROPPED AND SURFACE IRRIGATED AREA IS 7962 ACRES. THE REMAINING ACREAGE, MOSTLY PASTURE, IS ESTIMATED TO HAVE RECEIVED SOME WATER, CHIEFLY THROUGH SUB-IRRIGATION OR SEEPAGE.

(4) NEW INSTALLATION 1931 TO SERVE THE SAME LAND AS THE FORMER DIESTELHORST PLANT AT MILE 246.0 RIGHT, NOW ABANDONED.

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TABLE 31

*COLUSA TROUGH DIVERSIONS

WATER USER	**MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED		
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GENERAL	RICE	GUN CLUB (1)
HATTIE O'HAIR (2)	1.1 L(3)	32" BOX		138	144	120	120	120	180	60	882	150		
I. G. ZUMWALT	2.2 R	1-14"(4) 1-36"		59	288	209	149	180	50		935		1443 (5)	
SACRAMENTO SHOOTING CLUB	3.0 R	36" BOX			NO	DIVERSION								
A. D. J. LAND COMPANY	3.0 L	28" BOX			NO	DIVERSION								
SACRAMENTO SHOOTING CLUB	3.1 R(6) LAT. F 1.5 W	36" BOX						2	61	106	169			540
MAXWELL IRRIGATION DISTRICT #6	3.1 R(6) LAT. F 1.5 W	1-20"(7)			NO	DIVERSION								
LOUIS BYINGTON (8)	4.3 R	(9)			PLANT	REMOVED								
LOUIS BYINGTON (10)	4.3 L	1-8"			NO	DIVERSION								
SHARKEY GUN CLUB (10)	5.0 L	32"BOX(11)	NO	DIVERSION	UNTIL	NOVEMBER								
MAXWELL IRRIGATION DISTRICT #2A (12)	7.0 R	1-15" 1-26" 1-36"		679	951	932	897	720	804	1639	(13)6622		480 (12)	70 1945
BEARRUP & FESSIGM AND MARY E. ROUKE	11.5 L	2-32"BOX					125	125			250	250		
COMPTON-DELEVAN IRRIGATION DISTRICT	11.8 R				PLANT	REMOVED								
GUN CLUBS AT COMPTON WEIR	11.8 R	GRAVITY								49	(14) 49			200
— LATERAL HIGHWAY - BUTTE CITY TO WEST SIDE —		MILE 20.5												
RAZOR RANCH (GEO. ANTHONY) (15)	20.7 R	1-6"			72	26	65	28			191	130		
RAZOR RANCH (GEO. ANTHONY) (15)	21.1 R	1-15"		85	130	86	167	52		100	620	345		
HENRY JAMESON	22.0 R	1-16"		224	801	752	774	790	313		3654		230	
TOTALS			0	1185	2386	2250	2297	1892	1408	1954	13372	875	2153	2755

* MAIN DRAIN OF RECLAMATION DISTRICT 2047.
** MILEAGE ALONG TROUGH ABOVE COLUSA WILLIAMS HIGHWAY.
(1) ONLY DIVERSIONS WHICH OCCURRED PRIOR TO NOVEMBER 1ST ARE GIVEN FOR GUN CLUB ACREAGE. IN MOST INSTANCES THE DIVERSIONS FOR THIS PURPOSE EXTENDED INTO NOVEMBER AND DECEMBER.
(2) PLANT REINSTALLED IN 1931.
(3) BELOW COLUSA WILLIAMS HIGHWAY.
(4) NEW UNIT INSTALLED IN 1931.
(5) INCLUDES 1343 ACRES SERVED THROUGH GLENN-COLUSA IRRIGATION DISTRICT SYSTEM.
(6) PLANT DIVERTS WATER FROM A DRAIN CANAL CALLED LATERAL F. DRAIN ENTERS TROUGH AT MILE 3.1 RIGHT.
(7) 12" UNIT HAS BEEN REMOVED.
(8) PREVIOUSLY LISTED AS GOLDEN GATE GUN CLUB.
(9) PUMP MOVED TO MILE 5.0 LEFT.
(10) NEW INSTALLATION 1931.
(11) PUMP MOVED TO THIS LOCATION FROM MILE 4.3 RIGHT.
(12) SEE SACRAMENTO RIVER PLANT OF MAXWELL IRRIGATION DISTRICT (MILE 102.8 R) FOR ADDITIONAL WATER DIVERTED AND ACREAGE IRRIGATED.
(13) DIVERSION FOR GUN CLUE PURPOSES COMMENCED AUGUST 25TH.
(14) DIVERSION COMMENCED OCTOBER 28TH.
(15) PLANT WAS INSTALLED IN 1930 BUT NO RECORD OF OPERATION IN THAT YEAR WAS OBTAINED.

TABLE 32

**BACK BORROW PIT DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GENERAL	RICE
RECLAMATION DISTRICT 108 (WM. CRAWFORD & VAIL) (1)	8.8 R	1-14"			770	604	828	644	290		3136		300
HERSHEY ESTATE (C. J. KALFSBEEK)	11.15 R	1-16"(2) 1-14"		664	733	912	942	945	504		4700		960
HERSHEY ESTATE (WALLACE BROS.) (3)	13.25 L	1-14"			242		367				609		(3)
HERSHEY ESTATE	13.75 R		PLANT NOT INSTALLED 1931										
B. F. MUMMA	14.75 R	1-10"		94	223	195	255	186	14		967		170
— COUNTY LINE BRIDGE —	MILE 15.25												
COUNTY LINE GUN CLUB	15.75 R	1-15"				40	40		73	119	272	280	
C. R. SUGGET AND GREGORY ESTATE (4)	20.0 R	2-15" (5)		791	1615	1164	1415	1072	21		6078		730
GREGORY, BROWNING, KINDERY AND BRINDENBURG (A. KALFSBEEK, JR.) (6)	22.15 R	1-16" 1-12"		568	700	757	765	711	195		3696		450
J. W. BROWNING (VAIL) (3)	22.5 L	2-12"					104	601			705		(3)
— HANNUM BRIDGE —	MILE 22.8												
TOTALS			0	2117	4283	3672	4716	4159	1097	119	20163	280	2610

* MILEAGE ALONG BORROW PIT FROM OUTFALL GATE JUST ABOVE JUNCTION OF BORROW PIT WITH SACRAMENTO RIVER AT KNIGHTS LANDING.
** CARRIES RETURN WATER FROM COLUSA BASIN ALONG WEST BORDER OF RECLAMATION DISTRICTS 108 AND 787 AND THENCE TO DISCHARGE TO SACRAMENTO RIVER AT KNIGHTS LANDING.
(1) PLANT REINSTALLED 1931 - SEE PREVIOUS OPERATION IN 1926.
(2) REINSTALLED.
(3) THIS PLANT WAS INSTALLED IN 1931 TO SUPPLY ADDITIONAL WATER TO RICE LANDS WITHIN RECLAMATION DISTRICT 108 DURING PERIODS WHEN THE SUPPLY FROM THE WILKINS SLOUGH PLANT WAS DEFICIENT. (SEE SACRAMENTO RIVER DIVERSIONS, MILE 63.2 RIGHT).
(4) FORMERLY T. H. MUMMA.
(5) ADDITIONAL 15 INCH UNIT INSTALLED IN 1929.
(6) PLANT REINSTALLED 1931. SEE PREVIOUS OPERATION IN 1929.

TABLE 33

LOWER BUTTE CREEK AND BUTTE SLOUGH DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED		
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE	GUN CLUB
LOWER BUTTE CREEK														
RECLAMATION DISTRICT 833 (R. C. INGRAM)	2.9 L	36" BOX			88	258	522	433	16		1317	575		
EL ANZAR GUN CLUB	3.0 L	1-10"								27	27			70
RECLAMATION DISTRICT 1004 (COLUSA DELTA FARMS)	3.9 R	1-12" 1-15" 1-20"(3)		1026	1639	1265	1938	1869	300		8037	860 (2)	1106 (2)	
BUTTE LODGE GUN CLUB	4.0 R	1-22"						281	103	534	918			800
SOUTH BUTTE GUN CLUB	5.5 L	1-10"			NO	DIVERS	ION							
WINCHESTER GUN CLUB	5.5 L	1-12"								59	59			100
RECLAMATION DISTRICT 1004	9.3 R	GRAVITY			296	461	689	579	423	1113	(4) 3561	(4)	(4) (5)	800
BUTTE BASIN GUN CLUBS (6)	10 (7)	GRAVITY												5000
— BIGGS-AFTON ROAD —	MILE 19.4													
GLENN RICE FARMS (8)	19.8 R(9)	1-12"		163	379	271	398	429	129		1769		200	
JOHN HANNAH	20.2 R	1-20"			NO	DIVERS	ION							
JOHN HANNAH	21.2 R	1-36"			NO	DIVERS	ION							

* APPROXIMATE MILEAGE ALONG CREEK FROM JUNCTION WITH SACRAMENTO RIVER.

(1) ONLY DIVERSIONS WHICH OCCURRED PRIOR TO NOVEMBER 1ST ARE GIVEN FOR GUN CLUB ACREAGE. IN MOST INSTANCES THE DIVERSIONS FOR THIS PURPOSE EXTENDED INTO NOVEMBER AND DECEMBER.

(2) A PORTION OF THE DIVERSION FROM THE SACRAMENTO RIVER AT MILE 112.1 L WAS USED ON THIS ACREAGE AS WAS THE TOTAL DIVERSION PRIOR TO SEPTEMBER 1ST FROM BUTTE CREEK MILE 9.3 RIGHT.

(3) 20 INCH UNIT ADDED IN 1931.

(4) SEE BUTTE CREEK MILE 3.9 RIGHT.

(5) ONLY THE DIVERSION AFTER SEPTEMBER 1ST WAS USED ON THIS AREA.

(6) IN ADDITION TO GUN CLUBS UNDER OTHER DIVERSIONS LISTED, THIS COMPRISES THE GROUP OF CLUBS DIVERTING BUTTE CREEK WATER BY GRAVITY FROM THE MAIN OR INTERCONNECTING CHANNELS (SANBORN SLOUGH, ETC.) IN THE VICINITY OF MILE 10. THROUGH R.D.833 CANALS, MOST OF THE CLUBS IN THIS GROUP RECEIVE ALSO, DRAINAGE AND FEATHER RIVER WATER DIVERTED FOR THE CLUBS BY WESTERN CANAL. THESE DIVERSIONS ARE PRINCIPALLY IN THE FALL MONTHS AND THOSE FROM BUTTE CREEK HAVE NOT BEEN MEASURED. FOR DIVERSIONS VIA WESTERN CANAL SEE TABLE OF FEATHER RIVER DIVERSIONS MILE 59.7 R. THE AREA FLOODED BY THIS GROUP IS ESTIMATED TO BE APPROXIMATELY 5000 ACRES. THE CLUBS INCLUDED ARE WHITE MALLARD, WILD GOOSE, LAST CHANCE, BERRY AND KELLER, TULE GOOSE, BETTENS, GREENHEAD, FIELD AND TULE, NORTH BUTTE, HENSHAW, SACRAMENTO OUTING, ANDERSON, WEST BUTTE, AND COLUSA SHOOTING.

(7) ALL LEFT BANK DIVERSIONS EXCEPT WHITE MALLARD.

(8) IT IS REPORTED THAT THIS PLANT WAS INSTALLED IN 1923 AND USED IN 1924, 1926, 1928 AND 1930 FOR THE IRRIGATION OF RICE LAND. NO RECORD OF THE DIVERSIONS PRIOR TO 1931 HAS BEEN MADE OR REPORTED.

(9) PLANT IS ON HOWARD SLOUGH BUT OPPOSITE THIS MILEAGE ON BUTTE CREEK.

TABLE 33 (CONTINUED)

LOWER BUTTE CREEK AND BUTTE SLOUGH DIVERSIONS

WATER USER	*MILE AND BANK	AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED		
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE	GUN CLUB
**BUTTE SLOUGH														
M. MARTY	0.3 WEST	1-12"		62	55	65	37	35			254	64		
G. S. AND D. C. SMITH (1)	1.4 EAST	1-8"				107	202	224	29		562	100		
I. E. NALL	3.5 WEST	1-10"		54	37	57	43	50	13		254	122		
W. H. ROSS (C. E. RAY)	3.7 WEST	1-10"		5	18	39	52	42			156	42		
P. A. REISCHE	4.1 WEST	1-12"	4	31	40	113	155	66	6	6	421	210 (2)		
E. V. JACOBS (G. M. GOMES)	4.8 WEST	1-10"			124	85	132	115	99		555	105		
A. ARMSTRONG & COLUSA COUNTY BANK	5.1 WEST	1-10"		93	79	62	128	98	3		463	279		
T. J. HAGEMAN (1)	6.8 WEST	3-6"		3	110	87	110	98	44		452	140		
TOTALS (LOWER BUTTE CREEK AND BUTTE SLOUGH			4	1437	2865	2870	4406	4319	1165	1739	18805	2497	1306	6770 (3)

* APPROXIMATE MILEAGE ALONG SLOUGH FROM JUNCTION WITH SACRAMENTO RIVER.

** IN 1931 BUTTE SLOUGH IRRIGATION COMPANY BUILT A DAM AT THE MOUTH OF BUTTE CREEK AND THEREBY DIVERTED WATER VIA BUTTE SLOUGH TO PUMPING PLANTS AND A GRAVITY DIVERSION LOCATED ON WEST BORROW PIT OF SUTTER BY-PASS. THIS WAS A BUTTE SLOUGH DIVERSION IN ADDITION TO THOSE HERE LISTED AND EXCEPT FOR A SMALL UNMEASURED FLOW DIVERTED TO EAST BORROW PIT OF SUTTER BY-PASS OR SPILLED OVER WEST BORROW PIT CHECK DAM, WAS MEASURED BY THE SUTTER BY-PASS WEST BORROW PIT DIVERSIONS AT MILES 27.1 R, 28.4 R, AND 28.6 R. (SEE TABLE 34.)

(1) NEW INSTALLATION 1931.

(2) INCLUDES ADJOINING ACREAGES AS FOLLOWS: J. E. MESSICK 16; M. T. HEATON 20; FEITH 3, AND GRANNERMAN 5.

(3) NOTE THAT THIS INCLUDES 5000 ACRES FOR WHICH DIVERSIONS ARE NOT REPORTED.

TABLE 34

BY-PASS AND DRAINAGE CHANNEL DIVERSIONS

WATER USER	MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE
WEST BORROW PIT OF SUTTER BY-PASS													
SUTTER BASIN CORPORATION (WM. CRAWFORD) (2)	(1) 0.2 L	1-12"				112	145				(2) 257		(2)
SUTTER BASIN CORPORATION #6 (3)	2.2 L	1-8"					6	15			21		(3)
— SOUTHERN PACIFIC RR. CROSSING — MILE 2.5													
SUTTER BASIN CORPORATION #5 (3)	4.6 L	1-18"					555	509			1064		(3)
— KNIGHTS LANDING-MARYSVILLE CAUSEWAY — MILE 12.7													
— WEST BORROW PIT GAGING STATION — MILE 15.7		SEE TABLE 64											
MIDDLETON AND DESSEZ	17.0 R	1-15"			NO	DIVERSION							
— SOUTH LEVEE TISDALE BY-PASS — MILE 18.9													
— RECLAMATION DISTRICT 1660 GRAVITY RETURN — MILE 19.3				SEE FOOTNOTE TABLE 64									
D. C. SMITH, E. I. MC GRATH AND S. A. MC KEEHAN (4)	27.1 R	1-16" (5)		210	1005	595	1062	1185			(6) 4057	3180 (7)	
BUTTE SLOUGH IRRIGATION CO. LTD. (4)	28.4 R	GRAVITY				239	372	384	441		(8) 1436	(8)	
BURMOOD-TARKE-MC GRATH & MESSICK (4)	28.6 R	2-10"		23	399	193	250	101			966	540	
— NORTHERN ELECTRIC RR. CROSSING — MILE 29.15													
EAST BORROW PIT OF SUTTER BY-PASS													
SUTTER BASIN COMPANY	(9) 0.45 S*	1-8"			NO	DIVERSION							
RAY HUGHES (10)	0.1 S*	1-10"				205	29	97			331	150	
E. H. CHRISTENSEN (10)	1.4 N (11)	1-12"		256	343	303	365	314			1581		250
E. H. CHRISTENSEN (10)	1.4 N (11)	1-12"		209	280	228	350	217			1284		200
J. F. HOLMES AND R. E. HUGHES	1.5 N*	1-15"			NO	DIVERSION							
SUTTER BASIN COMPANY	2.2 N	1-16"			NO	DIVERSION							
J. F. HOLMES AND R. E. HUGHES (10)	3.1 N*	1-15"		327	659	576	673	560	56		2851		307
SUTTER BASIN COMPANY	4.1 N	1-16"			NO	DIVERSION							
— KNIGHTS LANDING-MARYSVILLE CAUSEWAY — MILE 4.4 N													
ARNOLD E. CHRISTENSEN (10)	5.8 N	1-15"		281	573	652	802	629	123		3060		200
— EAST LEVEE AND WADSWORTH CANAL — MILE 16.0 N													
R. L. MOREHEAD (12)	18.75 N	1-10"				86					(12) 86	(12)	
F. W. DE WITT & GEO. SMITH (10)	18.8 N*	1-4"			16	36	53	50	6		161	(13) 170	

(1) MILEAGE IS GIVEN NORTHERLY FROM DRAINAGE PLANT OF RECLAMATION DISTRICT 1500. MILE 9.15 WEST BORROW PIT IS OPPOSITE CHANDLER.
(2) TEMPORARY INSTALLATION 1931 SUPPLEMENTING FEATHER RIVER DIVERSION AT MILE 0.6 R. SEE ALSO SUPPLEMENTAL DIVERSION FROM SACRAMENTO SLOUGH AT MILE 0.3 LEFT.
(3) TEMPORARY INSTALLATION 1931 SUPPLEMENTING DIVERSIONS FROM FEATHER RIVER AT MILE 2.6 RIGHT.
(4) DIVERSIONS ON WEST BORROW PIT OF SUTTER BY-PASS AT 27.1 R, 28.4 R, AND 28.6 R (LATTER TWO ARE NEW INSTALLATIONS IN 1931) ARE FROM BUTTE SLOUGH WATER DIVERTED TO WEST BORROW PIT BY A DAM, CONSTRUCTED IN 1931, NEAR THE JUNCTION OF BUTTE SLOUGH AND SACRAMENTO RIVER.
(5) PREVIOUSLY REPORTED AS 10 INCH.
(6) SEE ADDITIONAL DIVERSION AT MILE 28.4 RIGHT.
(7) THIS ACREAGE IRRIGATED JOINTLY BY THIS DIVERSION AND THE ONE AT MILE 28.4 RIGHT.
(8) SEE PLANT AT MILE 27.1 RIGHT.
(9) MILEAGE IS GIVEN NORTHERLY OR SOUTHERLY FROM CHANDLER. CHANDLER IS OPPOSITE MILE 9.15 WEST BORROW PIT. PLANTS ARE ON LEFT BANK UNLESS MARKED WITH ASTERISK DENOTING RIGHT BANK.
(10) NEW INSTALLATION, 1931.
(11) PLANT IS ON DRAIN CANAL WHICH ENTERS BY-PASS AT THIS POINT.
(12) THIS PLANT WAS OPERATED TO SUPPLEMENT THE DIVERSION FOR THE ACREAGE REPORTED AT MILE 19.1 N.
(13) DE WITT 120 ACRES AND SMITH 50 ACRES.

TABLE 34 (CONTINUED)

BY-PASS AND DRAINAGE CHANNEL DIVERSIONS

WATER USER	MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GENERAL	RICE
EAST BORROW PIT OF SUTTER BY-PASS - CONTINUED													
MEYER-PLATTER-MOREHEAD-DEWITT BROS.-EPERSON & MIDDLETON (2)	(1) 19.1 N	1-14"		277	740	489	552	406	169		(3) 2633	(4) 677	
— NORTHERN ELECTRIC RR. CROSSING —		MILE 20.0 N											
TISDALE BY-PASS													
—SOUTHERN PACIFIC RR. CROSSING —	(5) MILE 2.1												
SUTTER BASIN COMPANY	2.25 S				PLANT	REMOVED							
SUTTER BASIN COMPANY	3.35 S				PLANT	REMOVED							
— WEST LEVEE SUTTER BY-PASS —	MILE 4.25												
SACRAMENTO SLOUGH													
SUTTER BASIN CORPORATION (WM. CRAWFORD) (7)	(6) 0.3 L	1-15"					248	79			(7) 327		(7)
A. R. WAYBUR	1.4 R	1-24"		177	1036	1553	1467	1665	729		6627		401
KNIGHTS LANDING RIDGE CUT													
RUSSELL BROTHERS	(8) 2.3 L	1-12"		48	22	44	34	46	44		238	91	
— RECLAMATION DISTRICT 730 DRAINAGE PLANT #2 —		MILE 3.8			SEE FOOTNOTE TABLE 60								
— WEST LEVEE YOLO BY-PASS —	MILE 6.3												
YOLO BY-PASS (EAST BORROW PIT OR TULE CANAL)													
— SACRAMENTO AND WOODLAND RR. CROSSING —	(9)	MILE 6.2											
— RECLAMATION DISTRICT 1600 DRAINAGE PLANT —		MILE 10.0		SEE FOOTNOTE TABLE 67									
FRANK FISHER AND HENRY RICH	10.1 R	1-30" (10)		317	1533	1853	1986	2110	1367		(11) 9166	300	900
— FREMONT WEIR (EAST END) —	MILE 12.3												
BACK BORROW PIT RECLAMATION DISTRICT 1000													
W. F. SANDERCOCK (LE CLARE & SONS)	(12) 0.6 R	1-10"		36		10	34	7			87	82	
— GAGING STATION —	MILE 2.1			SEE TABLE 66									

(1) MILEAGE IS GIVEN NORTHERLY OR SOUTHERLY FROM CHANDLER. CHANDLER IS OPPOSITE MILE 9.15 WEST BORROW PIT. PLANTS ARE ON LEFT BANK UNLESS MARKED WITH ASTERISK DENOTING RIGHT BANK.
(2) NEW INSTALLATION 1931.
(3) SEE SUPPLEMENTAL DIVERSION AT MILE 18.75 N.
(4) THIS ACREAGE DIVIDED AS FOLLOWS: MEYER 90, PLATTER 120, MOREHEAD 200, DE WITT BROS. AND EPPERSON 267.
(5) MILEAGE IS GIVEN EASTERLY FROM TISDALE WEIR.
(6) MILEAGE IS GIVEN EASTERLY FROM DRAINAGE PLANT OF RECLAMATION DISTRICT 1500 WHICH IS AT HEAD OF SLOUGH.
(7) TEMPORARY INSTALLATION 1931 SUPPLEMENTING FEATHER RIVER DIVERSION AT MILE 0.6 R. SEE ALSO SUPPLEMENTAL DIVERSION FROM WEST BORROW PIT SUTTER BY-PASS AT MILE 0.2 LEFT.
(8) MILEAGE IS GIVEN SOUTHERLY FROM HEAD IN BACK BORROW PIT NEAR KNIGHTS LANDING.
(9) MILEAGE IS GIVEN NORTHERLY FROM NORTH LEVEE OF SACRAMENTO BY-PASS.
(10) 16 INCH AND 24 INCH UNITS WERE REPLACED BY 30 INCH UNIT IN 1931.
(11) THE WATER IN THE BORROW PIT AT THIS PLANT WAS MADE UP FROM RECLAMATION DISTRICT 1600 SEEPAGE AND DIRECT DIVERSION FROM THE HERSHEY AND KELLER PLANTS AT MILES 16.27 R AND 22.5 R ON THE SACRAMENTO RIVER.
(12) MILEAGE IS GIVEN EASTERLY FROM SACRAMENTO RIVER.

TABLE 35

FEATHER RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE
SUTTER BASIN CORPORATION (WM. CRAWFORD) (1)	0.6 R	1-16"		198	606	630	281	607	252		(2) 2574		479
PUNTER AND RUTZ	1.55 L	1-6"			46						(3) 46	33	
SUTTER BASIN COMPANY	2.60 R	1-20" 1-26"		489	1749	2290	661	1913	260		(4) 7362	869	592
S. A. MC KEEHAN	5.44 L	1-6"		4	1	6	6	7	8	1	(5) 33	60	
J. M. INMAN (STARK BROS.) (6)	6.44 L	1-8"		55	56	82	54	41			288	50	
M. SCHEIBER	7.7 L	1-8"		8	69	58	71	54	46	7	313	60	
— NICOLAUS GAGING STATION —	MILE 9.3	SEE TABLE 13											
— NICOLAUS BRIDGE —	MILE 9.4												
GEO. POLLOCK COMPANY	9.75 R	1-12" 1-16"			505	588	390	634	530	84	2731		236 (7)
GARDEN HIGHWAY MUTUAL WATER COMPANY	13.1 R	1-20" 1-24"	60	872	369	780	791	502	266		3640	1127 (8)	
FEATHER RIVER WATER COMPANY	16.35 R	1-14"	327	221	317	276	379	219	111		1852	346	
PLUMAS MUTUAL WATER COMPANY	17.5 L	1-22"		1252	1773	1633	1844	1854	1099	411	9866	1800	
G. C. SHANNON	18.75 R	1-6"		39	61	51	33	17	11		212	58	
ALICIA MUTUAL WATER COMPANY	24.0 L	1-16" 1-20" (9) 1-26"		903	2680	2739	2934	2253	664	263	12436	1200	1300
W. D. BUTLER (10)	25.7 R	1-8"	29	54	65	56	33				237	40	
JACKSON DIGGS (11)	27.2 R	1-12"		320	186	128	187	44			865	160	
— MOUTH OF YUBA RIVER —	MILE 27.3												
— YUBA CITY-MARYSVILLE BRIDGE —	MILE 28.0												
J. L. SULLIVAN	33.9 R	1-10"	107	16	177	29	77	48			454	155	
SUTTER BUTTE CANAL COMPANY (SUNSET PLANT) (12)	38.1 R	2-42" 1-24"						198			(13) 198	(12)	(12)

* MILEAGE ALONG RIVER ABOVE MOUTH.
(1) NEW INSTALLATION 1931.
(2) DURING A PERIOD WHEN THERE WAS NO FLOW IN THE FEATHER RIVER AT THIS DIVERSION, SUPPLEMENTAL WATER WAS DIVERTED FROM SACRAMENTO SLOUGH AND THE WEST BORROW PIT OF SUTTER BY-PASS. SEE SUTTER BASIN CORPORATION DIVERSIONS ON THESE CHANNELS AT MILES 0.3 L AND 0.2 L, RESPECTIVELY.
(3) LIMITED DIVERSION DUE TO WATER SHORTAGE IN RIVER.
(4) DURING A PERIOD WHEN THERE WAS NO FLOW IN THE FEATHER RIVER AT THIS DIVERSION, SUPPLEMENTAL WATER WAS DIVERTED FROM THE WEST BORROW PIT OF SUTTER BY-PASS. SEE SUTTER BASIN CORPORATION DIVERSIONS ON THIS CHANNEL AT MILES 2.2 L AND 4.6 L.
(5) LIMITED DIVERSION DUE TO WATER SHORTAGE IN RIVER. ADDITIONAL WATER OBTAINED FROM WELLS.
(6) FORMERLY LISTED AS STARK BROS. COMPANY.
(7) THIS IS THE TOTAL ACREAGE PLANTED BUT DUE TO A SHORTAGE OF WATER IN JULY ONLY 135 ACRES WERE MATURED AND HARVESTED.
(8) INCLUDES 270 ACRES OF BROWN AND PURINGTON.
(9) THIS UNIT INSTALLED IN 1931.
(10) THIS IS NOT A NEW INSTALLATION BUT HAS NOT BEEN PREVIOUSLY REPORTED. ACCORDING TO DATA OBTAINED IN 1931, THE PLANT WAS INSTALLED IN 1908 AND OPERATED BY GAS ENGINE. NO DATA ON OPERATION FROM 1909 TO 1919. NO OPERATION IN 1920 AND 1921. OPERATED 1922 TO 1928. ELECTRIC MOTOR INSTALLED IN 1928. ABOUT 40 ACRES IRRIGATED 1922 TO 1931.
(11) NOT A NEW INSTALLATION IN 1931, BUT NOT PREVIOUSLY REPORTED. ACCORDING TO INFORMATION RECEIVED, THE PLANT WAS INSTALLED IN 1928. NO RECORD OF OPERATION PRIOR TO 1931 OBTAINED.
(12) SEE SUTTER BUTTE CANAL COMPANY DIVERSION AT MILE 58.1 RIGHT.
(13) DIVERSION SUPPLEMENTAL TO THAT AT MILE 58.1 RIGHT.

TABLE 35 (CONTINUED)

FEATHER RIVER DIVERSIONS (CONTINUED)

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE
PACIFIC HIGHWAY ORCHARDS TRACT (CHARLES COTTRELL)	(1)43.7 L H.SL. 0.4L	1-18"				73	46	47			165	75	
MOZNETT-WETMORE SUBDIVISION #1 (CHARLES ST. CLAIRE)	(1)43.7 L H.SL. 1.2L	1-10"		17	69	150	199	119	124		678	200	
MANUEL A. BARBA (M. ALMO)	(1)43.7 L H.SL.1.25L	1-8"		6	22	48	33	24	31		164	60	
A. P. BARBA (JOHN BETTENCOURT)	47.9 L	1-12"	8	26	204	146	169	202	186	15	956	165	
E. F. BIGGS	48.3 L	1-10"			75	113	170	28			386	325	
J. F. HARRIGER	51.1 L	1-7"		20	11	10	27	11	6	3	88	44	
EDWARD STEADMAN	51.4 R	1-10"			36	117	113	58			324	100	
SILVA-BERGTHOLDT	51.6 R	1-5"		11	2			4			17	15	
BLOWER BROS.	52.1 L	1-9"			49		32	31			112	120	
C. O. KISTER	52.5 L	1-8"		26	31	25	24	21	16		143	40	
F. L. MORRIS	52.7 L	1-8"		36	14	16	28		19		113	40	
FRANK DUTRA	52.9 R	1-6"				11	18	9	5		43	30	
G. H. BOGUE	53.1 R	1-6"		8	20	19	32	27	7		113	37	
BUDH SINGH	54.7 R	1-8"		114	30	42	80	26	16		308	60	
HEARST ESTATE (SUNICAL PACKING CO)	55.1 L	1-14"		187	176	214	220	291	200		1288	385	
L. A. KISTER	55.5 L	1-8"		97	33	66	64	8		15	283	100	
RIO BONITO RANCH	56.6 R	1-14"				96	27				123	30	
J. H. ABBEY (2)	56.8 R	1-8"			34	37	35	36	11		153	32	
ALVIN KISTER	57.0 L	1-8"			8	7	33	37	4		89	80	
J. E. CARRICO	57.0 R	1-8"		16	6	39	34	37	21	2	155	35	
HENRY HASELBUSCH	57.9 R	1-10"		25	34	33	39	38	2	23	194	72	
EMMA C. EAKLE (E. A. SWITZER)	58.1 R	1-8"			10	15	18	20	36		99	50	
SUTTER BUTTE CANAL COMPANY (3)	(3)58.1 R	GRAVITY	4463	44353	54983	46268	43433	36802	23514	11595	265411 (4)	15629 (5)	9106 (5)
RICHVALE IRRIGATION DISTRICT (3)	(3)58.1 R	GRAVITY	892	8871	10997	9253	8687	7360	4703	2319	53082	142	5300
WESTERN CANAL COMPANY (6)	59.7 R	GRAVITY		8961	22548	18880	20638	18327	7140	50	(6)96544	859	10066
TOTALS			5887	67203	98054	85024	81941	71953	39288	14788	464138	40454	41359

* MILEAGE ALONG RIVER ABOVE MOUTH.

(1) PLANT DIVERTS FEATHER RIVER WATER BACKED INTO HONCUT SLOUGH. SLOUGH IS TRIBUTARY TO FEATHER RIVER AT MILE 43.7 LEFT. MILEAGE OF PLANT ABOVE MOUTH OF HONCUT SLOUGH IS INDICATED.

(2) NEW INSTALLATION 1931.

(3) THIS IS NOW A COMMON POINT OF DIVERSION FOR SUTTER BUTTE CANAL COMPANY AND RICHVALE IRRIGATION DISTRICT. OWNERSHIP IN THE WATER IS DIVIDED FIVE-SIXTHS TO SUTTER BUTTE CANAL COMPANY AND ONE-SIXTH TO RICHVALE IRRIGATION DISTRICT AND THE TOTAL MEASURED DIVERSION HAS BEEN ARBITRARILY DIVIDED IN THIS RATIO TO GIVE THE DIVERSION FOR EACH AS HERE GIVEN.

(4) SEE MILE 38.1 RIGHT FOR SUPPLEMENTAL DIVERSION TO SUTTER BUTTE CANAL COMPANY SYSTEM.

(5) INCLUDES ACREAGE SERVED BY SUPPLEMENTAL DIVERSION AT SUNSET PLANT, MILE 38.1 RIGHT.

(6) IN ADDITION TO DIVERSIONS HERE LISTED THERE WERE DIVERSIONS BY WESTERN CANAL FOR FLOODING PONDS OF DUCK CLUBS IN BUTTE BASIN AS FOLLOWS: (ACRE-FEET) OCTOBER 9066, NOVEMBER 13983, DECEMBER 4290, TOTAL 27339.

TABLE 36

YUBA RIVER DIVERSIONS

WATER USER	* MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GENERAL	RICE
MARYSVILLE RIVER FARMS COMPANY (E. O. RUBKE)	2.8 L	1-8" (1)				24	20				44	33	
E. O. RUBKE (2)	3.9 L	1-8" (1)			14	11	25	22			72	35	
DANTONI ORCHARDS	4.2 L	1-10"			NO	DIVERSION							
WM. M. DINSMORE	4.5 L	1-6"			NO	DIVERSION							
DANTONI ORCHARDS	5.2 L	1-8"		172							172	55	
L. A. PLANT (2)	6.2 L	1-10"				102	24	62	21		209	90	
MARYSVILLE RIVER FARMS COMPANY	6.6 L	1-12"			133	272	265	225			895	250	
HALLWOOD IRRIGATION COMPANY AND CORDUA IRRIGATION DIST.	11.0 R	GRAVITY		9996	11654	9731	8362	8336	6118	5704	59901 (3)	4260 (3)	2950 (3)
W. P. HAMMON	12.3 L	GRAVITY		303	310	287	295	341	329	162	(4)2027	100	
TOTALS			0	10471	12111	10427	8991	8986	6468	5866	63320	4823	2950

* APPROXIMATE MILEAGE ALONG RIVER ABOVE HIGHWAY CROSSING AT MARYSVILLE.

(1) PORTABLE UNIT, USED AT MILE 2.8 LEFT AND 3.9 LEFT DURING 1931.

(2) NEW INSTALLATION 1931.

(3) HALLWOOD IRRIGATION COMPANY AND CORDUA IRRIGATION DISTRICT HAVE A COMMON POINT OF DIVERSION AND COMMON CANAL FOR ABOUT ONE-HALF MILE; DIVERSION AND ACREAGE FIGURES ARE FOR COMBINED PROJECTS. IRRIGATED ACREAGE IS SEGREGATED AS FOLLOWS: HALLWOOD, RICE 1400, GENERAL 3900; CORDUA, RICE 1550, GENERAL 360.

(4) THIS IS A CONTINUOUS GRAVITY DIVERSION. THE WATER IS USED ON AN ORANGE GROVE AND THE SURPLUS IS SPILLED BACK TO THE RIVER.

TABLE 37

AMERICAN RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	** ACREAGE IRRIGATED
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		
JOE CORY (1)	0.05 R	1-8"			20	7	13	10			50	60
G. A. MEISTER	3.2 L	1-10"		NO	DIVERSION							
G. A. MEISTER	3.6 L	1-4" 1-6"		23	30	15	21	18	20	15	142	75
G. A. MEISTER	3.8 L	1-6"		12	11	4	10	17	8	3	65	38
— SACRAMENTO GAGING STATION —	MILE 6.0	SEE TABLE 14										
CUTTER BROTHERS	6.8 L	1-5"		15	15	29	14	22	7		102	35
S. H. COWELL	7.1 L	1-7"	3	18	14						35	20
E. CLEMENS HORST	7.5 R	1-8"		55	77	29	13				174	40
FRED KING (2)	7.7 R	1-4"			0.3	5.0	5.8				11.1	30
H. MORITA	7.9 R	1-6"			53	41	9				103	40
M. T. HARDING	9.0 L	1-8"		15	24	11		19			69	40
EDWARD MORININI	9.2 R	1-8"			31	112	104	114	52		413	75
A. F. COUNSMAN	9.2 L	1-8"		NO	DIVERSION							
C. E. WELLS	9.45 L	1-5"		NO	DIVERSION							
C. E. WELLS	9.5 L	1-8"		NO	DIVERSION							
C. E. WELLS	9.55 L	1-5"		NO	DIVERSION							
HENRY COWELL (E. CLEMENS HORST)	9.9 L	1-5"		NO	DIVERSION							
GIBBENS AND RICHARDSON	10.2 R	1-8"					34	23	11		68	40
R. S. AND W. G. SEYDEL (3)	10.3 L	1-10"(4)			86						86	30
E. H. GERBER (GOLD NUGGET ORCHARD CO.)	10.4 R	1-5"		2	22		4				28	17
DEL PASO HOP COMPANY	10.5 R	1-8"		NO	DIVERSION							
ANNIE HOEY	11.2 L	1-6"		NO	DIVERSION							
J. T. GORE ESTATE	11.5 L	1-6"		NO	DIVERSION							
WM. A. MEYER	11.7 L	1-4"		13	14	10	15	5		1	58	29
HARRY NAKATOMI	11.7 L	1-5"		15	23			2			40	25
H. T. DANIELSON	13.1 R	1-5"			11	17	10	8	8	1	55	(5) 18
P. OSTERLE	13.2 R	1-6"				57	10	16			83	20
MARY DETERDING	13.9 R	1-6"			28	31	39	13		13	124	70
MARY DETERDING	15.1 R	1-6"			5	29	4				38	20
CARMICHAEL IRRIGATION DISTRICT	16.0 R	1-12" 1-8" 1-6"	43	301	659	516	931	760	404	255	3869	1950
WM. H. DEVLIN	17.1 R	1-6" 1-1¼"			3.9	3.0					6.9	(6) 22
— FAIR OAKS GAGING STATION —	MILE 19.2											
TOTALS			46	469	1127	916	1237	1027	510	288	5620	2694

* MILEAGE ALONG RIVER ABOVE MOUTH.
** ALL GENERAL CROPS. NO RICE.
(1) NEW INSTALLATION 1931.
(2) FORMERLY H. NAMURA.
(3) FORMERLY H. W. BARTELL.
(4) THIS UNIT INSTALLED IN 1931 TO REPLACE 20" UNIT WHICH HAS BEEN ABANDONED.
(5) INCLUDES 6 ACRES ON ADJOINING LANDS OF C. H. DAVIS.
(6) ADDITIONAL WATER FOR THIS ACREAGE OBTAINED FROM FAIROAKS WATER COMPANY.

TABLE 38

DELTA UPLANDS DIVERSIONS FROM CACHE SLOUGH

WATER USER	MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		
RECLAMATION DISTRICT NO. 2068	SW¼ NE¼ SEC. 34 T 6 N. R 1 E.	1-36" 1-30"		1681	2372	2554	2097	535			9239	3690

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TABLE 39

DELTA UPLANDS DIVERSIONS FROM OLD SAN JOAQUIN RIVER

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	** ACREAGE IRRIGATED
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		
EAST CONTRA COSTA IRRIGATION DISTRICT	36.5 L (1)	2-30" 1-24" 1-18"	2717	6387	5423	3224	5383	3596	227	17	26974	13357
BYRON-BETHANY IRRIGATION DISTRICT (2)	40.9 L	1-26" 1-30"	1176	3485	1888	2469	2847	2652	1139	140	15796	7853
JOE F. COSTA	(3)44.6 L	1-7"					58				58	20
E. H. STEVENSON (RAY BROS.)	(4)45.3 L	1-12"		80			39	63			182	111
H. LINDEMAN	47.2 L	1-12"	110	267	37	13	111	130			668	420
A. F. NOONIS	47.2 L	1-10"			42		22	81	32		177	47
WEST SIDE IRRIGATION DISTRICT	(5)47.65 L	7-15"	1394	4900	2125	1958	3910	2808	1019	27	18141	9155
N. E. AND JOHN WELTY (T.B.SILVA)	48.7 L	1-8"		50	11	20	30		44		155	70
NAGLEE-BURKE IRRIGATION DISTRICT	50.4 L	1-16" 1-18"	257	1533	530	1183	1321	1045	913	202	6984	2421
FREEMONT IRRIGATION ASSOCIATION	50.9 L	1-14"	81	372	314	279	329	371	119		1865	662
ATTILIO CASSERINI (6)	51.2 L	1-8"				20		23			43	36
LABRUCHERIE, PLATTI AND SMALLPAGE	52.4 L	1-10"		25	30	79	75	85	29	3	326	80
— TOM PAINE SLOUGH —	MILE 54.3											
TOTALS			5735	17099	10400	9245	14125	10854	3522	389	71369	34232

* DISTANCE ALONG THE RIVER FROM ITS MOUTH FOUR AND ONE-HALF MILES BELOW ANTIOCH. MILEAGE AS ESTABLISHED BY WAR DEPARTMENT SURVEY OF 1913-15.

** ALL GENERAL CROPS. NO RICE.

(1) TO JUNCTION OF OLD RIVER AND INDIAN SLOUGH. PUMPING PLANT IS LOCATED TWO AND ONE-HALF MILES WEST ALONG INDIAN SLOUGH.

(2) TO JUNCTION OF OLD RIVER AND ITALIAN SLOUGH. PUMPING PLANT IS LOCATED TWO AND THREE-FOURTHS MILES SOUTHWEST ALONG ITALIAN SLOUGH AND EXTENSION CUT.

(3) CORRECTED MILEAGE. PREVIOUSLY REPORTED AS MILE 45.2 LEFT. PLANT IS ON CUT WHICH JOINS RIVER AT MILE 44.6 LEFT.

(4) CORRECTION. PREVIOUSLY REPORTED AS 45.8 LEFT.

(5) TO JUNCTION OF OLD RIVER WITH INTAKE CUT. PUMPING PLANT IS LOCATED ONE MILE SOUTH ALONG INTAKE CUT.

(6) NEW INSTALLATION 1931.

TABLE 40

DELTA UPLANDS DIVERSIONS FROM TOM PAINE SLOUGH

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	** ACREAGE IRRIGATED
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		
STINSON ESTATE COMPANY	0.7 S	2-18"	25	181	130	227	251	240	93	243	1390	(1) 1873
STINSON ESTATE COMPANY (2)	1.2 S	1-18"		156			69				(3) 225	(3)
HOLLY WESTERN SUGAR COMPANY	2.1 S (4)	1-12"					174	174	168	173	(5) 689	INDUSTRIAL (5)
TRACY CLOVER IRRIGATION DIST.	2.1 S (4)	1-16"	177	329	195	200	229	203	216		1549	564
CALIFORNIA IRRIGATED FARMS CO.												
PLANT NUMBER 1	2.9 S	1-12"		118	90	82	89	68	76		523	(6) 2885
PLANT NUMBER 3	6.3 S	1-20"	328	974	712	827	1005	1348	1055	107	6356	(7)
PLANT NUMBER 5	8.3 S	1-12"		215	157	187	355	196	313		1423	(7)
PLANT NUMBER 5A	9.0 S	1-12"		136	40	79	153	57	60		525	(7)
TOTALS			530	2109	1324	1602	2325	2286	1981	523	12680	5322

* DISTANCE ALONG TOM PAINE SLOUGH FROM ITS MOUTH WHICH IS AT MILE 54.3 ON OLD SAN JOAQUIN RIVER (WAR DEPARTMENT SURVEY OF 1913-15).

** ALL GENERAL CROPS. NO RICE.

(1) THIS IS THE TOTAL ACREAGE IRRIGATED FROM THIS PLANT AND THAT AT MILE 1.2 S AND INCLUDES 965 ACRES IRRIGATED BY WASTE WATER FROM HOLLY WESTERN SUGAR COMPANY, MILE 2.1 S.

(2) NEW INSTALLATION 1931.

(3) SEE PLANT AT MILE 0.7 S FOR ACREAGE IRRIGATED AND ADDITIONAL WATER DIVERTED.

(4) TO JUNCTION OF TOM PAINE SLOUGH AND DREDGER CUT. PUMPING PLANT IS LOCATED 1½ MILES SOUTH ALONG DREDGER CUT.

(5) THIS WATER WAS REUSED BY STINSON ESTATE TO IRRIGATE 965 ACRES. SEE MILE 0.7 S.

(6) THIS IS THE TOTAL UPLANDS AREA (SOUTH OF TOM PAINE SLOUGH) IRRIGATED FROM ALL CALIFORNIA IRRIGATED FARMS COMPANY PLANTS ON TOM PAINE SLOUGH.

(7) SEE PLANT AT MILE 2.9 S.

TABLE 41

DELTA UPLANDS DIVERSIONS FROM SAN JOAQUIN RIVER

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	** ACREAGE IRRIGATED
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		
— GARWOOD BRIDGE —	MILE 45.3											
PAUL WESTON	46.3 R	(1) 1-12"		117	343	117	66	42	13		698	223
AUGUST EISELE	47.2 R	1-5"			1.4	1.3	1.2	0.3			4.2	1
WOLFINGER BROS.	47.3 R	1-10"		25		34	34				93	55
JOHN HAACK	47.7 R	1-4"				1.4	1.4	1.4			4.2	2
JOHN HAACK	48.0 R	1-12"			207	70	30	12	8		327	105
H. G. LEARNED (2)	48.3 R	1-4"		14	8	11	4	22	15	1	75	15
JOE CALCAGNO	48.5 R	1-6"		37	41	34	3	13	55	4	187	50
I. YOSHIDA	48.5 R	1-3½"		6	8	3	9	8	2		36	(3) 15
FRANK PICCARDO	48.6 R	1-6"		46	34	13	19	41	27	21	201	75
G. ACCINELLI	48.7 R	1-5"	13	18	40	27	25	41	22	9	(4) 195	(4) 60
M. O. COUPER (M. MATSUMOTO)	49.0 R	1-5"		1.8	1.2	2.1	2.8	2.1	1.7		11.7	6
METTLER, CROSS AND DRURY (S. B. CHAPMAN)	49.5 R	1-14"		38		28	34	34	26		160	123
A. A. RODGERS	50.1 R	1-10"		33		95	31	60			219	73
— BRANDT BRIDGE —	MILE 50.2											
N. LAGLER AND JOE REICHMUTH	50.4 R	1-8"		63	16	95	17	73	20		284	78
JOHN BRANDT	50.5 R	1-6"			NO	DIVERSION						
JOHN BRANDT (5)	50.8 R	1-10"			NO	DIVERSION						
F. DELIMA	53.4 R	1-8"	12		14	14	20	11	4		75	33
B. C. LEAL (6)	53.5 R	1-12"		5	55	60		57	12		189	100
M. DOS REIS (CORDOZA, SOUSA AND AVELLAR)	53.7 R	1-12"		81	123	153	152	209	40		758	430
W. C. FRANK (M. MARTIN COMPANY)	54.9 R	1-10"			31	31	32	28			122	45
— JUNCTION WITH MIDDLE RIVER —	MILE 56.2											
OAKWOOD STOCK FARM	57.0 R	1-14"	23	259	85	236	500	186	202		1491	(7) 211
S. MAURO	57.2 R	1-5"			NO	DIVERSION						
A. J. THOMPSON	57.3 R	1-5"		0.7	0.9	1.1	1.6	0.9	0.5		5.7	5
G. GARDELLA COMPANY (8)	57.5 R	1-4"		6	12	6	7	4	2		37	32
V. SANGUENETTI	58.4 R	1-2½"		4.9	2.8	1.8	4.4	4.2	0.2		18.3	15
G. B. FIGARI (G. ALFIERI)	58.6 R	1-3"		2.0	1.1	1.7	2.7	1.9	0.7		10.1	4
R. MAURO	58.7 R	1-4"		1.1	1.5	1.7	2.7	2.4			9.4	5
— MOSSDALE BRIDGE —	MILE 58.9	RECORDING GAGE										

* DISTANCE ALONG SAN JOAQUIN RIVER FROM ITS MOUTH FOUR AND ONE-HALF MILES BELOW ANTIOCH. (MILEAGE AS ESTABLISHED BY WAR DEPARTMENT SURVEY OF 1913-15.)

** ALL GENERAL CROPS. NO RICE.

(1) ON MAY 9TH THE FOUR AND SIX INCH UNITS WERE REPLACED BY TWELVE INCH UNIT.

(2) NEW INSTALLATION 1931.

(3) INCLUDES 9 ACRES IRRIGATED FROM PLANT AT MILE 48.7 RIGHT.

(4) THIS DIVERSION SERVED AN ADDITIONAL ACREAGE FOR I. YOSHIDA, MILE 48.5 RIGHT.

(5) PLANT INSTALLED IN 1930. NO OPERATION TO DATE.

(6) FORMERLY BANK OF OAKLAND.

(7) INCLUDES 80 ACRES ON ADJOINING LANDS OF J. A. SILVIERA.

(8) FORMERLY P. COLORI COMPANY.

TABLE 41 (CONTINUED)

DELTA UPLANDS DIVERSIONS FROM SAN JOAQUIN RIVER

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	** ACREAGE IRRIGATED
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		
C. C. ABERSOLD (1)	59.2 R	1-6"			2.3	0.4	0.4				3.1	2
H. A. NIESTRATH (JOSEPH EGGER)	59.3 R	1-14"		153	167	116	220	186			842	185
— JUNCTION WITH PARADISE CUT —	PARADISE	DAM	MILE 62.2									
BANTA CARBONA IRRIGATION DISTRICT	67.5 L	1-36" 3-24" 2-20"	2856	7732	6473	3906	10871	9989	3310	2009	47146	14298 (2)
MC MULLIN ESTATE	71.0 R	1-16"	70	406	257	205	209	506	215	44	1912	450
MORTENSEN-ANDERSON & WHITMAN	73.2 R	1-12"	35	328	82	210	317	224	165	38	1399	325
RIVER JUNCTION FARMS COMPANY(3)	(3) 74.7 R	1-14"										
— U.S.G.S. GAGING STATION —	"SAN JOAQUIN RIVER		NEAR VERNALIS"		MILE 76.7		SEE TABLE 19					
TOTALS			3009	9378	8007	5475	12617	11759	4141	2126	56513	17021

* DISTANCE ALONG SAN JOAQUIN RIVER FROM ITS MOUTH FOUR AND ONE-HALF MILES BELOW ANTIOCH. (MILEAGE AS ESTABLISHED BY WAR DEPARTMENT SURVEY OF 1913-15).

** ALL GENERAL CROPS. NO RICE.

(1) NEW INSTALLATION 1931.

(2) INCLUDES 1746 ACRES IN KASSON DISTRICT OUTSIDE OF BANTA CARBONA IRRIGATION DISTRICT BOUNDARIES.

(3) THIS PLANT WAS INCORRECTLY REPORTED AT THIS MILEAGE IN 1930. CORRECT LOCATION IS MILE 2.4 RIGHT ABOVE DURHAM FERRY BRIDGE, SEE TABLE 42.

TABLE 42

SAN JOAQUIN RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	ACREAGE IRRIGATED	
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		GEN-ERAL	RICE
— U.S.G.S. GAGING STATION "SAN JOAQUIN RIVER NEAR VERNALIS" —					MILE 0.0	SEE TABLE 19							
RIVER JUNCTION FARMS CO. NO. 2 (1)	2.4 R	1-14"		37	42	39	42				160	35	
— STANISLAUS RIVER —	MILE 3.0	SEE TABLE 27											
VERNALIS INVESTMENT COMPANY	5.25 L	3-12"	363	590	595	579	763	656	415	193	4154	750	
EL SOLYO RANCH	5.35 L	3-18" 1-12"	2926	2809	2932	3044	3259	3191	1586	926	20673	3962	
— TUOLUMNE RIVER —	MILE 14.3	SEE TABLE 25											
WEST STANISLAUS IRRIGATION DIST.	15.1 L	3-26"	1198	6082	4684	2840	7981	6386	2465	2759	34395	13076	
WHITE LAKE RANCH NO. 1	(2) 15.1 L	1-6"			NO	DIVERSION							
WHITE LAKE RANCH NO. 2	(2) 15.1 L	1-8"			NO	DIVERSION							
WHITE LAKE RANCH NO. 3	(2) 15.1 L	1-8"	32	101	61	49	95	66	35	29	468	100	
— LAIRD SLOUGH BRIDGE —	MILE 19.35	SEE TABLE 18											
CHARLES MOREING	22.2 L	1-16"		106	332	88	367	367	85	2	1347	260	
PATTERSON COLONY	27.7 L	4-26" 1-18" 1-14"	2888	6925	4637	6491	5452	3282	4156	932	34763	15381	
SARAH J. RIDGES	27.8 R	1-10"		184	127	154	168	75	73	5	786	210	
PATTERSON RANCH COMPANY	33.1 L	(3) 2-16"	623	1126	1170	1206	1382	1274	560	204	7545	710	500
E. USTICK	OPP. 34.2 R	30" BOX			NO	DIVERSION							
E. USTICK	35.85 R	1-12"	2	67	61	57	97	83	16	66	449	85	
— CROWS LANDING BRIDGE —	MILE 36.7												
JAMES J. JOHNSON	36.8 R	1-10"			9	33	35	39	35		151	40	
A. J. SILVIERA	37.15 R	1-6"	7	11	7	17	12	14	18	5	91	20	
A. J. SILVIERA	37.65 R	1-7"		18	14	21	22	20	13	5	113	35	
NELSON BROS.	38.25 R	1-10"			5	11	8	5	4		33	11	
L. B. AND E. M. CROW (T. F. LAUGHRY)	39.35 L	1-6"	45	45	36	61	75	82	66	50	460	114	
OSCAR HOGAN	39.75 R	1-12"		44	53	62	89	53	80	27	408	105	
— U.S.G.S. GAGING STATION "SAN JOAQUIN RIVER NEAR NEWMAN" —					MILE 47.0	SEE TABLE 17							
— MERCED RIVER —	MILE 47.05	SEE TABLE 21											
— SAN LUIS RANCH GAGE —	MILE 80.7												
TOTALS			8084	18145	14765	14752	19847	15593	9607	5203	105996	34894	500

* MILEAGE ALONG RIVER ABOVE DURHAM FERRY BRIDGE.
(1) NOT A NEW INSTALLATION 1931. THIS PLANT WAS INCORRECTLY REPORTED IN 1930 AT MILE 74.7 RIGHT UNDER "DELTA UPLANDS DIVERSIONS FROM SAN JOAQUIN RIVER".
(2) PUMP ON CUT LEADING TO WEST STANISLAUS IRRIGATION DISTRICT PLANT.
(3) PREVIOUSLY LISTED AS 20 INCH.

TABLE 43

MERCED RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	** ACREAGE IRRIGATED
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		
— MERCED RIVER GAGING STATION "MERCED RIVER NEAR MOUTH"				MILE 1.1		SEE TABLE 21						
STEVINSON CORPORATION	2.2 R	1-15"(1)										
STEVINSON CORPORATION	3.8 R	1-15"	64	457	67	120	127	135	169	82	1221	225
FLOYD STEVINSON	4.0 L	1-8"	1	10	26	33	44	24	9		147	45
J. F. PECK	6.1 L	1-18"		86	167	69	263	296	41		922	165
STEVINSON CORPORATION	6.55 L	1-15"	108	386	588	567	590	591	465	89	3384	520
FRANCIS HARTMAN	8.5 L	1-12"		24	69	48	27	55	38		261	85
MARY COLLIER	8.85 L	1-15"		68	161	101	216	154	79	8	787	130
GRACE MC CULLAGH	9.4 L	1-10"	83	227	219	200	256	197	121	23	1326	280
J. R. ADAMS	10.35 L	1-10"	65	206	272	256	275	251	209	102	1636	250
W. D. ADAMS	10.85 L	1-12"	78	209	267	245	268	278	225	93	1663	300
C. G. MC LAUGHLIN	11.4 L	1-6"	7	23	31	33	40	25	8	16	183	35
H. F. MILLIKEN	11.6 L	1-10" 1-12"	57	177	194	144	229	172	91	15	1079	220
— NEW MILLIKEN BRIDGE —	MILE 11.65											
BETTENCOURT, NEVES AND AZEVEDO	12.85 L	1-10"	58	152	158	181	214	191	105	37	1096	170
CALIFORNIA LANDS, INCORPORATED	16.5 L	1-12"	26	51	55	84	88	65	55	24	448	90
MERCED RIVERSIDE FARM COMPANY (2)	17.05 L	1-6"		4	4	4	8	8	6	3	37	15
— U.S.G.S. GAGING STATION — "MERCED RIVER NEAR LIVINGSTON"					MILE 17.1							
FRED GRIFFITH	17.7 L	1-5"		2	3	4	3	3	4		19	8
J. A. SHIELDS	18.2 L	1-6"		3	7	7	6	6	3		32	10
SCOTT HUGHES	20.4 L	1-6"	2	20	45	30	48	48	40	13	246	40
— SOUTHERN PACIFIC RAILROAD (MAIN LINE) —		MILE 21.05										
WM. COLLIER (CABRALL AND COMPANY)	22.0 R	1-6"		18	39	30	30	26	22	8	173	35
WM. COLLIER (CABRALL AND COMPANY)	22.2 R	1-12"	9	116	156	140	169	160	114	27	891	140

* MILEAGE ALONG RIVER ABOVE MOUTH.
** ALL GENERAL CROPS. NO RICE.
(1) FORMERLY LISTED AS 18 INCH.
(2) FORMERLY R. G. WOODWARD.

TABLE 43 (CONTINUED)

MERCED RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	** ACREAGE IRRIGATED
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		
MC CONNELL (VEIERA & SANTOS)	24.9 L	1-6"			NO	DIVERSION						
LINEHERS COMPANY	25.75 R	1-10"		55	152	74	36	4			321	80
STATE LAND SETTLEMENT (DELHI)	26.3 R	1-8"	15	68	87	84	108	53	14		429	140
C. A. LAUGHLIN	26.55 R	1-6"						2	5		7	5
— SANTA FE RAILROAD —	MILE 27.05											
N. K. SCHMIDT	27.6 R	1-10"	7	34	48	11		23	67		190	50
Y. TANABE	27.95 R	1-6"	9	17	12	8	25	14	12	5	102	20
G. H. LOVELY	28.4 R	1-4"	5	16	11	3	7	9	9	6	66	15
J. CAMPADONCIA	28.6 R	1-6"	5	16	12	9	15	10	7	4	78	12
R. K. KYNASTON	28.85 R	1-10"	6	21	29	34	41	25	15	15	186	60
C. L. MEHRTON	29.1 R	1-7"	7	13	11	3	4	12	9	7	66	30
J. G. STRONG (J. CAMPADONCIA)	29.75 R	1-6"	4	17	25	26	34	33			139	50
JOHN CARAGLIO AND LOUIS FIRPO	29.9 R	1-6"	7	24	25	16	21	20	14	2	129	30
JOHN CARAGLIO AND LOUIS FIRPO	30.95 R	1-12"	8	39	62	59	56	45	55	5	329	90
JOHN CARAGLIO (1)	31.7 R	1-8"		7	29	32	21	23	20	10	142	50
— SOUTHERN PACIFIC RAILROAD	OAKDALE BRANCH —		MILE 32.52									
L. RUSCONI	33.55 R	1-7"	147	251	225	197	240	236	79	154	1529	178
C. P. STOUT (2)	39.2 L	1-24"		19	42	50	44	38	18	17	228	50
— GAGING STATION "MERCED RIVER AT YOSEMITE VALLEY RAILROAD CROSSING"— MILE 42.1 SEE TABLE 20												
TOTALS			778	2836	3298	2902	3553	3232	2128	765	19492	3623

* MILEAGE ALONG RIVER ABOVE MOUTH.
** ALL GENERAL CROPS. NO RICE.
(1) PLANT WAS INSTALLED IN 1930 BUT RECORD OF OPERATION WAS NOT REPORTED. 1930 DIVERSIONS WERE (ACRE-FEET), MAY 11, JUNE 21, JULY 11, AUGUST 20, TOTAL 63.
(2) PLANT WAS INSTALLED IN 1930 BUT NOT REPORTED.

TABLE 44

DRY CREEK DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	** ACREAGE IRRIGATED
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		
— MODESTO EMPIRE BRIDGE —	MILE 0.75											
WM. BASSO	2.55 L	1-5"				1.6	1.3				(1) 2.9	(1) 1.5
— GAGING STATION "DRY CREEK NEAR MODESTO" —			MILE 2.60		SEE TABLE 23							
W. A. YOUNG	2.9 R	1-4"			NO	DIVERS	ION					
C. AYER	3.25 L	1-4"		4	2	2	3	1	1		13	4
W. H. HOWELL	5.0 L	1-6"	4	3	2	5	7	1			22	8
J. R. MILLS	5.3 L	1-5"	5	3	2	4	3	4	1	1	23	6
— SANTA FE RAILROAD —	MILE 6.1											
A. J. STURTEVANT, JR.	6.35 L	1-6"			NO	DIVERS	ION					
— NEW HOPE SCHOOL CROSSING —	MILE 10.6											
J. S. TULLY	14.15 R	1-6"		19	60	26	34	35	15		189	52
— SOUTHERN PACIFIC RAILROAD (OAKDALE BRANCH) —			MILE 16.35									
— GAGING STATION "DRY CREEK NEAR OLD WATERFORD BRIDGE"				MILE 16.9		SEE TABLE 22						
TOTALS			9	29	66	39	48	41	17	1	250	71

* MILEAGE ALONG CREEK ABOVE JUNCTION WITH TUOLUMNE RIVER.
** GENERAL CROPS. NO RICE.
(1) PREVIOUS REPORT OF NO DIVERSION BY THIS PLANT IN 1930 WAS INCORRECT. DIVERSIONS IN THAT YEAR WERE (ACRE-FEET) JUNE 0.7, JULY 1.7, TOTAL 2.4

TABLE 45

TUOLUMNE RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	** ACREAGE IRRIGATED
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		
JOHN CALDWELL	1.8 R	1-10"		179	138	124	111	111	73	13	749	190
J. M. DE SOUZA	2.2 R	1-6"	10	20	22	29	41	46	50	10	228	40
E. B. HENRY (1)	3.1 R	1-6"		21	21	53	56	37	27	7	222	75
— GAGING STATION "TUOLUMNE RIVER AT TUOLUMNE CITY" —				MILE 3.35		SEE TABLE 25						
BANCROFT FRUIT FARM	4.1 R	1-10"	39	106	125	102	100	65	28	3	568	155
BANCROFT FRUIT FARM	5.0 R	1-10"	30	78	88	45	101	86	24	25	477	120
RANDOLPH MARKETING COMPANY	7.1 R	1-10"		129	92	161	170	113	82	16	763	175
W. F. DUFFY	8.4 R	1-10"	48	41	63	67	91	111	74	13	508	115
JAMES BERRYHILL	13.0 L	1-6"			NO	DIVERSION						
JAMES BERRYHILL	13.6 L	1-6"			NO	DIVERSION						
— SOUTHERN PACIFIC RAILROAD (MAIN LINE) —			MILE 15.8									
— SANTA FE RAILROAD —	MILE 21.6											
— SOUTHERN PACIFIC RAILROAD (OAKDALE BRANCH) —			MILE 31.5									
GEORGE H. SAWYER	39.8 L	1-6"		2	3	2	3	3	1	1	15	10
A. J. JAMIESON	39.9 L	1-4"	1	9	8	2		13	4		37	14
— GAGING STATION "TUOLUMNE RIVER AT ROBERTS FERRY BRIDGE"					MILE 39.9		SEE TABLE 24					
TOTALS			128	585	560	585	673	585	363	83	3567	894

* MILEAGE ALONG RIVER ABOVE MOUTH.
** GENERAL CROPS. NO RICE.
(1) NEW INSTALLATION 1931.

TABLE 46

STANISLAUS RIVER DIVERSIONS

WATER USER	*MILE AND BANK	NUMBER AND SIZE OF PUMP	MONTHLY DIVERSIONS IN ACRE-FEET								TOTAL DIVERSION APRIL TO OCTOBER ACRE-FEET	** ACREAGE IRRIGATED
			MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.		
RIVER JUNCTION FARMS CO. NO. 2(1)	(1) 1.1 R											
— GAGING STATION "STANISLAUS RIVER AT ELLIOT RANCH"			MILE 5.24		SEE TABLE 27							
ELLIOT RANCH	5.25 L	2-14"		306	150	298	115	268	244	138	1519	460
RIVER JUNCTION FARMS	5.9 R	(2) 1-20"	31	951	932	1508	1672	1204	785	372	7455	1000
MC MULLIN RECLAMATION DISTRICT 2075 (3)	5.95 R	2-16" (4)	4	301	133	695	620	556	75	90	2474	241
HENRY PELUCCA	6.7 L	1-15"		34	28	27	34	30	18	1	172	43
S. M. UPDIKE	7.4 L	1-10"			NO	DIVERSION						
S. M. UPDIKE	8.2 L	1-12"	49	75	75	19	20	59	15	40	352	65
D. F. KOETITZ	10.1 L	1-10"	24	91	82	54	105	65	42	16	479	100
D. F. KOETITZ	10.4 L	1-18"			NO	DIVERSION						
— SOUTHERN PACIFIC RAILROAD (MAIN LINE) —		MILE 15.9										
G. R. STODDARD	19.9 L	1-7"				7	68	35	8	2	120	27
PALO ALTO STOCK FARM	20.75 R	1-14"		265	292	165	221	232	121	47	1343	325
— MODESTO-ESCALON BRIDGE —	MILE 28.15											
— SANTA FE RAILROAD —	MILE 31.85											
— SOUTHERN PACIFIC RAILROAD (OAKDALE BRANCH) —		MILE 39.0										
— GAGING STATION "STANISLAUS RIVER AT ORANGE BLOSSOM BRIDGE" —					MILE 44.7		SEE TABLE 26					
TOTALS			108	2023	1692	2773	2855	2449	1308	706	13914	2261

* MILEAGE ALONG RIVER ABOVE MOUTH.
** GENERAL CROPS. NO RICE.
(1) THIS PLANT WAS INCORRECTLY REPORTED AT THIS LOCATION ON STANISLAUS RIVER IN 1930. THE CORRECT LOCATION IS SAN JOAQUIN RIVER AT MILE 2.4 RIGHT ABOVE DURHAM FERRY BRIDGE. SEE TABLE 42.
(2) CORRECTION, PREVIOUSLY LISTED AS 18 INCH.
(3) FORMERLY LISTED AS MC MULLIN ESTATE.
(4) CORRECTION, PREVIOUSLY LISTED AS 1-24 INCH.

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CHAPTER V

MEASUREMENTS OF RETURN WATER

Sacramento Return Waters

In the Sacramento Valley the flow of all well defined channels carrying irrigation waters returned to the Sacramento River is measured and recorded. Table 48 lists these channels in downstream order and gives the total flow as computed from the measurements.

Between Colusa and Red Bluff there are no large well defined return channels. Records or estimates of all natural inflow from streams in this stretch of the river were, however, obtained. Above Red Bluff, from a point below Cottonwood to Redding there is a return from the irrigation of the Anderson-Cottonwood Irrigation District. An estimate of this return water is given in the footnote at the end of Table 30, Chapter IV.

Return Flow from other than Sacramento River Sources

In the water returned to the Sacramento River as included in Table 48 it should be noted that practically all of that entering the river through Butte Slough is derived from Feather River diversions through the Western and Sutter Butte canals. Of the discharge entering through Sacramento Slough, that portion flowing down the East Borrow Pit of Sutter By-Pass is, also, practically all from Feather River irrigation.

Relation of Sacramento Return Water to Irrigation Draft

Tables 49 and 50 record the Sacramento River return water, May to September, inclusive, 1931, and indicate the relation between

the return and the diversions from which it is derived. Because of the slight Spring precipitation, diversions began much earlier in 1931 and correspondingly the return flow began earlier in the season. The month of May could therefore be included in the period of the return water measurements whereas in previous years the first month has been either June or July. Since, in tables 49 and 50, it is the purpose to show the return water from Sacramento River diversions only, the inflow from Butte Slough, East Borrow Pit of Sutter By-Pass, Back Borrow Pit of Reclamation District 1000 and from the Feather and American Rivers has been excluded. In Table 49 is shown the relation to the diversions of that return water only which was measured at the well defined channels. With the records available for the discharge of the Sacramento River at Red Bluff, Butte City, Colusa, Wilkins Slough, Knights Landing, and Verona and all diversions between these points recorded, as well as the Feather River and other well defined inflows, it is possible to compute what should represent the total water returned to the river between each of these points, including not only the flow in the definite channels which were measured, but all seepage, groundwater return, etc., which could not be directly measured. The figures for the return water computed in this manner and the relation of this return to the draft are shown in Table 50. It should be noted, however, that the return shown for the Verona-Sacramento section is only that contributed by the measured drains since, as explained in Chapter III, the total return in this section including all accretions is not susceptible of computation in the manner outlined because of the fact that no record of flow actually

measured at Sacramento is available. The derivation of a possible approximation of the total return in the Verona-Sacramento section was shown in Chapter III as the difference between the net discharge at Sacramento as obtained from tidal cycle measurements and as computed; the computed discharge having been derived by adding to and subtracting from the Verona flow, the measured inflow and draft between Verona and Sacramento. As indicated, however, a reliable definition of the total return water in the Verona-Sacramento section would probably require continuous tidal cycle measurements at Sacramento for at least a month.

A comparison of Tables 49 and 50 shows that seepage, ground-water return, etc., which could not be directly measured, amounted to 11 per cent of the irrigation draft in the period May to September, inclusive, while the direct return measured in definite channels totaled 23 per cent of the draft. The total return amounted to 34 per cent of the draft. Plate 4 is a diagram plotted from the data of Table 50 showing the accumulated irrigation draft and return water in downstream order, Red Bluff to Sacramento, for the five months' period, May to September, 1931.

Draft-Return Water Relation for Particular Sacramento Valley Areas

In the Sacramento Valley there are certain units or districts that are set apart physically by levees or otherwise, so that the return water in each district may be readily segregated. In each case the records of all diversions to and discharges from the unit are available. Such units are, the area above the Colusa-Williams Highway Crossing of Colusa Trough, Reclamation District 108, and Reclamation District 1500. The relation between the 1931 draft and return water

for the Colusa Trough area is shown in Table 51 and for Reclamation Districts 108 and 1500, in Tables 52 and 53, respectively.

Tables 56 to 67, inclusive, present in detail the discharge measurements for the Sacramento Valley return water channels.

San Joaquin Return Waters

In the San Joaquin Valley return water measurements of 1931, the gaging stations were located at the same points as in 1929 and 1930 and the same methods were followed. That is, a continuous record of the discharge from May to September, inclusive, was secured at an upper and lower station on each stream: San Joaquin, Stanislaus, Tuolumne, and Merced Rivers, and Dry Creek. On the San Joaquin River, continuous records of discharge were also obtained for intermediate stations, one near Grayson (Laird Slough) and the other just below the junction with Merced River. The latter is the station maintained by the U. S. Geological Survey and referred to as "San Joaquin River near Newman". (See Table 17). Measurements and records of all pumping diversions between the upper and lower stations on each stream were also obtained, thereby completing the necessary data for the computation of the return water. The records for the gaging stations are given in Chapter III, Tables 17 to 27, inclusive, and the diversion records for the San Joaquin streams are given in Chapter IV, Tables 42 to 46, inclusive.

Table 54 gives the results of the San Joaquin return water measurements and Table 55 shows a comparison of the 1931 return water and irrigation draft in the San Joaquin Valley. Plate 5 depicts the accumulated irrigation draft and return water in downstream order,

San Luis Island to Vernalis, for the five months' period May to September, 1931.

Comparative Sacramento and San Joaquin Return Water, 1924 to 1931

The comparative figures, 1924 to 1931, for the Sacramento and San Joaquin seasonal return water in per cent of the irrigation draft are shown in Table 47. The total seasonal stream flow, in per cent of normal, of the Sacramento River at Red Bluff and the San Joaquin River near Vernalis, and the rice acreage irrigated from the Sacramento River have also been given in this table in order to show what relation, if any, there may have been between the variation from year to year in these data and the variation in the return water percentages. With respect to the Sacramento River data, the variation in the rice acreage seems to bear no definite relation to the variation in the return flow percentages but the decrease in the return flow percentage in the years when the stream flow was greatly below normal, is very marked. This is undoubtedly a reflection of the conservation and waste prevention measures effected in the seasons of low water supply. In these seasons, the spill from the rice fields and all controllable wastes were practically eliminated in order that the river diversions might be reduced accordingly. The latter, then, approached more nearly the actual consumptive requirements of the crops so that the return flow percentage was considerably smaller. In the seasons of less critical water supply and correspondingly less urgent demand for conservation, the greater facility in irrigation operations obtained by larger diversions and correspondingly greater wastes and spill, may offer an explanation of the larger return water percentages in these seasons.

In the years of more normal stream flow there probably occurs also, a greater accretion from groundwater storage, etc., and in this event the additional return from this source should not, strictly speaking, be included in the percentage figures since this would not be a return derived from the irrigation draft.

In the case of the San Joaquin return water data there appears to be no such definite relation between the seasonal flow of the San Joaquin River and its tributaries in per cent of normal and the return water percentages. It would appear that the average percentage of diversions occurring as return water in the San Joaquin River is considerably smaller than that for the Sacramento River. This difference may probably be attributed to the fact that, whereas, due to basin topography, practically all drainage from Sacramento River diversions is quickly returned to the river, in the San Joaquin Valley, much of the drainage from the major foothill diversions may pass to the underground water and from there, in the lower areas of many of the irrigation districts, be recovered by drainage pumps for re-use in the irrigation canals. Considerable of the San Joaquin return, therefore, may never reach the river to be accounted for in the return water measurements. The marked decrease in the return water percentages in the last few years may have been occasioned by a greater development of such rediversion and use of the return waters and also by the gradual attainment of a higher duty of water and consequent reduction in the gross diversions.

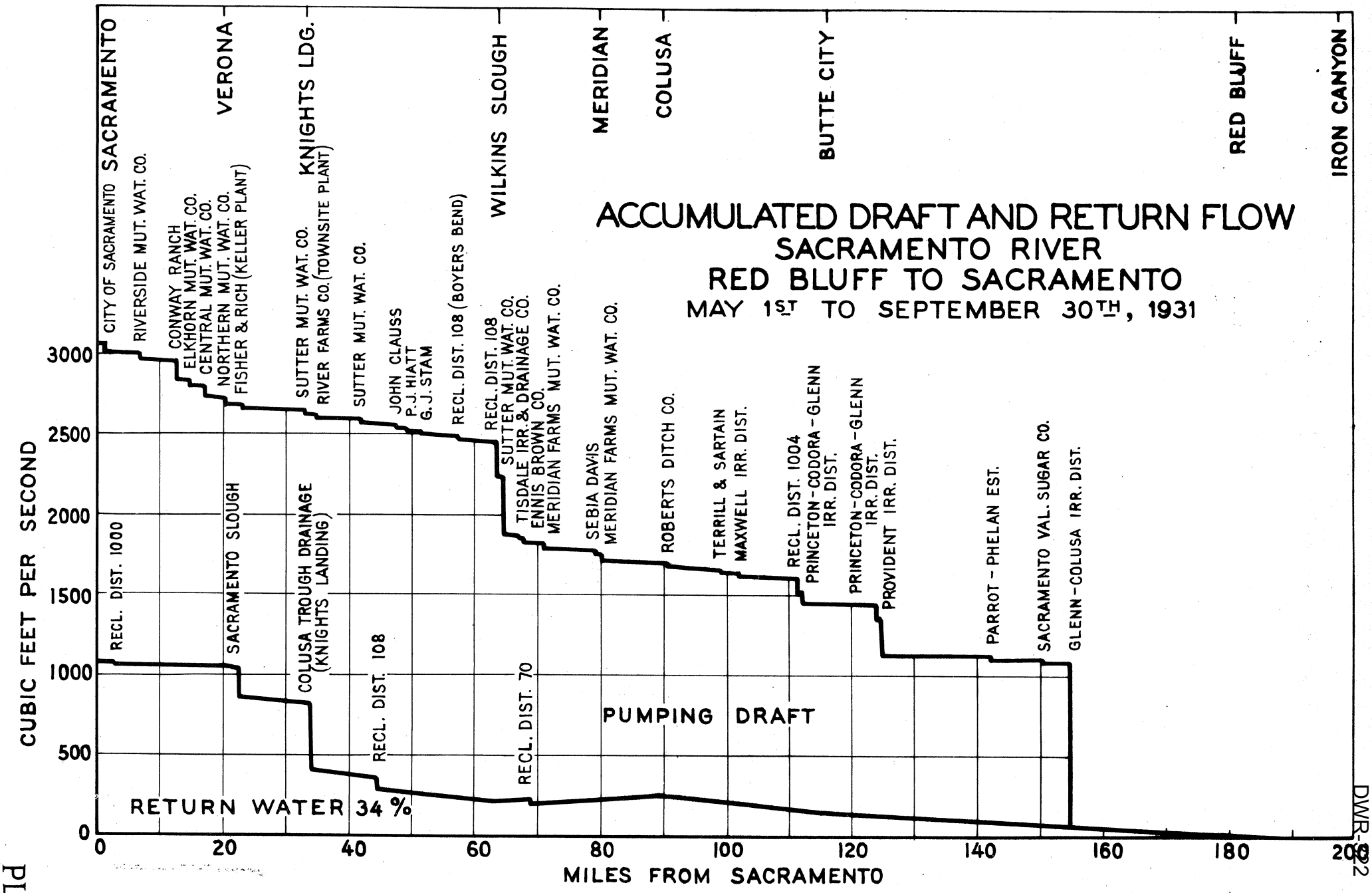
TABLE 47

SACRAMENTO AND SAN JOAQUIN RETURN WATER PERCENTAGES, 1924-1931

Year	Sacramento River				San Joaquin River		
	Seasonal Run-off at Red Bluff Per Cent of Normal *	Rice Acreage Irrigated from River	Return Water		Seasonal Run-off at Vernalis Per cent Normal **	Return Water	
			Period Months Inc.	Per cent of Draft		Period Months Inc.	Per cent of Draft
1924	36	59700	Jun.-Sep.	33	24	Jul.-Sep.	35
1925	86	58000	Jul.-Oct.	59	86	Aug.-Sep.	38
1926	61	87500	Jun.-Sep.	49	55	Jul.-Sep.	28
1927	117	79800	Jul.-Sep.	59	100	Aug.-Sep.	32
1928	82	63500	Jun.-Sep.	49	67	Jul.-Sep.	28
1929	47	43900	Jun.-Sep.	42	44	Jul.-Sep.	19
1930	65	56200	Jun.-Sep.	55	50	Jun.-Sep.	20
1931	36	73900	May -Sep.	34	23	May -Sep.	19

* 40-year Mean (1889-1929).

** 40-year Mean (1889-1929) of natural run-off at foothill stations of San Joaquin, Merced, Tuolumne and Stanislaus Rivers.



NOTE: IN ORDER TO SHOW RETURN WATER FROM SACRAMENTO RIVER IRRIGATION ONLY, THE DISCHARGE TO THE SACRAMENTO RIVER OF THE FEATHER AND AMERICAN RIVERS IS EXCLUDED AS IS ALSO RETURN THROUGH BUTTE SLOUGH, A PORTION OF THE RETURN THROUGH SACRAMENTO SLOUGH DERIVED FROM FEATHER RIVER DIVERSIONS AND THE RETURN THROUGH THE BACK BORROW PIT OF RECL. DIST. 1000.

PLATE 4

TABLE 48

WATER DISCHARGED TO THE SACRAMENTO RIVER ABOVE SACRAMENTO AS MEASURED AT DEFINITE RETURN CHANNELS

*From records for Butte Slough, District 70 Drain, District 108 Drain, Colusa Basin Drainage at Knights Landing, Sacramento Slough, District 1000 Drain (2d Bannon Slough) and Back Borrow Pit of District 1000.

Month	Acre-feet	Average Second-feet
May	61300	997
June	50900	855
July	27900	454
August	46700	759
September	58500	983
October	18200	296
Totals	263500	722

*See Tables 57 to 61, Inclusive, 65 and 66.

TABLE 49

RELATION BETWEEN RETURN WATER AND DRAFT, SACRAMENTO RIVER, RED BLUFF TO SACRAMENTO, MAY TO SEPTEMBER, (USING ONLY RETURN WATER WHICH ENTERED THROUGH DEFINITE MEASURED CHANNELS*)

	May		June		July		August		September		May to September Inclusive	
	Ac.Ft.	cfs	Ac.Ft.	cfs	Ac.Ft.	cfs	Ac.Ft.	cfs	Ac.Ft.	cfs	Ac.Ft.	cfs
RETURN												
Reclamation District 70 Drain	1470	24	1300	22	1410	23	1290	21	899	15	6369	21
Reclamation District 108 Drain	2390	39	3320	56	1120	18	7290	119	5550	93	19670	65
Colusa Basin Drainage at Knights Landing	33100	538	26200	440	11900	194	21100	343	28600	481	120900	398
Sacramento Slough (Less flow down East Borrow Pit of Sutter By-Pass)	7520	122	11360	191	12230	199	15740	256	14720	247	61570	203
Reclamation District 1000 Drain (2nd Bannon Slough)	0	0	0	0	0	0	0	0	1710	29	1710	6
Total Return	44480	723	42180	709	26660	434	45420	739	51479	865	210219	693
Total Diversions-Red Bluff to Sacramento	235557	3831	206037	3463	220434	3585	187425	3043	80256	1350	929709	3063
Return in per cent of Diversions	19%		20%		12%		24%		64%		23%	

NOTE: In order to show return water from Sacramento River irrigation only, the discharge to the river of Butte Slough is excluded, as is also a portion of the return through Sacramento Slough derived from Feather River diversions and the return through the Back Borrow Pit of Reclamation District 1000.

* As distinguished from use of all accretions as indicated in Table 50.

TABLE 50

*RELATION BETWEEN RETURN WATER AND DRAFT, SACRAMENTO RIVER, RED BLUFF TO SACRAMENTO, MAY TO SEPTEMBER
(INCLUDING ALL ACCRETIONS)

RIVER SECTION	MAY		JUNE		JULY		AUGUST		SEPTEMBER		TOTAL RETURN MAY-SEP. INC.		RED BLUFF TO LOWER END OF SECTION: RETURN		DRAFT		RETURN IN PER CENT OF DRAFT
	ACRE-FEET	AVER CFS.	ACRE-FEET	AVER CFS.	ACRE-FEET	AVER CFS.	ACRE-FEET	AVER CFS.	ACRE-FEET	AVER CFS	ACRE-FEET	AVER CFS.	ACRE-FEET	AVER CFS.	ACRE-FEET	AVER CFS.	
RED BLUFF-BUTTE CITY	12500	203	8140	137	10900	177	6360	104	4530	76	42430	140	42430	140	442878	1459	10%
BUTTE CITY-COLUSA	10800	176	6800	114	5300	86	2420	39	1790	30	27110	89	69540	229	516127	1701	13%
COLUSA-WILKINS SL.	-4590	-74	-4240	-71	1920	31	1380	22	-220	-4	-5750	-19	63790	210	747909	2465	9%
WILKINS SL.-KNIGHTS LDG.	56900	924	44600	750	24600	400	28200	459	27900	469	182200	600	245990	811	800381	2637	31%
KNIGHTS LDG.-VERONA	12200	198	18700	314	10500	171	11700	190	18600	313	71700	236	317690	1047	816378	2690	39%
VERONA-SACRAMENTO **	0	0	0	0	0	0	0	0	1710	29	1710	6	319400	1052	929709	3063	34%
TOTAL RETURN	87810	1427	74000	1244	53220	865	50060	814	54310	913	319400	1052					
TOTAL DRAFT - RED BLUFF TO SACRAMENTO	235557	3831	206037	3463	220434	3585	187425	3048	80256	1349	929709	3063					
RETURN IN PER CENT OF DRAFT	37%		36%		24%		27%		68%		34%						

* AS THE RETURN WATER IN THIS TABLE BETWEEN ANY TWO STATIONS IS COMPUTED AS THE DIFFERENCE IN DISCHARGE BETWEEN THE UPPER AND LOWER STATION, MAKING DUE ALLOWANCE FOR THE INTERVENING DIVERSIONS, THE RESULTS INCLUDE BOTH THOSE ACCRETIONS ENTERING FROM DEFINITE RETURN CHANNELS WHICH HAVE BEEN MEASURED AND ACCRETIONS DUE TO SEEPAGE, GROUNDWATER RETURN, ETC., WHICH CANNOT BE DIRECTLY MEASURED.

** SEE DISCUSSION IN TEXT OF CHAPTERS III AND V.

NOTE: COMPUTED FROM RECORD OF RIVER DISCHARGE AT RED BLUFF, BUTTE CITY, COLUSA, WILKINS SLOUGH, KNIGHTS LANDING, VERONA AND SACRAMENTO AND MEASURED DIVERSIONS BETWEEN THESE POINTS. IN THE RETURN WATER HERE SHOWN THE DISCHARGE TO THE SACRAMENTO RIVER OF THE FEATHER AND AMERICAN RIVERS IS EXCLUDED AS IS ALSO RETURN THROUGH BUTTE SLOUGH, A PORTION OF THE RETURN THROUGH SACRAMENTO SLOUGH DERIVED FROM FEATHER RIVER DIVERSIONS AND THE RETURN THROUGH THE BACK BORROW PIT OF RECLAMATION DISTRICT 1000. ALSO, INFLOW FROM MILL, ANTELOPE, DEER AND OTHER CREEKS BETWEEN RED BLUFF AND BUTTE CITY HAS BEEN EXCLUDED.

TABLE 51

RELATION BETWEEN THE RETURN WATER IN COLUSA TROUGH AT COLUSA-WILLIAMS HIGHWAY AND THE DIVERSIONS FROM WHICH THE RETURN WAIER WAS DERIVED

	Mile and Bank	May		June		July		August		September		May to Sept. Incl.		Acreage Irrigated		
		Ac.Ft.	cfs.	Ac.Ft.	cfs.	Ac.Ft.	cfs.	Ac.Ft.	cfs.	Ac.Ft.	cfs.	Ac.Ft.	cfs.	Rice	Gen'l	Gm Cl
DIVERSIONS																
- Sacramento River -																
Glenn-Colusa Irr. Dist.	154.8R	76340	1242	63575	1068	71961	1170	62324	1014	26878	452	301073	992	29313	23110	
Jacinto Irrigation Dist.	154.8R	2123	35	2210	37	3272	53	2418	39	1948	33	11976	39		4596	
Compton-Delevan Irr.Dist.	154.8R	2604	42	2520	42	2743	45	1762	29	76	1	9710	32	1839	130	
Provident Irrigation Dist.	154.8R	1324	22	1194	20	1419	23	1407	23	606	10	5950	20	556	105	
C. L. Leonard	154.8R	86	1	50	1	97	2	75	1	283	5	591	2		160	
California Lands Inc.	124.4R	56	1	282	5	317	5	244	4	261	4	1160	4		377	
Provident Irrigation Dist.	124.2R	20103	327	14539	244	15685	255	13552	220	7045	118	70924	234	6932	720	
Princeton-Codora-Glenn ID	123.9R	5858	95	5626	95	5765	94	6180	101	4701	79	28130	93)	2349	2911	
Princeton-Codora-Glenn ID	112.4R	6371	104	5258	88	5937	97	3781	61	1417	24	22764	75)			
American Trust Company	103.7R	430	7	412	7	484	8	358	6	236	4	1920	6		410	80
Maxwell Irrigation Dist.	102.8R	1603	26	1557	26	1740	28	962	16	31	1	5893	19	700	5	
A. F. & R. C. Wohlfrom	101.1R	132	3	224	4	56	1	0	0	0	0	462	2		130	
- Colusa Trough -																
Henry Jameson	22.0R	801	13	752	13	774	13	790	13	313	5	3430	11	230		
Razor Ranch (Geo.Anthony)	21.1R	130	2	86	1	167	3	52	1	0	0	435	1		345	
Razor Ranch (Geo.Anthony)	20.7R	72	1	26		65	1	23	1	0	0	191	1		130	
Bearrup & Fessigm & Rouke	11.5L	0	0	125	2	125	2	0	0	0	0	250	1		250	
Maxwell I.D. (Plant #2A)	7.0R	951	15	932	16	897	15	720	12	804	14	4304	14		480	1945
Sacramento Shooting Cl.Lat.F	3.1R	0	0	0	0	0	0	2		61	1	63				540
I. G. Zumwalt	2.2R	288	5	209	4	149	2	180	3	50	1	876	3		1443	
Total Diversions		119327	1941	99577	1673	111658	1817	94835	1544	44710	752	470107	1549	41919	35302	2565
RETURN																
Colusa Trough at Colusa-Williams Highway		33600	546	22890	383	14700	239	20500	333	24000	403	115600	381			
Trough Diversions		2242	37	2130	36	2177	35	1772	29	1228	21	9549	31			
Total Return		35842	583	24930	419	16877	274	22272	362	25228	424	125149	412			
Return in per cent of Diversions		30%		25%		15%		23%		56%		27%				

TABLE 52

RELATION BETWEEN RETURN WATER AND DIVERSIONS - RECLAMATION DISTRICT NUMBER 108

	May		June		July		August		September		May to Sep. Inclusive		Acreage Irrigated	
	Acre-feet	Aver. c.f.s.	Acre-feet	Aver. c.f.s.	Acre-feet	Aver. c.f.s.	Acre-feet	Aver. c.f.s.	Acre-feet	Aver. c.f.s.	Acre-feet	Aver. c.f.s.	Rice	Gen'l
Diversions (1)	23446	381	20872	351	18523	301	13523	220	1828	31	78197	258	11096	8757
Return Water (2)	2390	39	3320	56	1120	18	7290	119	5550	93	19670	65		
Return in per cent of Diversions	10%		16%		6%		54%		304%		25%			

(1) The diversions comprise all those from the Sacramento River, right bank, from Mile 43.1 to Mile 63.2. The principal ones are the plants of Reclamation District 108 at Wilkins Slough, Steiner Bend, Boyer Bend and Tyndall Mound.
(2) The return water is the discharge to the Sacramento River of Reclamation District 108 Drain at Rough and Ready Bend. See Table 59.

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TABLE 53

RELATION BETWEEN RETURN WATER AND DIVERSIONS - RECLAMATION DISTRICT NUMBER 1500

	May		June		July		August		September		May to Sep. Inclusive		Acreage Irrigated	
	Acre-feet	Aver. c.f.s.	Acre-feet	Aver. c.f.s.	Acre-feet	Aver. c.f.s.	Acre-feet	Aver. c.f.s.	Acre-feet	Aver. c.f.s.	Acre-feet	Aver. c.f.s.	Rice	Gen'l
Diversions (1)	33156	539	31877	536	29698	483	28911	470	17670	297	141312	466	7251	29767
Return Water (2)	5880	96	9550	160	13100	213	16900	275	13200	222	58630	193		
Return in per cent of Diversions	18%		30%		44%		58%		75%		41%			

(1) The diversions comprise all those from the Sacramento River, left bank, from Mile 29.9 to Mile 63.75. The principal ones are Sutter Mutual Water Company's plants at Tisdale, State Ranch Bend, and Portuguese Bend.
(2) The return water is the discharge through the drainage plant of Reclamation District 1500 on the west borrow pit of Sutter By-Pass. This water reaches the Sacramento River via Sacramento Slough. See Table 62.

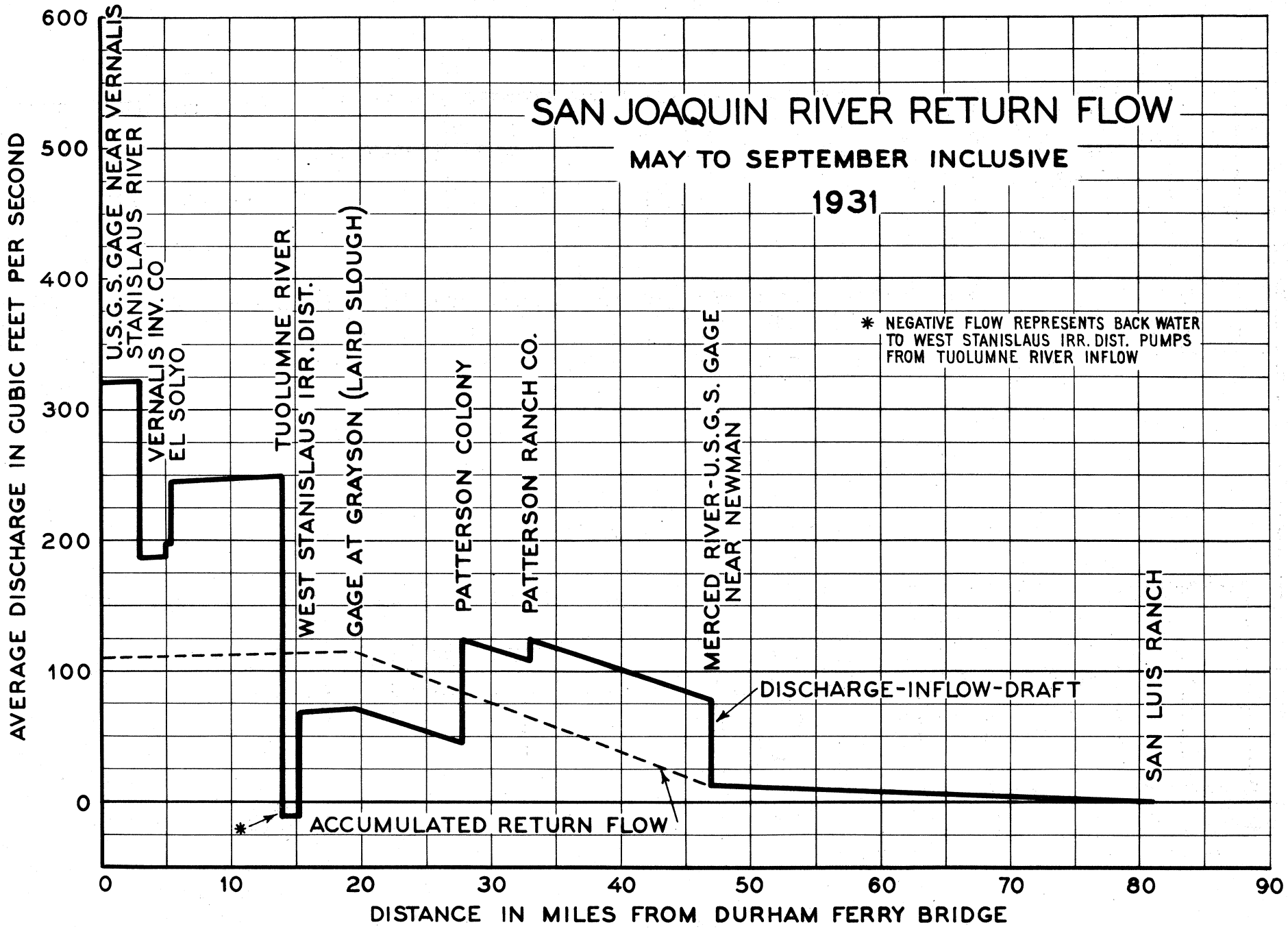
SAN JOAQUIN RIVER RETURN FLOW
MAY TO SEPTEMBER INCLUSIVE
1931
* NEGATIVE FLOW REPRESENTS BACK WATER TO WEST STANISLAUS IRR. DIST. PUMPS FROM TUOLUMNE RIVER INFLOW
U.S.G.S. GAGE NEAR VERNALIS
STANISLAUS RIVER
VERNALIS INV. CO
EL SOLYO
TUOLUMNE RIVER
WEST STANISLAUS IRR. DIST.
GAGE AT GRAYSON (LAIRD SLOUGH)
PATTERSON COLONY
PATTERSON RANCH CO.
MERCED RIVER-U.S.G.S. GAGE NEAR NEWMAN
SAN LUIS RANCH
DISCHARGE-INFLOW-DRAFT
ACCUMULATED RETURN FLOW
AVERAGE DISCHARGE IN CUBIC FEET PER SECOND
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
DISTANCE IN MILES FROM DURHAM FERRY BRIDGE

PLATE 5

TABLE 54

RETURN FLOW IN SAN JOAQUIN VALLEY STREAMS DURING THE IRRIGATION SEASON — 1931

		MAY		JUNE		JULY		AUGUST		SEPTEMBER		MAY-SEP. INCL.	
		AC. FT.	C.F.S.	AC. FT.	C.F.S.	AC. FT.	C.F.S.	AC. FT.	C.F.S.	AC. FT.	C.F.S.	AC. FT.	C.F.S.
SAN JOAQUIN RIVER													
DISCHARGE AT SAN LUIS RANCH		0		0		0		0			0		0
DISCHARGE NEAR VERNALIS	TABLE 19	27300	444	23300	392	14300	233	14000	228	19000	320	97900	322
INFLOW OF MERCED, TUOLUMNE, AND STANISLAUS RIVERS	TABLES 21, 25 AND 27	32800	533	30070	506	26170	426	24450	398	25270	425	138760	457
NET ACCRETION) SAN LUIS RANCH		-5500	-89	-6770	-114	-11870	-193	-10450	-170	-6270	-105	-40860	-135
DIVERSIONS) TO		14765	240	14752	248	19847	323	15593	254	9607	161	74564	246
NET RETURN FLOW) DURHAM FERRY BRIDGE		9265	151	7982	134	7977	130	5143	84	3337	56	33704	111
STANISLAUS RIVER													
DISCHARGE AT ORANGE BLOSSOM BRIDGE	TABLE 26	1970	32	1890	32	1970	32	1560	25	1490	25	8880	29
DISCHARGE AT ELLIOT RANCH	TABLE 27	11000	179	8420	142	7550	123	6770	110	7210	121	40950	135
ACCRETION) ORANGE BLOSSOM BRIDGE		9030	147	6530	110	5580	91	5210	85	5720	96	32070	106
DIVERSIONS) TO		1692	27	2773	46	2855	46	2449	40	1308	22	11077	36
NET RETURN FLOW) ELLIOT RANCH		10722	174	9303	156	8435	137	7659	125	7028	118	43147	142
TUOLUMNE RIVER													
DISCHARGE AT ROBERTS FERRY BRIDGE	TABLE 24	1760	29	2200	37	1930	31	1890	31	1640	28	9420	31
DISCHARGE AT TUOLUMNE CITY	TABLE 25	16700	272	15900	267	15700	255	15600	254	15500	261	79400	262
INFLOW OF DRY CREEK	TABLE 23	1820	30	1660	28	1460	24	1350	22	1210	20	7500	25
NET ACCRETION) ROBERTS FERRY BRIDGE		13120	213	12040	202	12310	200	12360	201	12650	213	62480	206
DIVERSIONS) TO		379	6	379	7	465	8	391	6	213	3	1827	6
NET RETURN FLOW) TUOLUMNE CITY		13499	219	12419	209	12775	208	12751	207	12863	216	64307	212
DRY CREEK													
DISCHARGE NEAR OLD WATERFORD BRIDGE	TABLE 22	715	12	475	8	180	3	241	4	126	2	1737	6
DISCHARGE AT MOUTH	TABLE 23	1820	30	1660	28	1460	24	1350	22	1210	20	7500	25
ACCRETION) OLD WATERFORD BRIDGE		1105	18	1185	20	1280	21	1109	18	1084	18	5763	19
DIVERSIONS) TO		66	1	39	1	48	1	41	1	17	—	211	1
NET RETURN FLOW) MOUTH		1171	19	1224	21	1328	22	1150	19	1101	18	5974	20
MERCED RIVER													
DISCHARGE AT YOSEMITE VALLEY RR. CROSSING	TABLE 20	786	13	744	12	678	11	530	9	63	1	2801	9
DISCHARGE NEAR MOUTH	TABLE 21	5300	86	5950	100	3120	51	2280	37	2660	45	19310	63
ACCRETION) YOSEMITE VALLEY RR. CROSSING		4514	73	5206	88	2442	40	1750	28	2597	44	16509	54
DIVERSIONS) TO		3298	54	2902	48	3553	58	3232	53	2128	35	15113	50
NET RETURN FLOW) MOUTH		7812	127	8108	136	5995	98	4982	81	4725	79	31622	104

TABLE 55

COMPARISON OF DIVERSIONS AND RETURN WATER, SAN JOAQUIN VALLEY, 1931
(QUANTITIES IN ACRE-FEET EXCEPT AS NOTED)

	MAY	JUN.	JUL.	AUG.	SEP.	MAY-SEP. INCL.
DIVERSIONS						
SAN JOAQUIN RIVER NEAR FRIANT (1) (2) (MILLER AND LUX CANALS, ETC.)	107000	55400	52900	38700	9280	263280
MERCED RIVER AT EXCHEQUER (1) (2) (MERCED IRR. DIST. CANAL, ETC.)	76900	68400	12900	10600	1020	169820
TURLOCK IRRIGATION DISTRICT CANAL (1)	56300	61900	67600	41900	1720	229420
MODESTO IRRIGATION DISTRICT CANAL (1)	38900	32000	31500	11600	180	114180
SOUTH SAN JOAQUIN AND OAKDALE IRRIGATION DISTRICT CANAL (1)	45700	22100	31800	5870	8810	114280
OAKDALE IRRIGATION DISTRICT CANAL (1)	12200	11800	12400	3620	3560	43580
PUMPING DIVERSIONS - SAN JOAQUIN, STANISLAUS, TUOLUMNE, MERCED RIVERS AND DRY CREEK (3)	20400	21100	27000	21900	13400	103800
TOTAL DIVERSIONS	357400	272700	236100	134190	37970	1038360
TOTAL DIVERSIONS (AVERAGE SECOND-FEET)	5810	4580	3840	2180	638	3420
RETURN						
SAN JOAQUIN RIVER NEAR VERNALIS (1)	27300	23300	14300	14000	19000	97900
PUMPING DIVERSIONS - SAN JOAQUIN, STANISLAUS, TUOLUMNE, MERCED RIVERS AND DRY CREEK (3)	20400	21100	27000	21900	13400	103800
TOTAL RETURN	47700	44400	41300	35900	32400	201700
TOTAL RETURN* (AVERAGE SECOND-FEET)	775	746	672	584	544	665
RETURN IN PER CENT OF DIVERSIONS*	13	16	18	27	85	19*

* UNDETERMINED RETURN WATER FROM SOUTH SAN JOAQUIN IRRIGATION DISTRICT ENTERING SAN JOAQUIN RIVER BELOW VERNALIS GAGING STATION IS NOT INCLUDED IN THESE FIGURES. ALSO, NO ACCOUNT IS TAKEN OF RETURN TO GROUNDWATER RE-DIVERTED TO IRRIGATION CANALS VIA DRAINAGE PUMPS IN THE VARIOUS IRRIGATION DISTRICTS.

(1) U. S. G. S. STATION.
(2) THIS FLOW ALL DIVERTED BELOW GAGING STATION AFTER MAY 1ST.
(3) SEE TABLES 42 TO 46, INCLUSIVE. THIS IS RETURN WATER DIVERTED BY PUMPING.

TABLE 56

DISCHARGE OF COLUSA TROUGH AT COLUSA-WILLIAMS HIGHWAY

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		490	568	214	277	414	176
2		386	497	214	279	336	158
3		376	474	207	302	458	154
4		384	456	194	307	462	140
5		430	470	187	291	460	140
6		420	450	178	295	446	131
7		625	420	194	281	442	126
8		799	400	203	281	460	122
9		685	380	210	283	482	112
10		496	364	226	297	486	109
11		380	380	237	293	496	107
12		344	372	244	344	500	103
13	185*	360	372	262	388	520	102
14	194	430	364	259	316	552	103
15	207	520	388	257	299	549	103
16	221	572	472	257	302	572	93
17	214	610	516	257	314	577	84
18	203	720	496	262	324	572	79
19	230	768	456	253	328	510	48
20	239	577	426	255	348	436	39
21	232	360	414	270	346	334	23
22	297	271	376	248	332	284	33
23	562	261	330	248	330	257	79
24	619	293	295	239	370	225	56
25	579	547	261	239	398	230	48
26	520	824	216	255	386	230	77
27	496	934	226	253	394	216	75
28	462	920	216	273	400	199	56
29	302	821	217	268	394	198	57
30	460	707	217	279	408	190	42
31		645		289	420		33
Mean	**346	546	383	239	333	403	91
Ac.Ft. for Month	**12300	33600	22800	14700	20500	24000	5570

NOTE: This is return water flowing in the main drain of Reclamation District 2047; it is drainage chiefly from lands irrigated by Glenn-Colusa, Provident, Princeton-Codora-Glenn, Compton-Delevan, and Maxwell Irrigation Districts.

* Beginning of record for season.
** 18 days.

TABLE 57

DISCHARGE OF BUTTE SLOUGH

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		70	146	79	3	67	64
2		88	146	75	8	73	59
3		131	139	26	10	40	62
4		125	146	32	3	46	57
5		125	139	35	3	56	52
6		139	139	51	3	50	47
7		139	153	49	3	55	47
8		145	152	43	3	97	45
9		145	95	30	3	112	45
10		153	89	12	3	96	45
11		129	100	9	3	116	53
12	100*	124	106	13	5	128	49
13	93	124	112	3	33	145	72
14	93	81	130	3	29	120	83
15	93	86	146	3	13	119	98
16	93	86	126	3	3	118	83
17	93	83	160	14	3	117	78
18	93	120	155	22	3	117	74
19	100	120	145	3	3	118	67
20		120	147	3	46	119	60
21		120	183	3	68	121	64
22	8	94	175	3	6	123	53
23	53	82	168	3	8	125	53
24	110	94	159	3	3	127	54
25	104	94	145	3	7	128	55
26	110	98	127	3	9	118	66
27	53	153	106	3	15	89	16
28	53	161	118	3	63	79	
29	131	161	110	4	60	69	
30	117	161	95	3	3	64	7
31		163		3	66		18
Mean	79**	120	135	17.5	15.8	98.5	52.4
Disch. to Sac. R. Acre-ft.	2970**	7370	8050	1080	974	5860	3220
Nat. Flow in Butte Cr. See Tbl. 12	900**	200	0	0	0	466	708
Net Return Water - Sacto. R. Acre-feet	2070**	7170	8050	1080	974	5390	2510

NOTE: To determine the amount of this discharge that is strictly return water the discharge for the station measuring natural flow in Butte Creek one mile west of the East Side Highway (See Table 12) is subtracted as shown above. There are no diversions below gaging station.

This return water is practically all from lands irrigated by Feather River diversions, and is measured at a dam near the mouth. Butte Slough joins the Sacramento River at Mile 84 Left.

* Beginning of record for season.
** 19 days.

TABLE 58

DISCHARGE OF RECLAMATION DISTRICT 70 DRAIN

Day	Daily Discharge in Second-feet							
	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	*	0	22	32	24	24	17	9
2		0	21	31	23	25	14	9
3		0	21	32	22	26	17	8
4		0	21	29	23	28	18	6
5		0	21	25	23	26	17	7
6		0	21	19	23	26	17	6
7		0	21	19	23	25	17	7
8		18	21	20	25	24	17	6
9		24	22	22	23	23	17	7
10		23	22	28	19	24	19	6
11		23	23	25	17	23	18	7
12		23	23	24	19	26	19	6
13		24	23	15	19	23	18	7
14	W	35	24	16	19	22	17	7
15	O	30	24	17	19	22	15	7
16	L	24	24	19	19	22	16	8
17	F	16	24	24	23	24	15	8
18		18	23	26	24	21	15	6
19	O	17	23	22	24	20	14	9
20	N	19	22	23	28	20	13	9
21		22	21	12	23	18	14	10
22		21	20	15	24	17	13	8
23		19	20	15	24	17	12	8
24		20	21	21	24	14	13	7
25		20	24	22	25	14	14	6
26		21	30	21	25	15	13	6
27		21	33	21	25	14	12	6
28		20	30	19	25	15	12	6
29		22	31	19	25	16	10	6
30		22	32	22	25	18	10	6
31			31		25	18		6
Mean		21.7**	23.9	21.8	22.9	21.0	15.1	7.1
Ac.Ft. for Month		996**	1470	1300	1410	1290	899	436

NOTE: All gravity flow.
This is the drainage returned to the Sacramento River at Mile 68.8 left from District 70.

* Beginning of record for season.
** 23 days.

TABLE 59

DISCHARGE OF RECLAMATION DISTRICT 108 DRAIN AT ROUGH & READY BEND

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	*		88	31	40	300	37
2			88	31	41	186	7
3			83	32	40	176	1
4		72	55	12	40		
5		73	50	12	39	123	
6		70	45	12	92	120	
7		69	39	16	90	76	
8		72	39	16	88	29	
9		86	39	17	86	36	
10		114	40	17	85	48	
11		114	39	17	107	62	
12	NO		39	8	102	57	
13	FLOW		39		101	32	
14			39		97	83	
15			39		94	163	
16			39		57	151	
17			58		97	148	
18			82		122	142	
19			82		118	123	
20			81		118	110	
21			80		92	97	
22			80		90	87	
23			79		93	73	
24			49	44	95	69	
25		57	55	44	146	65	
26		54	55	44	234	61	
27		54	56	43	252	52	
28		81	55	42	266	47	
29		100	30	42	263	42	
30		96	30	42	249	42	
31		93		42	241		
Mean		39	56	18	119	93	1.4
Ac.Ft. for Month		2390	3320	1120	7290	5550	89

NOTE: This is all gravity flow and represents drainage from Reclamation District 108 discharged to the Sacramento River at Rough & Ready Bend, Mile 44.0 Right.

* Beginning of record for season.

TABLE 60

DISCHARGE OF COLUSA BASIN DRAINAGE AT KNIGHTS LANDING

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		457	697	200	274	450	274
2		457	660	204	274	469	274
3		421	587	219	274	461	256
4		403	550	175	300	517	226
5		410	513	141	311	539	182
6		410	494	108	300	513	163
7		476	513	119	289	520	145
8		605	469	491	286	528	163
9		715	457	138	297	513	175
10		660	450	145	311	513	182
11		513	410	163	323	550	173
12		403	385	171	341	568	165
13		348	381	178	367	554	157
14	182*	348	337	163	389	535	149
15	182	392	385	197	363	554	141
16	145	494	439	204	352	580	133
17	163	587	513	204	341	594	125
18	182	678	550	204	348	583	114
19	182	771	531	182	367	595	103
20	219	771	531	171	348	553	92
21	200	624	524	167	352	511	81
22	274	439	491	182	334	469	70
23	330	293	457	175	330	428	59
24	550	237	403	167	337	388	48
25	605	108	345	175	363	348	51
26	568	513	293	200	402	308	54
27	513	789	230	212	385	330	57
28	494	861	200	234	397	316	59
29	457	879	204	237	410	330	62
30	348	843	186	230	425	282	50
31		771		241	443		37
Mean	329**	538	440	194	343	481	130
Ac.Ft. for Month	11100**	33100	26200	11900	21100	28600	7970

NOTE: This represents the drainage from Colusa Basin passing down the Back Borrow Pit of Reclamation Districts 108 and 787 and entering the Sacramento River at Mile 34.15 Right. This is just above the Knights Landing gaging station. It includes also any water coming from the Knights Landing Ridge Cut.

* Beginning of record for season.

** 17 days.

TABLE 61

DISCHARGE OF SACRAMENTO SLOUGH*

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	73	57	34	237	240	311	264
2	73	369	136	244	252	285	253
3	78	375	91	233	254	324	145
4	75	447	95	226	318	249	112
5	75	537	86	221	273	317	92
6	95	625	129	212	264	271	116
7	109	480	109	222	264	277	111
8	111	510	109	218	287	333	111
9	43	596	132	203	261	302	113
10	9	535	133	246	278	308	115
11	10	394	52	262	262	452	112
12	9	339	220	260	261	314	110
13	9	116	208	258	264	353	109
14	10	128	133	256	285	283	80
15	10	130	171	257	299	313	104
16	9	275	258	257	291	284	98
17	6	267	323	257	295	297	89
18	6	288	430	257	365	296	82
19	6	636	346	254	332	290	79
20	6	666	374	251	315	272	79
21	6	130	358	248	314	244	80
22	6	137	355	245	373	242	80
23	6	138	408	244	400	246	76
24	10	140	403	249	341	249	73
25	14	142	315	241	330	214	72
26	19	136	266	240	324	221	55
27	319	43	309	228	230	211	50
28	305	40	268	227	331	194	67
29	286	128	305	239	332	193	63
30	50	199	276	239	336	210	61
31		34		239	304		61
Mean	61.3	291	228	241	299	279	100
Ac.Ft. for Month	3650	17900	13600	14800	18400	16600	6170
Monthly Diversions Below Head of Slough	177	1036	1553	2388	2413	729	0
Discharge to Sacto. River Acre-feet	3470	16900	12000	12400	16000	15900	6170

* Water discharged through Sacramento Slough to the Sacramento River at Mile 21.2 Left. This is return water from irrigation and represents the sum of measurements at three points as follows: Reclamation District 1500 Drain, See Table 62; Sutter By-Pass East Borrow Pit, See Table 63; and Sutter By-Pass West Borrow Pit, See Table 64.

TABLE 62

DISCHARGE OF RECLAMATION DISTRICT 1500 DRAIN*

Day	Daily Discharge in Second-feet							
	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	**	65			195	222	280	123
2		65		102	202	231	255	119
3		70	18	56	196	231	280	110
4		66	102	60	195	296	204	80
5		66	205	51	196	251	272	58
6		86	305	94	189	243	225	80
7		100	169	74	196	253	230	73
8		100	208	74	189	267	255	70
9		35	305	97	171	244	221	70
10			254	98	210	259	225	69
11			127	10	222	241	264	69
12			84	171	222	238	242	69
13				152	222	238	280	70
14				70	222	256	234	44
15				102	222	270	264	69
16	41			180	222	262	234	65
17				236	222	266	250	59
18	41		30	333	222	326	250	54
19			386	250	222	304	246	51
20	47		425	252	222	288	230	51
21			89	238	222	287	204	51
22	78			222	222	347	204	51
23				278	222	374	204	51
24	47			292	228	316	203	51
25				208	222	306	165	52
26	70			180	222	300	170	36
27	41			242	210	207	162	33
28	25			208	210	306	148	51
29	62		91	252	222	305	136	48
30	47		165	234	222	306	128	47
31	47				222	272		48
Mean	17.6	21.8	95.6	160	213	275	222	63.6
Ac.Ft. for Month	1080	1300	5880	9550	13100	16900	13200	3910

* This discharge through Reclamation District 1500 drainage plant combines with the discharge given in Tables 63 and 64 to form the entire flow of Sacramento Slough, See Table 61.

** Beginning of record for season.

TABLE 63

DISCHARGE OF SUTTER BY-PASS - EAST BORROW PIT
(WILLOW SLOUGH AT CHANDLER)*

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	3**	4	3		4	4	106
2	3	319	3		4	4	100
3	3	310	4		4	19	4
4	4	300	4		4	19	4
5	4	290	4		4	19	4
6	4	278	4	4	4	19	3
7	4	267	4	4	4	19	3
8	3	256	4	4	4	47	4
9	3	243	4	4	4	47	4
10	4	231	4	4	4	46	4
11	4	215	4	4	4	147	3
12	3	202	4	3	4	27	3
13	3	65	4	3	4	28	3
14	4	80	4	3	4	3	3
15	4	85	4	4	4	3	4
16	3	233	4	4	4	3	4
17		225	4	4	4	3	3
18		217	4	4	4	4	3
19		210	4	4	4	4	3
20		202	32	4	4	4	3
21		2	32	4	4	4	4
22		96	46	4	4	4	4
23		95	46	4	4	4	3
24		95	31	4	4	4	3
25		95	31	3	4	4	3
26		93	17	3	4	4	4
27	294	3	4	4	4	4	4
28	273	3	4	4	4	4	4
29	247	3	4	4	4	18	3
30	4	3		4	4	46	3
31		3		4	4		3
Mean	29.1	152	10.7	3.2	4.0	18.8	9.9
Ac.Ft. for Month	1730	9370	637	196	246	1120	607

* This flow is practically all return water from lands irrigated by Feather River diversions. This flow combines with the discharge given in Tables 62 and 64 to form the entire flow in Sacramento Slough. See Table 61.

** Beginning of record for season.

TABLE 64

DISCHARGE OF SUTTER BY-PASS - WEST BORROW PIT
(Opposite Gelshauser Slough)*

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	5**	53	31	42	14	27	35
2	5	50	31	42	17	26	34
3	5	47	31	37	19	25	31
4	5	45	31	31	18	26	28
5	5	42	31	25	18	26	30
6	5	42	31	19	17	27	33
7	5	44	31	22	17	28	35
8	5	46	31	25	16	31	37
9	5	48	31	28	13	34	39
10	5	50	31	32	15	37	42
11	6	52	38	36	17	41	40
12	6	53	45	35	19	45	38
13	6	51	52	33	22	45	36
14	6	48	59	31	25	46	33
15	6	45	65	31	25	46	31
16	6	42	74	31	25	47	29
17	6	42	83	31	25	44	27
18	6	41	93	31	25	42	25
19	6	40	92	28	24	40	25
20	6	39	90	25	23	38	25
21	6	39	88	22	23	36	25
22	6	41	87	19	22	34	25
23	6	43	84	18	22	38	22
24	10	45	80	17	21	42	19
25	14	47	76	16	20	45	17
26	19	43	69	15	20	47	15
27	25	40	63	14	19	45	13
28	32	37	56	13	21	42	12
29	39	34	49	13	23	39	12
30	46	31	42	13	26	36	11
31		31		13	28		10
Mean	10.4	43.6	56.5	25.4	20.6	37.5	26.8
Ac. Ft. for Month	621	2680	3360	1560	1270	2230	1650

* This flow is measured at a point 15.7 miles above the main drainage plant of Reclamation District 1500. It includes all return water from Reclamation District 1660. This flow combines with the discharge given in Tables 62 and 63 to form the entire flow in Sacramento Slough. See Table 61.

** Beginning of record for season.

TABLE 65

DISCHARGE OF RECLAMATION DISTRICT 1000 DRAIN (2d BANNON SLOUGH)

Day	Daily Discharge in Second-feet							
	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	*							
2								
3								
4								47
5								
6								
7								
8		-	-	-	-	-		
9		-	-	-	-	-		
10							63	36
11	64	N	N	N	N	N	63	
12		O	O	O	O	O	58	30
13		I	I	I	I	I	58	
14		T	T	T	T	T	53	
15		A	A	A	A	A	58	
16		R	R	R	R	R	58	
17		E	E	E	E	E	63	
18		P	P	P	P	P	58	
19		O	O	O	O	O	58	
20							42	42
21		O	O	O	O	O	32	
22		N	N	N	N	N	31	
23		-	-	-	-	-	26	
24								
25		-	-	-	-	-	42	
26							37	
27							32	
28							31	
29								
30	80							
31								
Mean	4.6	0	0	0	0	0	28.7	5.0
Ac.Ft. for Month	286	0	0	0	0	0	1710	307

NOTE: This is the drainage pumped back to the Sacramento River at Mile 2.1 Left from District 1000.

* Beginning of record for season.

TABLE 66

DISCHARGE OF BACK BORROW PIT RECLAMATION DISTRICT 1000

Day	Daily Discharge in Second-feet						
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
1		2					
2		2					
3		2					
4		2					
5		2					
6		2					
7		2					
8		2					
9		2					
10		2	-	-	-	-	-	-
11		1	-	-	-	-	-	-
12		1	W	W	W	W	W	W
13	4*	1	O	O	O	O	O	O
14	4	1	L	L	L	L	L	L
15	4	1	F	F	F	F	F	F
16	4	1						
17	4	1	O	O	O	O	O	O
18	4		N	N	N	N	N	N
19	4		-	-	-	-	-	-
20	4							
21	3		-	-	-	-	-	-
22	3							
23	3							
24	3							
25	3							
26	3							
27	2							
28	2							
29	2							
30	2							
31								
Mean	**3.2	0.9	0	0	0	0	0	0
Ac.Ft. for Month	**115	53	0	0	0	0	0	0

NOTE: This is water flowing down the borrow pit outside the east levee of Reclamation District 1000 and entering the Sacramento River at Mile 1.3 L. It is measured at the Old Garden Highway crossing (Natomas Trestle). This drainage is probably not derived from Sacramento River sources.

* Beginning of record for season.
** 18 days.

TABLE 67

DISCHARGE OF YOLO BY-PASS-EAST BORROW PIT (TULE CANAL)*

	Daily Discharge in Second-feet					
	May	Jun.	Jul.	Aug.	Sep.	Oct.
1	**					
2						
3						
4						
5						
6						
7						
8	I	I	I	I	I	I
9						
10	*	I	I	I	I	I
11	W	W	W	W	W	W
12	O	O	O	O	O	O
13	L	L	L	L	L	L
14	F	F	F	F	F	F
15						
16	O	O	O	O	O	O
17	N	N	N	N	N	N
18						
19	I	I	I	I	I	I
20	I	I	I	I	I	I
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
Mean	0	0	0	0	0	0
Ac.Ft. for Month	0	0	0	0	0	0

* Measured at north levee of Sacramento By-Pass. This station records any undiverted drainage from Reclamation District 1600.

** Beginning of record for season.

CHAPTER VI

USE OF WATER IN THE SACRAMENTO-SAN JOAQUIN DELTA

As outlined in detail in preceding reports, this investigation having as its objective, a complete annual determination of the consumptive use of water in the entire Sacramento-San Joaquin Delta, has comprised the experimental work to determine the unit consumptive use of water by the various irrigated crops and vegetation in the Delta and the general field work to obtain annually a complete census of the irrigated crops and water consuming areas. With the unit consumptive use of water determined by the experimental work and the complete census available, the former may be applied to the data of the latter to derive the consumptive use of water in the Delta as a whole or on individual tracts or islands.

Cooperative Irrigation Investigations

Through the Federal-State cooperation for Irrigation Investigations the experimental work has been conducted by the Division of Irrigation, Bureau of Agricultural Engineering, U. S. Department of Agriculture, and has included probably as its most successful feature and that furnishing most definite and conclusive results, the consumptive use determinations for various Delta crops and vegetation grown in tanks. With the close of the 1930 season, the major portion of this investigation was practically completed. That is, the tank work had covered the range of the principal crops grown in the Delta as well as aquatic growths and weeds. At that time, therefore, an analysis and summary of the results were submitted by the Bureau of Agricultural Engineering and used as the basis for the computations of the con-

sumptive use of water in the Sacramento-San Joaquin Delta as presented in the State Engineer's Bulletin No. 27, "Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay".

The period of the investigation with respect to certain of the unit consumptive use determinations appeared to have been somewhat short as the basis for final conclusions and it was considered desirable to continue the experimental work on a smaller scale in 1931. The items included in this continuation of the work have comprised the maintenance of tule and cat-tail tanks at Clarksburg and King Island, tule tanks at Simmons Island, evaporation stations at Clarksburg and Simmons Island, asparagus tanks on the Richmond-Chase Tract, and a general study of the character, occurrence and extent of water consuming weed growths in the Delta. The investigation prior to 1931 of the use of water by tules and cat-tails revealed a surprisingly high rate of consumption and indicated the advisability of corroboration through a further period of observation. The maintenance of the asparagus tanks in 1931 was pursuant to the program adopted at the time of their installation in 1927, that is, that the experiment should continue throughout the economic life of the plants. The work done and the results of these investigations in 1931 are presented in detail in the report by Major O. V. P. Stout which follows in this chapter. The work planned to be continued in 1932 includes maintenance of the tule and cat-tail tanks at King Island, the tule tanks at Simmons Island, weed tanks at King Island, the asparagus tanks, and complete evaporation stations at King. and Simmons Islands and at two or more additional Delta locations to be selected.

Annual Census of Irrigated Crop Acreages and Water Consuming Areas

The annual census of the irrigated crop acreages and water consuming areas of the Delta was conducted through the Water Supervisor's office as an activity in conjunction with the special investigation of the Delta losses in 1931 due to the high encroachment of salinity. (See Chapter VIII). In connection with the latter investigation, detailed information was obtained for practically every subdivision or ownership on each island or tract in the Delta. This afforded an opportunity for a very complete census of the irrigated crop acreages and the various areas of aquatic growths, weeds, idle and bare lands, water surfaces, etc. The detail of the 1931 census is shown in Table 68.

1931 Consumptive Use of Water in the Sacramento-San Joaquin Delta

The total consumptive use of water in the Sacramento-San Joaquin Delta in 1931 has been derived in the same manner that the 1929 consumptive use was derived in Bulletin No. 27. Table 69 shows the unit consumptive use for the various irrigated crops, aquatic growths, bare land, idle land in weeds, and open water surfaces. These are the units which were developed from the experimental data and used in the computations of Bulletin No. 27. It is possible that the unit consumptive use figures of Table 69 with respect to aquatic growths, weeds, and evaporation may be modified in accordance with further information derived from the experimental work now in progress, but pending final conclusions from the latter investigations, the data of Table 69 have been used as the basis for the computation of the total consumptive use of water.

In the course of the Delta investigations it has been found that in general all lands below a certain elevation, whether idle or cropped, receive and consume water derived by seepage from the adjacent channels. It was necessary, therefore, that all such lands be accounted for in the computations for the total consumptive use of water. It was determined that Elevation 5, U.S.G.S. datum, would best represent the elevation below which it would be necessary to take the seepage into account and above which unirrigated and idle lands could be considered as non-water consuming. This required that the census should include a segregation, as above or below Elevation 5, of all unirrigated crops and pasture, idle lands in weeds, and bare lands, and these segregations are indicated in Table 68.

The figures of Table 70 showing the total seasonal and annual consumption of water in 1931 by the various Delta crops and water consuming areas were derived by application of the unit figures of Table 69 to the total acreage segregations of Table 68. As shown by Table 70, the seasonal consumptive use of water in 1931 by the Delta's irrigated crop area of 339,300 acres amounted to 756,010 acre-feet or 2.23 acre-feet per acre. The seasonal use on the total consumptive area of 446,310 acres (including aquatic growths, bare lands, idle lands in weeds, open water surfaces, etc.), amounted to 1,167,390 acre-feet or 2.61 acre-feet per acre.

In Tables 71 and 72 the total consumptive use of water in 1931 has been segregated to show the use in each river delta, Table 71 showing that in the Sacramento Delta, and Table 72 that in the San Joaquin Delta.

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Table 73 shows a general classification of the 1931 irrigated crop lands with respect to peat and sedimentary soils.

TABLE 68

DETAIL OF IRRIGATED AND NON-IRRIGATED CROPS AND ACREAGES IN THE DELTA, 1931

Island or tract	Acreage of irrigated crops and water consuming areas*																		Acreage of non-irrigated crops and non-water consuming areas†			Total acreage‡
	Irrigated crop acreage																					
	Alfalfa	Asparagus	Beans	Beets	Celery	Corn	Fruit	Grain and hay	Onions	Pasture	Potatoes	Seed	Truck and miscellaneous vegetables	Total irrigated crop acreage	Idle lands in weeds below elev. 5.0	Bare lands below elev. 5.0**	Aquatic growths and interior water surfaces	Total water consuming acreage*†	Grain and hay above elev. 5.0	Pasture, idle and bare lands above elev. 5.0**	Levees†	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
Andrus Island—Reclamation Districts Nos. 317, 407, 556	372	1,563	576	949	515	713	1,040	308	6	130		49	446	6,667	342	230	123	7,362			461	7,823
Bacon Island—Reclamation District No. 2028				810		353		1,149	188	40	1,603	130	6	4,279	960	117	164	5,520			105	5,625
Baird Ranch—Portion of Reclamation District No. 800						264		230		400		1,290		2,184	700	75	9	2,968			32	3,000
Bethel Tract—Reclamation District No. 1619	35	400			150	370		405			2			1,362	1,380	439	139	3,320			84	3,404
Bigger and Inman Ranch										870				870		18	82	970			30	1,000
Bishop Tract—Reclamation District No. 2042		284		675		45		533	104	134	302			2,077	108	32	72	2,289			61	2,350
Bishop Highlands										138				138	307	5	23	473	160	360	7	1,000
Black Point Spoil Area																				575		575
Boggs Tract—Reclamation District No. 404	925		80			100		420		200			80	1,805	68	520	68	2,461		122	71	[12]2,654
Bouldin Island—Reclamation District No. 756		572	51		600	1,895		467	270		1,270			5,125	600	61	84	5,870			136	6,006
Brack Tract—Reclamation District No. 2033	133	1,530		1,365		12	60							3,100			383	3,483		1,096	79	4,658
Bradford Island—Reclamation District No. 2059	10	490				139		28		485				1,152	691	38	121	2,002			57	2,059
Brannan Island—Reclamation District No. 2067	637	2,470	1	700	150	1,276	314	151		43	5		75	5,822	380	59	223	6,484		462	317	[27]7,263
Byron Tract—Portion of Reclamation District No. 800	240					800		1,170		200	520			2,930	250	26	26	3,232			88	3,320
California Irrigated Farms—Portions of Rec. Dists. 2058 and 2062	4,580	30	3,600			150	5	200			25			8,590	1,063	230	300	10,183			107	[30]10,290
Canal Ranch	272	1,732	180					450		10				2,644	376	83	178	3,281			70	[4]3,351
Clifton Court Tract—Reclamation District No. 802	185	340				2,312		560						[5]3,397	180	20	46	[5]3,643			69	3,362
Collinsville Manor																				433		[4]433
Coney Island						940								940	24	11	45	1,020			40	1,060
Content—(Private Reclamations near)		8	37	25		44	3			52		30	10	209	23			232	95	77	30	[6]434
Deadhorse Island						195								195			6	201			20	221
Donlan Island—Reclamation District No. 274		150	10				7				10		10	[7]187		40		[7]227			[7]20	230
Drexler Tract			400			1,200		900		468				2,968		50	110	3,128			74	3,202
Edinger-Johnson Reclamation District—Includes Rec. Dist. 745	68	40	20	118		20	171	120		60			75	692	28			720		101	65	[8]886
Ehrhardt Club		500								10			10	520			60	580		34	17	631
Elmwood Tract						600				176				776		4	5	785			32	[1]817
Empire Tract—Reclamation District No. 2029				884	60	1,486		7			918			3,355	74	40	130	3,599			79	3,678
Fabian Tract—Reclamation District No. 773			262			1,929		3,451						5,642	700	95	136	6,573	346	141	136	7,196
Fay Island			91											91		2	3	96			13	109
Fern Island																				100	23	123
Fink and Winler Ranch—Portion of Rec. Dist. No. 2062	400					50				203				653		12	36	701			59	760
Fox Ranch (George R. Fox)	146							30						176		2		178			5	183
Franks Tract		185		860		752		376	25	540	397	100		3,235	35		48	3,318			107	3,425
Grand Island—Reclamation District No. 3	555	3,497	3,334	1,388	1,340	1,034	2,359	1,246		93	15	77	590	15,528	75	357	280	16,240			774	17,014
Hastings Tract—Reclamation District No. 2060	45	1,910		1,852				567						4,374		80	322	4,776	1,785	268	610	7,439
Headreach Island																				110	26	[1]136
Henning Tract—Portion of Reclamation District No. 2030	150		250						300		1,200			1,900	453	21	222	2,596			104	2,700
Hog Island																				77	24	[1]101
Holland Tract (Little Holland-Seaborn)			100	700		1,100		500						2,400	400		20	2,820			40	2,860
Holland Tract—Reclamation District No. 2025						2,506		626						3,132	828	60	170	4,190			85	4,275
Honker Lake Tract			120			180		1,075		300		60		1,735	51	10	22	1,818			72	1,890
Horseshoe Island	140													140				140		495	5	640
Hotchkiss Tract—Includes Reclamation District No. 799	505	820		20		130	5	360		145			80	2,065	1,493		63	3,621			79	3,700
Ida Island	3	18	3			1								25	9	16		50				50
Jersey Island—Reclamation District No. 830		862				1,200	10	445		200		23		2,740	634	5	62	3,441			117	3,558
Jones Tract (Upper)—Reclamation District No. 2039						3,867		1,480				361		5,708	430	24	84	6,246			112	[6]6,358
Jones Tract (Lower)—Reclamation District No. 2038						1,447		2,246			1,616			5,309	265	65	87	5,726		20	109	[5]5,855
Kimball Island															65			65				65
King Island—Reclamation District No. 2044				1,102	186	218		1,483			70			3,059		40	86	3,185			75	3,260
Liberty Reclamation District	8	1,720	454	2,037	129	877		138	591			10	110	6,074	38	13	175	6,300			450	6,750
Mandeville Island—Reclamation District No. 2027			252			1,387		1,147	28		1,167	229		4,210	723	54	180	5,167		166	135	[15]5,468
March Garden and Brookside Tracts	85					89	15	80		158			70	497	50	7	4	558			12	[10]570
McCormack Tract		400	1,301											[11]1,701		6	18	[11]1,725			65	1,576
McDonald Island—Portion of Reclamation District No. 2030			80	1,524				489			290			2,383	501	328	111	3,323			105	[3]3,428
Medford Island—Reclamation District No. 2041						338		355			317			1,010	70	9	67	1,156			47	1,203
Merritt Island—Reclamation District No. 150	1,104	174	140	752		166	283	85				1,561		[12]4,265	42	50	35	[12]4,392	239	180	200	4,986
Mildred Island—Reclamation District No. 2021									45		834			879	272	14	30	1,195			52	1,247
Moreing Ranch (Lewis Moreing)—Portions of Reclamation Districts Nos. 2058 and 2062	295													295			42	337	740	341	52	1,470
Orwood Highlands										270		160		430	41	617	47	1,135				1,135
Orwood Tract—Reclamation District No. 2024		115	23			368		627		15	205	15		1,368	834	50	80	2,332			65	2,397
Palm Tract—Reclamation District No. 2036			30			845		320		1,141		26		2,362	32	45	65	2,504			60	2,564
Pierson District—Reclamation District No. 551	365	661	2,212	50		312	1,462	2,316		53		106	90	7,627	157	240	115	8,139	291	130	410	8,970
Pocket, The (Roberts Island)	25					75		339		40				479		27	14	520			33	553
Porter Estate[13]																	[14]2,200	[14]2,200				[14]2,200
Prospect Island—Reclamation District No. 1667		860	1,133	459		260								[15]2,712		30	93	[15]2,835			193	2,505
Quimby Island						550								550	179	14	25	768			54	822
Randall Island—Reclamation District No. 755	12		25				373	5				3	2	[16]420		3		[16]423			14	417
Rhode Island						78								78		2	5	85			5	90
Rio Blanco Tract				237					22		180			439	128	25	20	612			63	675
Rindge Tract—Reclamation District No. 2037								3,655			2,293			5,948	462	100	130	6,640			200	[6]6,840
Roberts Island (Lower Division)—Reclamation District No. 684	1,115	520	192	407		3,176	2	2,106		1,001	748			[17]9,267	345	348	160	[17]10,120		138	142	[10]10,195
Roberts Island (Middle Division)—Reclamation District No. 524	2,995	45	1,493		3	1,436	8	4,080		315	225	7	12	[18]10,619		209	215	[18]11,043			114	11,000
Roberts Island (Upper Division)—Reclamation District No. 544	527		1,083			325	21	473	12	166	23			2,630	250		80	2,960	4,385		130	7,475
Rough and Ready Island—Reclamation District No. 403	125					210	75	402		25	175			[19]1,012	314		24	[19]1,350		315	82	[1]1,647
Ryer Island—Reclamation District No. 501	204	8,786	552	644	331	203	387	190	14			30	19	[20]11,360		230	320	[20]11,910			320	12,210
Sargeant-Barnhart Tract	105	110				445		20	18		348		30	1,076		11	66	1,153			25	[1]1,178
Sherman Island—Reclamation District No. 341	352	7,652		120		145		506		20		12	5	8,812	524	484	117	9,937			368	10,305
Shima Tract						361		759			439			1,559	172	22	22	1,775			95	1,870
Smith Tract (R. R. and N. A. Smith)		80				250		530		160	10	5		1,035	567	10	12	1,624	350		51	2,025
Spud Island																				80	23	103
State Farm	112	11	32	24		50	101	490		64			40	924				924		102		[21]1,026
Staten Island		1,854	147	867	158	1,983	305	1,957		107	1,166			8,544		189	181	8,914			346	9,260
Stockton Acres—Reclamation District No. 828							5						10	15	430			445		190	40	[1]675
Sutter Island—Reclamation District No. 349	106	136	185			25	1,044	165		5		567	19	2,252	96	90	84	2,522			192	2,714
Terminous Tract—Reclamation District No. 548	56	3,455	178	547	1,611	664	3	485	157	1,613	787	56	6	[22]9,618	334	205	300	[22]10,457			142	[23]10,508
Tule Island																				46	18	64
Twitchell Island—Reclamation District No. 1601	10	960	315			595	25	1,500					4	[24]3,409	67	20	65	[24]3,561			200	3,631
Tyler Island—Reclamation Districts Nos. 136, 364, 532, 563 and 807	697	6,948			60	150	289	115					40	8,299		126	260	8,685			262	8,947
Union Island—Reclamation Districts Nos. 1 and 2	319	3,623	2,135	734		5,279	210	9,776		5	30	85		[25]22,196	122	179	240	[25]22,737	440		284	23,000
Veale Tract—Reclamation District No. 2065		100				3		300		600				1,003	295	12	12	1,322			41	1,363
Venice Island—Reclamation District No. 2023		40	40		1,000	100		1,000	275		30		25	2,510	707	50	120	3,387		202	247	[3]3,836
Victoria Island—Reclamation District No. 2040		250	450	747		3,500		1,300			300		400	6,947	75	58	127	7,207			103	7,310
Webb Tract—Reclamation District No. 2026		400				1,422		1,290		496	180			3,788	1,346	80	208	5,422			100	5,522
West Island		120					34							154			4	158			22	180
Widdow Island										50				50		2	3	55			10	65
Woodward Island						1,475			23		125	22		1,645	456	35	43	2,179			66	2,245
Wright Tract	550	60				677								1,287		3	9	1,299			59	1,358
Reclamation District No. 50—Spoil Area																	[14]2,590	[14]2,590		510	100	[4]3,200
Reclamation District No. 307—Lisbon	271	19	204	2,010		12	4	987		13	3	594	301	4,418	200	75	104	4,797	936	171	182	6,086
Reclamation District No. 348	1,263	1,454	1,160	696		139	238	2,802		72		175	362	8,361		130	80	8,571	511	270	126	9,478
Reclamation District No. 369—Locke							180							180	336	9	14	539			15	554
Reclamation District No. 535	116	2	55			1	38	20		20	4		628	884		200	190	1,274	1,399	1,468	54	4,195
Reclamation District No. 536—Egbert	1,150	2,815	70				6	1,212		50				5,303	2,255		34	7,592	500	699	142	8,933
Reclamation District No. 554—Walnut Grove		57	48	100			18		30	10		257		520	118	33	6	677			22	699
Reclamation District No. 673—Pocket	185	227	325		10	8	23	70	10	57		169	863	1,947		60	70	2,077	405	439	178	3,099
Reclamation District No. 744	135	67	101				137	2				876	91	1,409		94	45	1,548			70	1,618
Reclamation District No. 746—Bonnie Brae							104							104		5	4	113		11	11	135
Reclamation District No. 765—Glide	696		12	122						90		130	10	1,060		25	45	1,130	20	50	122	1,322
Reclamation District No. 813	275		100	200			174	945		30		3		1,727			85	1,812	515	154	70	2,551
Reclamation District No. 824—Freeport	117					30							218	[26]365			6	[26]371		95	35	463
Reclamation District No. 900—West Sacramento	3,321	10	59	327		57	408		20	140		175	1,665	[27]6,182			336	[27]6,518	1,538	3,041	210	11,200
Reclamation District No. 999	765	9,278	2,998	6,863		79	599	25	1,631	10	210	1,574	56	[28]24,088		105	757	[28]24,950	583	605	1,600	26,136
Reclamation District No. 1002	20	170	293			325	170	500						1,478	2,997	849	250	5,574	470	657	160	6,861
Reclamation District No. 1614—Smith							60	540		1,055			40	1,695		12	20	1,727			45	[1]1,772
Totals	26,882	70,580	[29]26,992	[29]30,915	6,303	[29]55,798	10,775	65,086	[29]3,769	12,748	18,042	8,967	[29]6,498	[30]343,355	28,527	8,481	14,802	[30]395,165	15,708	14,531	[31]13,565	434,909

*All acreages below elevation 5.0 U.S.G.S. datum are considered as irrigated or consuming water.

**Includes roads, camp areas, interior levees, etc.

† The total levee area includes water consuming acreages estimated at 4,400 willows and 4,583 weeds which should be included in column 19. No survey was made to segregate these items to the individual islands and tracts.

‡ These figures represent gross area, i. e., entire area inside surrounding water channels.

[1] Revised to conform with area changes resulting from construction of Stockton Ship Canal.

[2] Revised to conform with recent map.

[3] This is not the total lands of the California Irrigated Farms Company. Approximately 3,400 acres south of Tom Paine Slough is classed in the "Delta Uplands." See Delta Uplands Diversions from Tom Paine Slough.

[4] Revised to conform with latest survey.

[5] Includes 350 acres corn double cropped after grain.

[6] This area previously reported as part of Reclamation Districts 746 and 813.

[7] Includes 10 acres double crop beans and 7 acres of pears on levee.

[8] Revised to conform with Reclamation Board assessment map.

[9] Revised to conform with data furnished by owners.

[10] After sale of a portion to State Farm.

[11] Includes 214 acres asparagus interplanted to beans.

[12] Includes 25 acres corn double cropped after barley.

[13] Previously listed as Reclamation District 799.

[14] Area has been flooded and is subject to tidal flow due to broken levees.

[15] Includes 523 acres asparagus interplanted to beans.

[16] Includes 20 acres beans double cropped.

[17] Includes 205 acres soudan grass double cropped after grain.

[18] Includes 157 acres beans double cropped after grain.

[19] Includes 100 acres corn double cropped after grain.

[20] Includes 20 acres asparagus interplanted to beans.

[21] Revised to conform with recent map. Includes area purchased from March Garden Tract.

[22] Includes 78 acres double cropped onions, 3 acres double cropped corn, and 10 acres interplanted beans.

[23] Revised to conform with 1931 map

[24] Includes 130 acres interplanted corn.

[25] Includes 210 acres interplanted beans and 251 acres double cropped area.

[26] Includes 38 acres truck garden double cropped.

[27] Includes 107 acres tomatoes double cropped after spinach.

[28] Includes 1602 acres of interplanted and double cropped beans, beets and truck.

[29] Includes second crop and interplantings.

[30] Includes 4,053 acres of second crop and interplantings.

[31] Includes 7 acres irrigated pears on levee.

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TABLE 69

UNIT CONSUMPTIVE USE OF WATER IN SACRAMENTO-SAN JOAQUIN DELTA**
Acre-feet per Acre

Crop or Classification	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total Seasonal Use	Total Annual Use
Alfalfa	(.06)	(.08)	.10	.30	.40	.50	.65	.55	.50	.20	(.10)	(.07)	3.20	3.51
Asparagus	.05	.05	.05	.05	.08	.14	.40	.68	.55	.42	.12	.10	2.69	2.69
Beans	(.06)	(.08)	(.08)	(.16)	(.20)	.14	.24	.58	.37	(.09)	(.07)	(.05)	1.33	2.12
Beets	(.06)	(.08)	(.08)	.13	.32	.51	.61*	.53*	.20*	(.13)	(.10)	(.07)	2.30	2.82
Celery	(.04)	(.04)	(.04)	(.08)	(.10)	.10	.10	.20	.25	.30	.20	.05	1.20	1.50
Corn	(.04)	(.04)	(.04)	(.08)	(.10)	.24	.85	.84*	.40*	.10	(.10)	(.07)	2.43	2.90
Fruit	(.04)	(.04)	(.04)	.18	.32	.50	.57	.40	.23	.07	(.07)	(.05)	2.27	2.51
Grain and Hay	(.04)	(.04)	.07	.60	.83	.20	(.14)	(.23)	(.21)	(.14)	(.07)	(.05)	1.70	2.62
Onions	(.04)	(.04)	.08	.13	.27	.49	.43	.20	(.16)	(.13)	(.10)	(.07)	1.60	2.14
Pasture	.08	.10	.20	.25	.25	.25	.25	.25	.20	.15	.10	.08	2.16	2.16
Potatoes	(.06)	(.08)	(.08)	(.16)	.15	.38	.52	.30	.15	(.09)	(.07)	(.05)	1.50	2.09
Seed	(.06)	(.08)	(.08)	.10	.25	.50	.50	.50	.35	.10	(.10)	(.07)	2.30	2.69
Truck	(.06)	(.08)	.10	.10	.25	.50	.45	.45	.30	.15	.10	(.07)	2.40	2.61
Tules	.16	.09	.30	.74	1.10	1.28	1.53	1.32	1.18	.98	.59	.36	9.63	9.63
Willows	.05	.03	.09	.22	.33	.38	.46	.40	.35	.29	.18	.10	2.88	2.88
Bare Land	.04	.04	.04	.08	.10	.13	.14	.13	.11	.09	.07	.05	1.02	1.02
Idle Land with Weeds***	.06	.08	.08	.16	.20	.26	.28	.24	.16	.13	.10	.07	1.82	1.82
Open Water Surfaces	.08	.13	.23	.34	.60	.76	.84	.73	.60	.33	.14	.08	4.91	4.91

NOTE: Figures shown in brackets ( ) represent estimated consumptive use on cropped areas before planting and after harvest. (Evaporation from bare land, use by weeds, etc.).

* Includes estimated additional use by weeds during these months.

** These are the data as determined for and published in Bulletin No.27 - "Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay" - Table 1.

*** Average for land below elevation 5.0 U.S.G.S. datum. Use on unirrigated lands above elevation 5.0 is considered zero.

TABLE 70

CONSUMPTIVE USE OF WATER IN THE SACRAMENTO-SAN JOAQUIN DELTA, 1931
ACRE-FEET

CROP OR CLASSIFICATION	ACREAGE 1/	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL SEA-SONAL USE	TOTAL ANNUAL USE
ALFALFA	26882	(1610)	(2150)	2690	8060	10750	13440	17470	14790	13440	5380	(2690)	(1880)	86020	94350
ASPARAGUS 2/	70580	3530	3530	3530	3530	5650	9920	28940	49540	39780	29660	8480	7060	193150	193150
BEANS 3/	26992 5/	(1460)	(1950)	(1960)	(4110)	(5170)	3460	5890	14210	9070	(2210)	(1720)	(1220)	32630	52430
BEETS	30915 5/	(1850)	(2470)	(2480)	4070	9940	15750	18850*	16390*	6210*	(4030)	(3090)	(2170)	71210	87300
CELERY	6303	(250)	(250)	(250)	(500)	(630)	630	630	1260	1580	1890	1260	320	7570	9450
CORN 3/	55798 5/	(2230)	(2230)	(2240)	(4710)	(5920)	13360	47320	46760*	22270*	5570	(5570)	(3890)	135280	162070
FRUIT	10775	(430)	(430)	(430)	1940	3450	5390	6140	4310	2480	750	(750)	(540)	24460	27040
GRAIN AND HAY 4/	65086	(2560)	(2560)	4480	38370	53070	12790	(8950)	(14710)	(13430)	(8950)	(4480)	(3200)	108710	167550
ONIONS	3769 5/	(150)	(150)	310	530	1060	1830	1630	770	(610)	(490)	(380)	(270)	6130	8180
PASTURE	12748	1020	1270	2550	3190	3190	3190	3190	3190	2550	1910	1270	1020	27540	27540
POTATOES	18042	(1080)	(1440)	(1440)	(2890)	2710	6360	9380	5410	2710	(1620)	(1260)	(900)	27070	37700
SEED	8967	(540)	(720)	(720)	900	2240	4480	4480	4480	3140	900	(900)	(630)	20620	24130
TRUCK	6498 5/	(390)	(520)	640	670	1650	3230	2920	2920	1950	990	650	(450)	15620	16980
TOTAL IRRIGATED CROPS	343355 6/	17100	19670	23720	73470	105430	94330	155790	178740	119220	64350	32500	23550	736010	907870
TULES	8300 7/	1330	750	2490	6140	9130	10620	12700	10960	9790	8130	4900	2990	79930	79930
WILLOWS	5600 8/	280	170	500	1230	1850	2130	2580	2240	1960	1620	1010	560	16130	16130
BARE LANDS 10/	8480 9/	340	340	340	680	850	1100	1190	1100	930	760	590	420	8640	8640
IDLE LANDS WITH WEEDS 10/	35230 11/	2110	2820	2820	5640	7050	9160	9860	8460	5640	4580	3520	2470	64130	64130
OPEN WATER SURFACES	49400 12/	3950	6420	11360	16800	29640	37540	41500	38530	29640	16300	6920	3950	242550	242550
TOTAL CONSUMPTIVE AREA	446310 13/	25110	30170	41230	103960	153950	154880	223620	240030	167180	95740	49440	33940	1167390	1319250
UNIT CONSUMPTION-AC.FT.PER AC.															
TOTAL CONSUMPTIVE AREA	446310	.06	.07	.09	.23	.35	.35	.50	.54	.37	.21	.11	.08	2.61	2.96
IRRIGATED CROP AREA	339300 13/	.05	.06	.07	.21	.31	.28	.46	.53	.35	.19	.10	.07	2.23	2.68

NOTE: FIGURES IN BRACKETS ( ) REPRESENT CONSUMPTIVE USE ON CROPPED AREAS BEFORE PLANTING AND AFTER HARVEST. (EVAPORATION FROM BARE LAND, USE BY WEEDS, ETC.)

* INCLUDES ESTIMATED ADDITIONAL USE BY WEEDS DURING THESE MONTHS.

1/ DATA FROM TABLE 68.

2/ FIGURES FOR ASPARAGUS INCLUDE ALLOWANCE FOR GREATER USER BY AREAS INTERCROPPED WITH BEANS AND CORN.

3/ FIGURES INCLUDE USE BY AREAS DOUBLE CROPPED AFTER GRAIN BUT DO NOT INCLUDE USE BY INTERCROPPED ASPARAGUS ACREAGE. (SEE 2/).

4/ FIGURES DO NOT INCLUDE USE BY DOUBLE CROPPED AREAS (SEE 3/).

5/ INCLUDES SECOND CROP AND INTERPLANTINGS.

6/ INCLUDES 4053 ACRES OF SECOND CROP AND INTERPLANTINGS.

7/ INTERIOR, 3000 ACRES AND EXTERIOR CHANNELS, 5300 ACRES.

8/ INTERIOR, AS A PORTION OF LEVEE ACREAGE, 4400 ACRES; EXTERIOR CHANNELS, 1200 ACRES.

9/ INCLUDES ROADS, CAMP AREAS, INTERIOR LEVEES, ETC.

10/ BELOW ELEVATION 5.0 U.S.G.S. DATUM. NON-IRRIGATED AND IDLE LANDS ABOVE THIS ELEVATION ARE NOT CONSIDERED AS CONSUMING WATER.

11/ INCLUDES 28527 ACRES INTERIOR; 4583 ACRES AS A PORTION OF LEVEE AREA; 1800 ACRES OAKS AND BRUSH IN EXTERIOR CHANNELS; 320 ACRES TOTAL FOR A GROUP OF SMALL ISLANDS NOT INCLUDED IN TABLE 68.

12/ INCLUDES INTERIOR WATER SURFACES, 7500 ACRES; FLOODED RECLAMATIONS, 4300; OPEN EXTERIOR CHANNELS WITHIN THE DELTA, 36500 ACRES; AND OPEN CHANNELS BETWEEN DELTA BOUNDARY AND STREAM GAGING STATIONS (RECORDING FLOW TO THE DELTA), 1100 ACRES.

13/ IN THIS TOTAL, THE ACREAGE OF IRRIGATED CROPS HAS BEEN CORRECTED FOR SECOND CROP AND INTERPLANTINGS (SEE 6/).

TABLE 71

CONSUMPTIVE USE OF WATER IN THE SACRAMENTO DELTA, 1931
ACRE-FEET

CROP OR CLASSIFICATION	ACREAGE	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL SEA-SONAL USE	TOTAL ANNUAL USE
ALFALFA	10406	(620)	(830)	1040	3120	4160	5200	6760	5720	5200	2080	(1040)	(730)	33280	36500
ASPARAGUS 1/	34245	1710	1710	1710	1710	2740	4800	14190	24480	19590	14380	4110	3420	94550	94550
BEANS 2/	10736 5/	(520)	(690)	(690)	(1400)	(1750)	1210	2080	5040	3220	(780)	(610)	(430)	11550	18420
BEETS	18317 5/	(1090)	(1460)	(1470)	2430	5910	9320	11160*	9720*	3690*	(2390)	(1830)	(1290)	42230	51760
CELERY	1960	(80)	(80)	(80)	(160)	(200)	200	200	390	490	590	390	100	2360	2960
CORN 3/	5626 5/	(220)	(220)	(220)	(470)	(580)	1350	4780	4720*	2250*	560	(560)	(390)	13660	16320
FRUIT	8291	(330)	(330)	(330)	1490	2650	4150	4730	3320	1910	580	(580)	(410)	18830	20810
GRAIN AND HAY 4/	6607	(260)	(260)	450	3880	5360	1290	(900)	(1490)	(1360)	(900)	(450)	(320)	10980	16920
ONIONS	2296	(90)	(90)	180	300	620	1120	990	460	(370)	(300)	(230)	(160)	3670	4910
PASTURE	1027	80	100	210	260	260	260	260	260	210	150	100	80	2230	2230
POTATOES	237	(10)	(20)	(20)	(40)	40	90	120	70	40	(20)	(20)	(10)	360	500
SEED	6161	(370)	(490)	(490)	620	1540	3080	3080	3080	2160	620	(620)	(430)	14180	16580
TRUCK	4932 5/	(300)	(390)	490	490	1230	2470	2220	2220	1480	740	490	(350)	11830	12870
TOTAL IRRIGATED CROPS	110841 6/	5680	6670	7380	16370	27040	34540	51470	60970	41970	24090	11030	8120	259710	295330
TULES	1920 7/	310	170	580	1420	2110	2460	2940	2530	2270	1880	1130	690	18490	18490
WILLOWS	2000 8/	100	60	100	440	660	760	920	800	700	580	360	200	5760	5760
BARE LANDS 10/	1770 9/	70	70	70	140	180	230	250	230	190	160	120	90	1800	1800
IDLE LAND WITH WEEDS 10/	6770 11/	410	540	540	1080	1350	1760	1900	1620	1080	880	680	470	12310	12310
OPEN WATER SURFACES	16800 12/	1340	2180	3860	5710	10080	12770	14110	13100	10080	5540	2350	1340	82460	82460
TOTAL CONSUMPTIVE AREA	137760 13/	7910	9690	12610	25160	41420	52520	71590	79250	56290	33130	15670	10910	380530	416150
UNIT CONSUMPTION AC.FT.PER AC.															
TOTAL CONSUMPTIVE AREA	137760	.06	.07	.09	.18	.30	.38	.52	.58	.41	.24	.11	.08	2.76	3.02
IRRIGATED CROP AREA	108500 13/	.05	.06	.07	.15	.25	.32	.48	.56	.39	.22	.10	.07	2.39	2.72

NOTE: FIGURES IN BRACKETS ( ) REPRESENT CONSUMPTIVE USE ON CROPPED AREAS BEFORE PLANTING AND AFTER HARVEST. (EVAPORATION FROM BARE LAND, USE BY WEEDS, ETC.)

* INCLUDES ESTIMATED ADDITIONAL USE BY WEEDS DURING THESE MONTHS.

1/ FIGURES FOR ASPARAGUS INCLUDE ALLOWANCE FOR GREATER USE BY AREAS INTERCROPPED WITH BEANS.

2/ FIGURES INCLUDE USE BY AREAS DOUBLE CROPPED AFTER GRAIN BUT DO NOT INCLUDE USE BY INTERCROPPED ASPARAGUS ACREAGE (SEE 1/).

3/ FIGURES INCLUDE USE BY AREAS DOUBLE CROPPED AFTER GRAIN.

4/ FIGURES DO NOT INCLUDE USE BY DOUBLE CROPPED AREAS (SEE 2/ AND 3/).

5/ INCLUDES SECOND CROP AND INTERPLANTINGS.

6/ INCLUDES 2335 ACRES OF SECOND CROP AND INTERPLANTINGS.

7/ INTERIOR, 1320 ACRES AND EXTERIOR CHANNELS, 600 ACRES.

8/ INTERIOR, AS A PORTION OF LEVEE ACREAGE, 1900 ACRES; EXTERIOR CHANNELS 100 ACRES.

9/ INCLUDES ROADS, CAMP AREAS, INTERIOR LEVEES, ETC.

10/ BELOW ELEVATION 5.0 U.S.G.S. DATUM. NON-IRRIGATED AND IDLE LANDS ABOVE THIS ELEVATION ARE NOT CONSIDERED AS CONSUMING WATER.

11/ INCLUDES 4260 ACRES INTERIOR; 2320 ACRES AS A PORTION OF LEVEE AREA; 100 ACRES OAKS AND BRUSH IN EXTERIOR CHANNELS; 90 ACRES FOR A SMALL AREA NOT INCLUDED IN TABLE 68.

12/ INCLUDES INTERIOR WATER SURFACES, 2500 ACRES; FLOODED RECLAMATIONS, 2100 ACRES; OPEN EXTERIOR CHANNELS WITHIN THE DELTA, 11200 ACRES; OPEN CHANNELS BETWEEN DELTA BOUNDARY AND STREAM GAGING STATION, 1000 ACRES.

13/ IN THIS TOTAL THE ACREAGE OF IRRIGATED CROPS HAS BEEN CORRECTED FOR SECOND CROP AND INTERPLANTINGS (SEE 6/).

TABLE 72

CONSUMPTIVE USE OF WATER IN THE SAN JOAQUIN DELTA, 1931
ACRE-FEET

CROP OR CLASSIFICATION	ACREAGE	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	TOTAL SEA-SONAL USE	TOTAL ANNUAL USE
ALFALFA	16476	(990)	(1320)	1650	4940	6590	8240	10710	9070	8240	3300	(1650)	(1150)	52740	57850
ASPARAGUS 1/	36335	1820	1820	1820	1820	2910	5120	14750	25060	20190	15280	4370	3640	98600	98600
BEANS 2/	16256 4/	(940)	(1260)	(1270)	(2710)	(3420)	2250	3810	9170	5850	(1430)	(1110)	(790)	21080	34010
BEETS	12598	(760)	(1010)	(1010)	1640	4030	6430	7690*	6670*	2520*	(1640)	(1260)	(880)	28980	35540
CELERY	4343	(170)	(170)	(170)	(340)	(430)	430	430	870	1090	1300	870	220	5210	6490
CORN 2/	50172 4/	(2010)	(2010)	(2020)	(4240)	(5340)	12010	42540	42040*	20020*	5010	(5010)	(3500)	121620	145750
FRUIT	2484	(100)	(100)	(100)	450	800	1240	1410	990	570	170	(170)	(130)	5630	6230
GRAIN AND HAY 3/	58479	(2300)	(2300)	4030	34490	47710	11500	(8050)	(13220)	(12070)	(8050)	(4030)	(2880)	97730	150630
ONIONS	1473 4/	(60)	(60)	130	230	440	710	640	310	(240)	(190)	(150)	(110)	2460	3270
PASTURE	11721	940	1170	2340	2930	2930	2930	2930	2930	2340	1760	1170	940	25310	25310
POTATOES	17805	(1070)	(1420)	(1420)	(2850)	2670	6770	9260	5340	2670	(1600)	(1240)	(890)	26710	37200
SEED	2806	(170)	(230)	(230)	280	700	1400	1400	1400	980	280	(280)	(200)	6440	7550
TRUCK	1566 4/	(90)	(130)	150	180	420	760	700	700	470	250	160	(100)	3790	4110
TOTAL IRRIGATED CROPS	232514 5/	11420	13000	16340	57100	78390	59790	104320	117770	77250	40260	21470	15430	496300	612540
TULES	6380 6/	1020	580	1910	4720	7020	8160	9760	8430	7520	6250	3770	2300	61440	61440
WILLOWS	3600 7/	180	110	320	790	1190	1370	1660	1440	1260	1040	650	360	10370	10370
BARE LANDS 9/	6710 8/	270	270	270	540	670	870	940	870	740	600	470	330	6840	6840
IDLE LAND WITH WEEDS 9/	28460 10/	1700	2280	2280	4560	5700	7400	7960	6840	4560	3700	2840	2000	51820	51820
OPEN WATER SURFACES	32600 11/	2610	4240	7500	11090	19560	24770	27390	25430	19560	10760	4570	2610	160090	160090
TOTAL CONSUMPTIVE AREA	308550 12/	17200	20480	28620	78800	112530	102360	152030	160780	110890	62610	33770	23030	786860	903100
UNIT CONSUMPTION AC.FT.PER AC.															
TOTAL CONSUMPTIVE AREA	308550	.06	.07	.09	.26	.37	.33	.49	.52	.36	.20	.11	.07	2.55	2.93
IRRIGATED CROP AREA	230800	.05	.06	.07	.25	.34	.26	.45	.51	.33	.17	.09	.07	2.15	2.65

NOTE: FIGURES IN BRACKETS ( ) REPRESENT CONSUMPTIVE USE ON CROPPED AREAS BEFORE PLANTING AND AFTER HARVEST. (EVAPORATION FROM BARE LAND, USE BY WEEDS, ETC.)

* INCLUDES ESTIMATED ADDITIONAL USE BY WEEDS DURING THESE MONTHS.
1/ FIGURES FOR ASPARAGUS INCLUDE ALLOWANCE FOR GREATER USE BY AREAS INTERCROPPED WITH BEANS AND CORN.
2/ FIGURES INCLUDE USE BY AREAS DOUBLE CROPPED AFTER GRAIN BUT DO NOT INCLUDE USE BY INTERCROPPED ASPARAGUS ACREAGE. (SEE 1/).
3/ FIGURES DO NOT INCLUDE USE BY DOUBLE CROPPED AREAS (SEE 2/).
4/ INCLUDES SECOND CROP AND INTERPLANTINGS.
5/ INCLUDES 1718 ACRES OF SECOND CROP AND INTERPLANTINGS.
6/ INTERIOR, 1680 ACRES AND EXTERIOR CHANNELS, 4700 ACRES.
7/ INTERIOR, AS A PORTION OF LEVEE ACREAGE, 2500 ACRES; EXTERIOR CHANNELS 1100 ACRES.
8/ INCLUDES ROADS, CAMP AREAS, INTERIOR LEVEES, ETC.
9/ BELOW ELEVATION 5.0 U.S.G.S. DATUM. NON-IRRIGATED AND IDLE LANDS ABOVE THIS ELEVATION ARE NOT CONSIDERED AS CONSUMING WATER.
10/ INCLUDES 24267 ACRES INTERIOR; 2263 ACRES AS A PORTION OF LEVEE AREA; 1700 ACRES OAKS AND BRUSH IN EXTERIOR CHANNELS; 230 ACRES FOR A GROUP OF SMALL ISLANDS NOT INCLUDED IN TABLE 68.
11/ INCLUDES INTERIOR WATER SURFACES, 5000 ACRES; FLOODED RECLAMATIONS, 2200 ACRES; OPEN EXTERIOR CHANNELS WITHIN THE DELTA, 25300 ACRES; OPEN CHANNELS BETWEEN DELTA BOUNDARY AND STREAM GAGING STATION, 100 ACRES.
12/ IN THIS TOTAL THE ACREAGE OF IRRIGATED CROPS HAS BEEN CORRECTED FOR SECOND CROP AND INTERPLANTINGS (SEE 5/).

TABLE 73

GENERAL SOIL CLASSIFICATION OF THE IRRIGATED CROP LANDS IN THE DELTA, 1931

Crop	Peat Soil Acreage Irrigated	Sedimentary Soil. Acreage Irrigated	Total
Alfalfa	6494	20388	26882
Asparagus	30753	39827	70580
Beans	5538	21454	26992
Beets	12707	18208	30915
Celery	4824	1479	6303
Corn	40367	15431	55798
Fruit	700	10075	10775
Grain and Hay	32062	33024	65086
Onions	2034	1735	3769
Pasture	7194	5554	12748
Potatoes	16779	1263	18042
Seed	1101	7866	8967
Truck and Miscellaneous Vegetables	1013	5485	6498
Totals	161566	181789	343355

COOPERATIVE IRRIGATION INVESTIGATIONS IN THE SACRAMENTO-SAN JOAQUIN DELTA IN 1931

BY

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The Cooperative Irrigation Investigations in the Sacramento-San Joaquin Delta in 1931 were limited to a continuation of the experiments on the use of water by asparagus, tules and cat-tails grown in tanks, the maintenance of two evaporation stations, and a general study of the character, occurrence and extent of weed growths in the Delta.

TANK EXPERIMENTS

Tules and Cat-tails

Experiments with tules and cat-tails growing in tanks were carried on in 1931, being in each case a continuation of the work of one or more years preceding.

The results obtained at Clarksburg are given in Tables 74 and 75. It will be noted that the remarkably high rate of use of water found at Clarksburg in previous years (1929 and 1930) continued through the growing season of 1931. Tanks Numbers 6 and 7, being the heaviest users of water, were put under test for leakage in August of 1931. The test was made by cutting down the plants and covering the tanks with a wooden bulkhead to prevent them from growing again, thus preventing loss of water by transpiration. The tank was also made so nearly airtight that there was no circulation of air and presumably no evaporation in the ordinary sense, although there was undoubtedly a

TABLE 74

USE OF WATER BY CAT-TAILS GROWN IN TANKS, NEAR CLARKSBURG, RECLAMATION DISTRICT 999, 1931

TANK NO.	USE OF WATER – ACRE-FEET PER ACRE												
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
2	0.22	0.22	0.58	1.08	2.28	2.28	2.96	2.51	1.66	0.91	0.43	0.23	15.36
3	0.21	0.20	0.49	1.12	1.94	2.11	2.51	1.92	1.36	0.83	0.51	0.22	13.42
4	0.20	0.21	0.52	1.30	2.51	2.78	3.34	2.78	1.90	1.04	0.54	0.29	17.41
5	0.23	0.25	0.50	1.15	1.98	1.83	2.04	1.82	1.28	0.76	0.37	0.13	12.34
6	0.22	0.24	0.60	1.44	2.80	2.77	3.51	—UNDER TEST FOR LEAKAGE—					
MEANS	0.22	0.22	0.54	1.22	2.30	2.35	2.87	*2.26	*1.55	*0.94	*0.46	*0.22	*14.63

*MEAN OF FOUR TANKS

TABLE 75

USE OF WATER BY TULES GROWN IN TANKS, NEAR CLARKSBURG, RECLAMATION DISTRICT 999, 1931

TANK NO.	USE OF WATER – ACRE-FEET PER ACRE												
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
7	0.21	0.23	0.54	1.32	3.02	2.88	4.35	—UNDER TEST FOR LEAKAGE—					
8	0.20	0.24	0.48	1.18	2.45	2.39	3.02	2.59	1.78	1.01	0.51	0.20	16.05
9	0.20	0.26	0.48	1.12	2.14	2.20	2.76	1.98	1.37	0.82	0.41	0.20	13.94
10	0.19	0.24	0.51	1.08	2.07	2.26	2.88	1.71	1.23	0.66	0.43	0.23	13.49
11	0.21	0.19	0.40	0.90	1.84	1.65	1.63	1.32	1.16	0.72	0.39	0.19	10.60
12	0.20	0.20	0.25	0.84	1.75	1.26	2.75	2.36	1.72	1.09	0.61	0.27	13.30
MEANS	0.20	0.23	0.44	1.07	2.21	2.11	2.90	*1.99	*1.45	*0.86	*0.47	*0.22	*13.48

*MEAN OF FIVE TANKS

TABLE 76

RECORD OF ELEVATIONS OF WATER SURFACE IN CLARKSBURG TANKS NUMBERS 6 AND 7 UNDER TEST FOR LEAKAGE

DATE 1931	DISTANCE FROM INDEX POINT TO WATER SURFACE FEET		DROP IN ELEVATION OF WATER SURFACE – FEET				REMARKS
			INCREMENT		TOTAL		
	TANK NO. 6	TANK NO. 7	TANK NO. 6	TANK NO. 7	TANK NO. 6	TANK NO. 7	
AUG. 25	1.418	0.845	.000	.000	.000	.000	WOODEN BULKHEADS WITH SMALL PERFORATIONS STUFFED WITH COTTON, FITTED TIGHTLY IN TOPS OF SOIL CYLINDERS ON AUGUST 19TH.
AUG. 29	1.458	0.886	.040	.041	.040	.041	
SEP. 4	1.504	0.930	.046	.044	.086	.085	
SEP. 11	1.559	1.011	.055	.081	.141	.166	
SEP. 19	1.583	1.050	.024	.039	.165	.205	
SEP. 23	1.608	1.101	.025	.051	.190	.256	READING OF TANK NO.6 NOT PRECISE ON SEPTEMBER 23D.
SEP. 26	1.613	1.114	.005	.013	.195	.269	
OCT. 3	1.637	1.145	.024	.031	.219	.300	
OCT. 7	1.652	1.166	.015	.021	.234	.321	
OCT. 10	(1.661 (1.000	(1.185 (1.000	.009	.019	.243	.340	
OCT. 13	1.019	1.018	.019	.018	.262	.358	
OCT. 17	1.032	1.036	.013	.018	.275	.376	
OCT. 26	1.077	1.078	.045	.042	.320	.418	
NOV. 3	1.120	1.107	.043	.029	.363	.447	
NOV. 13	1.178	1.159	.058	.052	.421	.499	
NOV. 23	1.170	1.167	–.008	.008	.413	.507	
NOV. 25	1.169	1.168	–.001	.001	.412	.508	OILCLOTH PUT OVER ENTIRE TOPS OF TANKS.
DEC. 3	1.153	1.173	–.016	.005	.396	.513	
DEC. 12	1.174	1.193	.021	.020	.417	.523	

"breathing" in and out through minute openings to the interior of the tank, resulting in the lowering of water surface shown in Table 76. The tanks were taken up in the Spring of 1932, and examined for leaks while the water was still in them. No leak was found in Tank Number 7, but there was a pin-hole leak in the wall of Tank Number 6 at the bottom. This leak had manifestly been made by the sharp corner of the iron strap on the bottom of the inside cylinder striking against the wall of the outer cylinder, either when the tanks were placed or when they were handled in taking up, with the possibility that it may have resulted from movement due to some unknown cause at some time between the setting and the taking up of the tanks. The results of the tests on Tanks Numbers 6 and 7 when they were in place are recorded in Table 76. Since the losses of water from the two tanks run so nearly in parallel, with the greater increment of loss for identical periods of time being usually found in Tank Number 7 (which did not leak), and the pin-hole leak found in Tank Number 6 showing bright metal in the opening, it is concluded that the leak was not there while the tank was in service. A precisely similar leak, so far as could be judged by the eye, was found in Tank Number 4, another heavy user of water, when it was taken up. A fact which indicates that neither Tank Number 4 nor Number 6 leaked while in service is that the loss from neither of them in the Winter months was materially different from other tanks.

The results obtained in 1931 from two tanks of tules and two of cat-tails set in July, 1930 at Camp 3, King Island, are given in Table 77. It is to be noted that the King Island tanks are set in the midst of large tule and cat-tail patches so that the tank plants are under the natural conditions of exposure to wind and sun representative

TABLE 77

USE OF WATER BY CAT-TAILS AND TULES GROWN IN TANKS AT CAMP 3, KING ISLAND
1931

TANK NUMBER	PLANT	WATER SURFACE ABOVE GROUND SURFACE FEET	USE OF WATER – ACRE-FEET PER ACRE													COMPARATIVE PLANT SIZE (2)
			JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC. (3)	YEAR (4)	
1	CAT-TAILS	0.0	0.14	0.13	0.25	0.52	0.52	0.31	0.33	0.18	0.13	0.15	0.07		2.8	UNDERSIZE
2	CAT-TAILS	1.0	–	NO USABLE RECORD		–	(1)0.72	0.82	0.92	0.82	0.67	0.53	0.26		6.2	UNDERSIZE
3	TULES	1.0	–	NO USABLE RECORD		–	(1)1.33	1.13	1.32	1.16	0.80	0.51	0.19		8.0	NORMAL
4	TULES	0.0	0.17	0.15	0.45	0.58	1.00	0.88	0.88	0.71	0.53	0.15	0.07		5.7	UNDERSIZE

(1) INCLUDES APRIL 29TH AND 30TH.
(2) THE COMPARISON FOR SIZE IS WITH SURROUNDING PATCH PLANTS OF THE SAME KIND. PLANTS IN TANKS NUMBERS 1 AND 2 WERE UNDERSIZE ALL SEASON. PLANTS IN TANK NUMBER 4 WERE NORMAL SIZE AT BEGINNING OF SEASON.
(3) HEAVY RAINS DERANGED CONDITIONS SO THAT NO RELIABLE RECORD FOR DECEMBER WAS OBTAINED.
(4) ESTIMATED. CLOSELY FOR TANKS NUMBERS 1 AND 4. ROUGHLY FOR TANKS NUMBERS 2 AND 3.

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TABLE 78

USE OF WATER BY TULES GROWN IN TANKS AT SIMMONS ISLAND, NEAR BAY POINT, 1931

TANK NO.	WATER SURFACE ABOVE GROUND SURFACE FEET	USE OF WATER – ACRE-FEET PER ACRE													NUMBER OF STALKS IN JULY*
		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR (APPROX)	
1	1.0	0.11	0.15	0.23	0.28	0.38	0.48	0.61	0.48	0.43	0.21	0.11	(0.11)	3.58	11
2	0.0	(0.11)	(0.11)	(0.12)	0.14	0.94	0.80	0.69	0.52	0.36	0.22	0.11	(0.11)	4.23	19
3	1.0	(0.11)	(0.15)	(0.28)	0.34	1.01	0.87	0.84	0.67	0.60	0.46	0.29	(0.11)	5.73	35
4	0.0	(0.11)	(0.15)	(0.24)	0.29	0.96	0.89	0.78	0.59	0.54	(0.30)	0.14	(0.11)	5.10	30
MEANS		(0.11)	(0.14)	(0.22)	0.26	0.82	0.76	0.73	0.57	0.48	(0.30)	0.16	(0.11)	4.66	

NOTE: FIGURES IN PARENTHESES ARE ESTIMATED.
* THERE WERE SOME NEW SPROUTS IN ALL TANKS IN JULY.

of massed tule areas, whereas the Clarksburg tanks are in an open field entirely exposed except for some small nearby roadside trees which may break slightly the force of a northeast wind.

Tules set in four tanks at Simmons Island in July, 1930, have not proved to be heavy users of water. This is probably due to the salt in the water taken from the Bay for use in the tanks at that point. In the season of 1931, in Tank Number 4, for instance, the evaporation and transpiration amounted to about 16.5 cubic feet of water. The original salt content of this body of water remained behind in about 9.5 cubic feet of water standing in the tank. The process thus brought about nearly a triple concentration of the salt. The water was changed in the Spring of 1932, but the damage had been done and it was necessary to replace the tules with fresh ones from the surrounding patch in order to secure a growth. The results obtained in 1931 are given in Table 78.

Asparagus

The experiment with asparagus in tanks was started in 1927. It is located on the Richmond-Chase Ranch three miles east of Terminous. A full description of the set-up appears on pages 116 et seq. of the 1930 Water Supervisor Report.

Continuation of observations in 1931 still leaves us with no precise correlation between consumptive use of water and any of the other determined elements of the experiment. The approach to correlation of use of water and yield of mature tops in 1930 did not hold in 1931.

Tables 79, 80, and 81, except for the inclusion of the results

TABLE 79

GROUP AVERAGE OF USE OF WATER, WEIGHT OF TOPS AND YIELD OF SPEARS
ASPARAGUS TANKS, RICHMOND-CHASE TRACT

GROUP	* DISTANCE FROM SOIL SURFACE TO WATER FEET	1927		1928		1929	1929		1930	1930		1931	1931	
		USE OF WATER AC.FT. PER ACRE	WEIGHT OF TOPS GRAMS	USE OF WATER AC.FT. PER AC.	WEIGHT OF TOPS GRAMS	YIELD OF SPEARS TONS PER ACRE	USE OF WATER AC.FT. PER ACRE	WEIGHT OF TOPS GRAMS	YIELD OF SPEARS TONS PER ACRE	USE OF WATER AC.FT. PER AC.	WEIGHT OF TOPS GRAMS	YIELD OF SPEARS TONS PER ACRE	USE OF WATER AC.FT. PER AC.	WEIGHT OF TOPS GRAMS
I	2	2.28	111.2	4.59	389.7	7.10	3.19	478.4	5.88	2.97	298.3	6.38	4.26	555
II	3	1.39	84.7	3.22	270.2	5.55	2.02	276.4	5.01	**(2.11) 1.82	**(228.5) 185.3	4.93	3.45	365
III	4	1.35	133.3	2.17	225.0	5.70	1.58	384.9	7.09	**(2.59) 2.31	**(356.7) 297.8	6.26	3.72	452

* NOMINAL APPROXIMATE DEPTHS. ACTUAL DEPTHS VARIED FROM THESE BUT NOT WIDELY.
** DURING THE 1930 GROWING SEASON, GROUPS II AND III EACH HAD A TANK WITH A COMPARATIVELY POOR TOP GROWTH. THE NUMBERS IN BRACKETS ARE THE AVERAGES FOR THE GROUPS OMITTING THE WEAK INDIVIDUALS.

TABLE 80

YIELDS OF SPEARS FROM ASPARAGUS TANKS IN 1929, 1930 AND 1931
RICHMOND-CHASE TRACT

TANK	* DEPTH TO WATER FEET	SEX S-STAMINATE P-PISTILLATE	NUMBER OF SPEARS			TOTAL WEIGHT OF SPEARS IN GRAMS			AVERAGE WEIGHT OF SPEARS IN GRAMS		
			1929	1930	1931	1929	1930	1931	1929	1930	1931
1	2	P	17	16	14	830.1	678.9	707.3	48.8	42.3	50.5
2	2	S	34	34	41	2141.2	1477.4	2346.0	63.0	43.5	57.2
3	2	P	22	35	20	1366.6	1225.4	1017.5	62.1	35.0	50.9
4	2	P	25	35	22	1148.6	1164.1	863.3	45.9	33.3	39.2
5	3	P	41	27	18	1751.0	830.0	727.1	42.7	30.7	40.4
6	3	S	27	34	24	1062.5	1214.5	960.6	39.4	35.7	40.0
7	3	P	22	25	23	920.9	761.2	801.1	41.9	30.4	34.8
8	3	S	28	52	48	558.3	1066.4	1316.6	20.0	20.5	27.4
9	4	P	43	63	32	2024.1	2439.5	1745.7	47.1	38.7	54.6
10	4	S	20	32	25	802.4	929.4	1296.6	40.1	29.0	51.9
11	4	P	15	22	14	832.7	1143.6	1123.2	55.5	52.0	80.2
12	4	S	21	26	13	747.2	970.2	655.3	35.6	37.3	50.4

*NOMINAL APPROXIMATE DEPTHS. ACTUAL DEPTHS VARIED FROM THESE BUT NOT WIDELY.

TABLE 81

USE OF WATER AND YIELD OF TOPS*, ASPARAGUS TANKS, 1927 TO 1931, INCLUSIVE
RICHMOND-CHASE TRACT

TANK	** DISTANCE FROM SOIL SURFACE TO WATER FEET	1927		1928		1929		1930		1931	
		USE OF WATER ACRE FEET PER ACRE	WEIGHT OF TOPS GRAMS	USE OF WATER ACRE FEET PER AC.	WEIGHT OF TOPS GRAMS	USE OF WATER ACRE FEET PER AC.	WEIGHT OF TOPS GRAMS	USE OF WATER ACRE FEET PER AC.	WEIGHT OF TOPS GRAMS	USE OF WATER ACRE FEET PER AC.	WEIGHT OF TOPS GRAMS
1	2	1.72	69.5	3.30	291.1	2.44	396.9	2.65	305.7	3.75	535
2	2	2.62	107.1	6.29	466.4	3.93	609.5	3.48	278.8	4.90	664
3	2	2.17	127.6	4.98	401.7	3.08	396.9	3.13	332.0	4.28	608
4	2	2.62	140.5	3.78	399.7	3.31	510.3	2.63	276.7	4.10	413
5	3	1.13	59.9	2.57	309.0	1.00	113.4	.93	61.2	1.65	118
6	3	1.41	112.8	3.20	194.5	2.21	255.2	1.19	159.5	3.44	446
7	3	1.35	56.5	3.36	309.3	2.04	311.9	1.95	176.9	3.30	412
8	3	1.67	109.5	3.75	268.0	2.82	425.3	3.20	343.0	5.40	484
9	4	1.85	91.0	3.87	374.0	1.79	419.6	2.80	293.1	4.08	518
10	4	.83	45.4	1.30	128.0	1.04	198.5	1.48	120.2	2.97	272
11	4	1.40	43.8	1.95	205.3	1.88	482.0	2.82	424.0	5.01	555
12	4	1.32	152.9	1.55	192.5	1.61	439.4	2.14	352.9	2.80	462

* EXCLUSIVE OF BERRIES.
** NOMINAL APPROXIMATE DEPTHS. ACTUAL DEPTHS VARIED FROM THESE BUT NOT WIDELY.

for 1931, are the same as Tables 65, 66, and 67, respectively, in the 1930 report.

At the close of the growing season in 1931 note was made of the number of mature tops produced in each tank. Table 82 gives for each tank the number of spears produced and the number of mature tops which grew after cutting ceased.

TABLE 82

COMPARISON OF NUMBERS OF SPEARS CUT AND TOPS GROWN IN ASPARAGUS TANKS, RICHMOND-CHASE TRACT, 1931

Number of Tank	1	2	3	4	5	6	7	8	9	10	11	12
Number of Spears	14	41	20	22	18	24	23	48	32	25	14	13
Number of Tops	7	10	9	4	7	12	21	15	14	8	5	11

From Table 79 it is seen that there has been no continuous increase in yield of spears with maturity of the plants in any one of the groups. The situation is somewhat different in regard to tops, in that there has been increase of yield in each group in each successive year except 1930.

A noteworthy fact which appears is that group II (Table 79), except as to weight of tops in 1928, shows less yield of tops and less yield of spears than does either group I or group III.

EVAPORATION RECORDS

Evaporation pans were maintained in 1931 near the tule tanks at Clarksburg and Simmons Island. The dimensions and settings of the pans were as follows:

Clarksburg: Circular pan 2.86 feet in diameter and 2.45 feet deep. Water surface maintained at from one to six inches below the rim of the pan. Pan set in the ground so that the rim is about six inches above ground surface. Pan record corrected for rainfall according to record obtained at headquarters of the Holland Land Company, about one mile distant.

Simmons Island: Circular pan 42 inches in diameter and 18 inches deep. Water surface maintained at from 3.5 to 7.5 inches below the rim of the pan. Pan set on grillage leveled up with earth on top of low levee. Pan record corrected for rainfall according to record of gages set a few feet from the pan.

At both locations the observations were made at intervals averaging about one week. The rainfall correction is the only one which has been applied to the pan readings. Table 83 sets forth the evaporation, in feet, at both locations.

RAINFALL RECORDS

Table 84 presents the available records of rainfall at Delta stations in 1931. Allowance has been made for the rainfall as shown by these records, in the computations of the use of water by the tank plants and in the reported evaporation data. At the King-Bishop Bridge, Richmond-Chase Tract and Holland Land Company Headquarters stations the rainfall is recorded for the day on which it fell. The record for Richmond-Chase Tract is only available for the latter months of 1931. At Camp 3 King Island and Simmons Island stations there were no resident observers and the gages were visited about once a week. Hence no daily record is available. No record was obtained at King Island, January to March, inclusive, and in May, nor at Simmons Island, January to May, inclusive.

TABLE 83

EVAPORATION FROM FREE WATER SURFACE IN LAND PANS,
CLARKSBURG AND SIMMONS ISLAND, 1931

STATION	EVAPORATION IN FEET												
	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	YEAR
CLARKSBURG	.092 (1)	.122	.284	.446	.604	.537	.567	.483	.497	.346	.182	.120	4.280
SIMMONS ISLAND	—	—	—	.614	.943	.885	1.184	.971	.720	.456	.200 (2)	.180 (2)	6.795 (3)

(1) FIRST FOUR DAYS ESTIMATED.

(2) TOTAL FOR NOVEMBER AND DECEMBER IS .380. APPORTIONMENT BETWEEN THE TWO MONTHS IS ESTIMATED.

(3) FIRST THREE MONTHS ESTIMATED TO BE SAME PROPORTION OF WHOLE YEAR AS AT CLARKSBURG.

TABLE 84

RAINFALL AT STATIONS IN THE SACRAMENTO-SAN JOAQUIN DELTA IN 1931

KING-BISHOP BRIDGE		TULE PATCH CP. 3 KING ISLAND*		RICHMOND-CHASE TRACT		SIMMONS ISLAND*		HOLLAND LD. CO. HDQTRS. CLARKSBURG	
DATE	RAINFALL INCHES	MONTH	RAINFALL INCHES	DATE	RAINFALL INCHES	MONTH	RAINFALL INCHES	DATE	RAINFALL INCHES
				(4)		(5)			
JAN. 1	1.08	JAN.	(1)	OCT. 23	0.19	JUN.	0.51(6)	JAN. 1	0.58
3	0.34	FEB.	(1)	24	0.07	JUL.	0	2	0.59
5	0.77	MAR.	(1)	TOTAL		AUG.	0	5	0.67
6	0.11	APR.	0.(2	OCTOBER	0.26	SEP.	0	6	0.12
7	0.18	MAY	(2)	NOV. 10	0.09	OCT.	0.34	7	0.20
22	0.12	JUN.	0.04	14	0.47	NOV.	2.37(7)	22	0.14
23	0.74	JUL.	0	15	0.66	DEC.	5.95(8)	23	0.79
31	0.07	AUG.	0	17	0.05			31	0.07
TOTAL JANUARY	3.04	SEP.	0	20	0.19			TOTAL JANUARY	3.16
FEB. 4	0.08	OCT.	0.18	TOTAL NOV.	1.46			FEB. 4	0.07
10	0.21	NOV.	1.59	DEC. 11	0.43			8	0.04
14	0.52	DEC.	6.98(3)	12	0.59			10	0.09
15	0.30			21	0.50			14	0.72
19	0.51			22	0.10			15	0.16
TOTAL FEB.	1.62			24	1.85			16	0.02
MAR. 11	0.45			25	0.32			17	0.07
18	0.37			27	1.46			19	0.57
24	0.08			28	1.08			27	0.05
TOTAL MARCH	0.90			31	0.56			TOTAL FEB.	1.79
APR. 24	0.04			TOTAL DEC.	6.89			MAR. 11	0.42
27	0.11							12	0.75
TOTAL APRIL	0.15							18	0.18
MAY 14	0.05							24	0.05
25	0.45							27	0.10
28	0.05							TOTAL MARCH	1.50
TOTAL MAY	0.55							APR. 22	0.07
JUN. 15	0.21							26	0.03
OCT. 22	0.34							TOTAL APRIL	0.10
NOV. 10	0.10							MAY 13	0.03
11	0.08							25	0.70
15	1.03							TOTAL MAY	0.73
16	0.07							JUN. 6	0.05
19	0.20							15	0.47
26	0.14							16	0.11
TOTAL NOV.	1.62							TOTAL JUNE	0.63
DEC. 11	0.39							OCT. 23	0.41
13	0.54							26	0.07
20	0.48							TOTAL OCT.	0.48
21	0.18							NOV. 10	0.17
23	0.29							14	0.40
24	1.36							15	0.87
25	0.18							17	0.08
26	0.04							18	0.03
27	1.38							27	0.04
28	1.25							TOTAL NOV.	1.59
29	0.06							DEC. 10	0.04
30	0.48							11	0.16
TOTAL DEC.	6.63							14	0.43
TOTAL YEAR	15.06							21	0.70
								22	0.19
								23	0.24
								24	1.35
								25	0.19
								27	2.50
								28	1.29
								30	0.06
								31	0.57
								TOTAL DEC.	7.72
								TOTAL YEAR	17.70

* NO RESIDENT OBSERVER — GAGE VISITED ABOUT ONCE A WEEK. THIS PROCEDURE DOES NOT AFFORD A DAILY RECORD.

(1) NO RECORD. (2) NO RELIABLE RECORD. (3) TO DECEMBER 28TH.
(4) RECORD ONLY AVAILABLE FOR LATTER MONTHS OF YEAR. (5) NO RECORD JAN. TO MAY.
(6) POSSIBLY INCOMPLETE. (7) FIRST 28 DAYS. (8) NOV. 29TH TO JAN. 1ST, INCLUSIVE.

CHAPTER VII

SALINITY

Purpose

As outlined in previous reports, the purpose of the salinity investigation has been to record the occurrence and extent of the encroachment of salinity from San Francisco Bay and to establish the relation between movement of salinity, stream flow to the Delta and tidal action. With the recent completion of the special salinity investigation begun in 1929 as a part of the State Water Resources Investigation, this relation has been established for the conditions which obtained during the period of the investigation, and the results of this study and analysis are presented in Bulletin No. 27, "Variation and Control of Salinity in Sacramento-San Joaquin Delta and Upper San Francisco Bay". Although the relation sought has thus been established there are certain considerations pointing to the desirability and importance of a continuation of the salinity, tidal and stream flow records. The utilization of the established relation lies chiefly in the present determination of the amount of stored water needed for salinity control and, when that storage shall have been provided, in the determination of its proper release to effect the desired control. Obviously when control by means of storage releases becomes operative, records showing the variation of the salinity will be essential. But most essential also appears to be the requirement that in the meantime there shall have been maintained an unbroken record of the salinity, tidal and stream flow variations. Such a record will be required not only in the corroboration of the relation

as at present established, but as the basis for a check of possible modifications of the relation due to changes in channel and tidal conditions which may or will have taken place.

In view of these considerations then, and an additional one of especial significance in 1931, - the necessity of keeping the Delta water users advised as to salinity conditions - the salinity investigation has continued in 1931 to the extent of maintaining complete records at all salinity and tide gage stations, and it is contemplated that this program will be continued in the future.

1931 Scope

The scope of the investigation each season has been such as to insure that samples of water to be tested for salinity would be taken at regular intervals at a sufficient number of stations throughout the Delta and Upper Bay region that the advance and retreat of the salinity from early Summer to late Fall would be completely recorded. In 1931 the Summer stream flow to the Delta was the lowest of record and correspondingly this year witnessed the highest salinity encroachment of record. This is indicated on Plate 6 which shows the limit of encroachment into the Delta of salinity of 100 parts of chlorine per 100,000 parts of water in the years 1920 to 1931, inclusive. Sixty-five stations were established and maintained in order to completely record the 1931 salinity, and samples were received from an average of sixty stations throughout the period from July to November. Nineteen stations are maintained permanently throughout the year as are also seven stations at which drainage water is sampled. The work in 1931 included also the regular maintenance of tide gages, the edition of salinity bulletins,

and many special investigations of the salinity in local areas.

Station Maintenance and Records

As in the past, the salinity sampling at all regular stations was done by local observers. Each observer was provided with a schedule showing the exact time for taking the samples so that, throughout the Delta at four-day intervals, all samples would be taken at approximately one and one-half hours after the same high tide. The observers were furnished with stamped containers for the sample bottles so that the latter could be mailed as filled to the laboratory at Sacramento. All testing was done at the chemical laboratory of the Division of Highways. The record of the tests of all samples taken at the regular stations in 1931 is given in Table 90, and Table 89 gives the location and description of each station.

In connection with the investigation of losses in the Delta due to salinity in 1931 (see Chapter VIII) it was necessary to know the salinity on a given date at locations other than the regular sampling stations. To supply this information, a series of Delta maps were prepared showing, for the first of each month May to December inclusive, lines of equal salinity at intervals of 50 parts of chlorine per 100,000 parts of water. These lines were derived from the plotted tests of the samples taken at the first of the month at the regular stations. These maps, when combined as shown on Plate 7, furnish a graphic picturization of the encroachment and retreat of the salinity in the period May to December, 1931.

The maximum salinity as recorded at the stations operated in 1931 is shown in Table 85. For comparative purposes, this table shows

also the maximum salinity recorded at these stations in previous years beginning with 1924. A comparison of the Summer stream flow to the Delta in 1931 and the corresponding salinity at certain of the lower Delta stations is shown on Plate 9.

Salinity Bulletins

With the unusually early encroachment of salinity in the 1931 season, water users throughout the Delta were anxious to obtain the results of the tests in order that their irrigation operations might be governed to prevent the use of water of injurious salinity content. In the period from May 1st to November 15th therefore, bulletins reporting the salinity at the various stations were mailed to a large list of Delta water users at weekly or ten-day intervals. This service as well as that in testing many samples taken at points other than the regular stations, was in great demand and was probably instrumental to a considerable extent in reducing or preventing damage from the use of water of too high salinity.

Upper Limits of Sacramento River Salinity

By the middle of July salinity was advancing up the Sacramento River at a very rapid rate and it was desired to obtain a closer definition of its upstream limits and distribution than would have been given by the tests of the samples taken at four-day intervals at the regular stations between Paintersville Bridge and Sacramento. In the period from July 19th to August 15th, therefore, nine sampling "traverses" of the river were made by launch. On each traverse sampling was begun at Paintersville Bridge at one and one-half hours after high tide and, following this phase of the tide upstream as far as Sacramento, samples

were taken at short distance intervals along the entire traverse. The tests for each traverse furnished a "profile" which showed the progressive upstream decrease in salinity and defined the upstream limit of the encroachment. These traverses are shown on Plate 8. It will be noted that the greatest advance of salinity in the lowest three mile section is indicated by the traverse of August 11th but that the greatest advance in the vicinity of Hood Ferry is shown by the traverse of July 28th. The upstream limit of the encroachment is indicated by the traverses to have been about two miles above Hood Ferry. Above this point there was some variation between zero and about ten parts of chlorine but this was apparently the normal salinity content of the river flow passing Sacramento (practically all return water) and was not a result of the encroachment from San Francisco Bay.

Mokelumne Delta Investigation

Through a cooperation between Mokelumne River Delta water users, Woodbridge Irrigation District, East Bay Municipal Utility District, and the Pacific Gas and Electric Company, arrangements were made for the release of stored water in July and August, 1931, in order to retard the encroachment of salinity into the Mokelumne Delta. It was requested by Mokelumne Delta water users that the salinity sampling be planned so as to follow up and check the results of these releases. In addition to furnishing this requested service, it appeared that under the operation of the plan for salinity control by storage releases, the more extended sampling should furnish interesting and valuable data on the relation between stream flow and salinity in this particular area of the Delta. Arrangements were accordingly made for a more

detailed investigation of the salinity in the Mokelumne Delta than would otherwise have been conducted.

The release of stored water was started on July 23d and on the same date daily sampling was begun at the various Mokelumne Delta salinity stations. The releases were continued in varying amounts until August 22d and the daily sampling was maintained until September 15th. Before and after the period of the releases, the sampling was maintained at the regular four-day intervals. The results of the sampling at the Mokelumne Delta stations during the period from July 1st to October 1st are shown in Table 86.

Comparisons of Mokelumne River discharge and the salinity at Mokelumne Delta stations during the months of July, August, and September, are shown on Plates 10, 11, and 12. It was thought that the retardation or repulsion of salinity in the South Fork (East side of Staten Island) might be more efficiently accomplished by an increase in the flow entering this fork through Beaver and Sycamore Sloughs. Accordingly, a small portion of the released storage was diverted via Woodbridge Irrigation District canals to these sloughs and thence to the South Fork. No record was obtained to show the division of the main river discharge to the North and South Forks. The discharge of the North Fork only would have been effective in the control of salinity at stations along this fork, but lacking the segregation of flow to the north and south forks, the river discharge as measured below the Woodbridge dam was plotted on Plate 10 for comparison with the salinity at the North Fork stations. The salinity stations at Staten Island Camps 20 and 25 are located on the South Fork between Beaver and Sycamore Sloughs. To show, then, the influence of the

stream flow on the salinity at these stations the Mokelumne River discharge below Woodbridge Dam plus the inflow to the South Fork from Beaver Slough was plotted on Plate 11. For the South Fork stations below Sycamore Slough, Plate 12 compares the salinity to the combined discharge of the Mokelumne River below Woodbridge Dam and Beaver and Sycamore Sloughs.

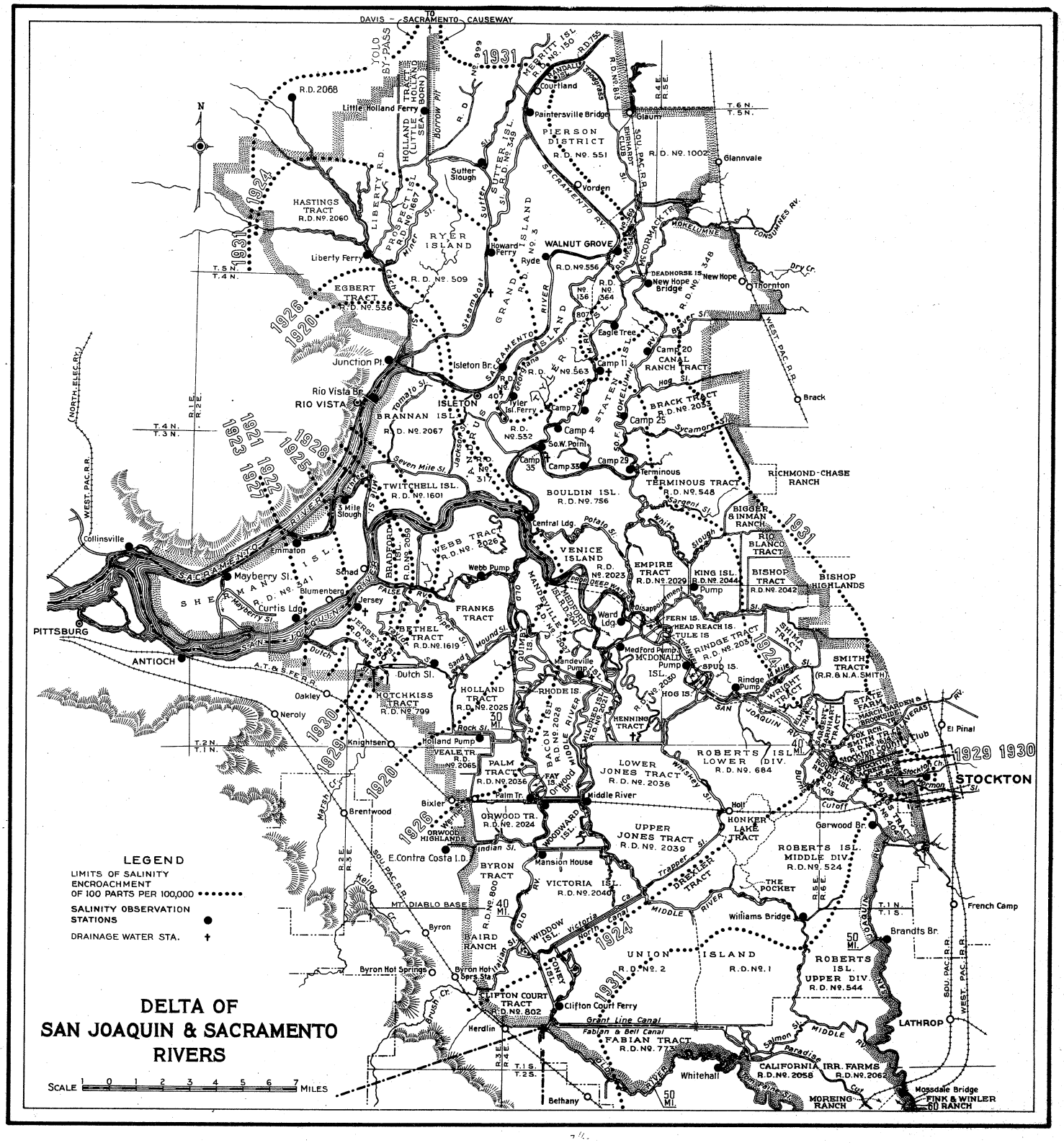
No detailed analysis has been completed to establish the relation between stream flow, salinity and tidal action, that might be derived from these records. Inspection of Plates 10, 11, and 12 would indicate that the increased stream flow was apparently of little benefit below Camp 7 on the North Fork and below Camp 29 on the South Fork. At upper stations, however, the marked increase in the salinity coincident with the stopping of the storage releases indicates that during August the salinity was quite effectively checked and that considerable benefit must undoubtedly have been derived from the release of the stored water.

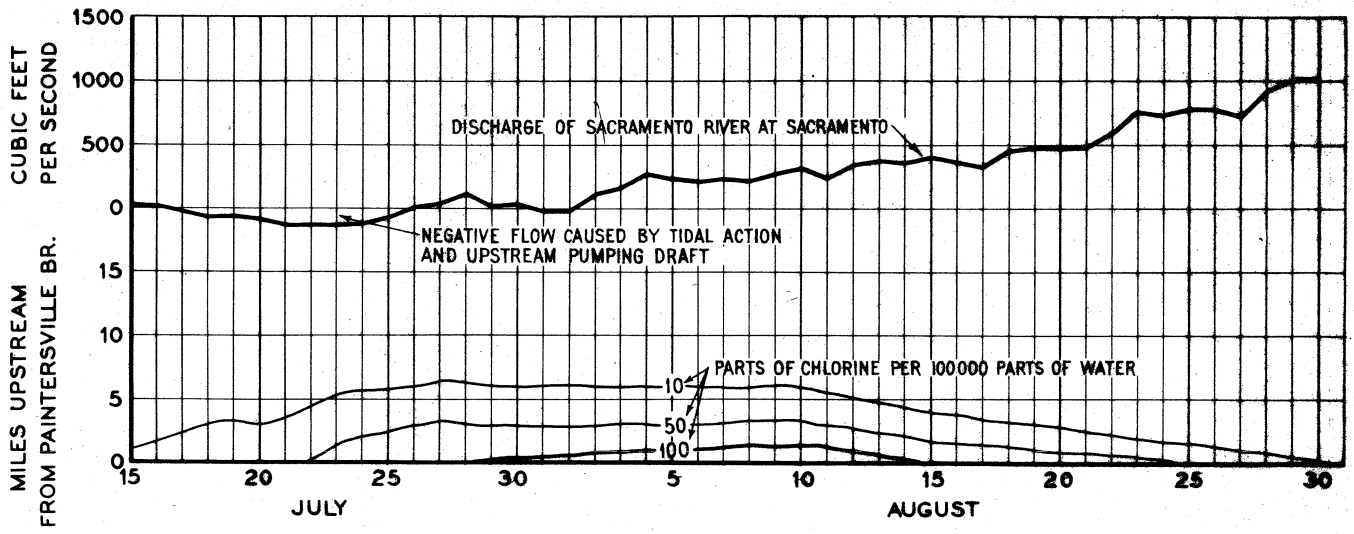
At the lower stations, with the mean salinity for a tidal cycle at approximately 100 parts of chlorine per 100,000 parts of water, some irrigation could be carried on during low tide periods when the salinity was below 100 parts. As an aid to the water users in determining from the regular high tide salinity tests what the corresponding low tide salinities would be, two sets of observations covering a tidal cycle were made at Staten Island stations, one at Camp 7 August 15-16, and the other at Camp 29 August 20-21st. The variation of salinity with the tide as found by these observations is shown in Table 87. Further special observations were made at Staten Island Camps 7 and 29 to show the variation of salinity with depth

and the results of these tests are shown in Table 88.

Tide Gages

In the analysis of the relation between salinity, stream flow and tidal action as presented in Bulletin No. 27, the comprehensive information covering the tidal variations throughout the Delta as obtained from the records of the tide gages was important and essential. If, then, a further such analysis under subsequent salinity, stream flow and tidal conditions is to be made, the tide gage records will be indispensible. In conjunction, therefore, with the continued salinity sampling in 1931, the operation of the recording tide gages at upper bay and delta stations has been maintained. Of the stations which supplied data used in the investigation for Bulletin No. 27, four are being maintained by the U. S. Army Engineers, one each by U. S. Coast and Geodetic Survey, U. S. Navy, East Contra Costa Irrigation District and Staten Island Land Company and the remaining stations, eight in number, are being maintained by the Water Supervisor. The latter are located at Sacramento, Walnut Grove, San Joaquin end of Georgiana Slough, Sacramento and San Joaquin ends of Three Mile Slough, Antioch, Collinsville, and Mossdale Bridge (San Joaquin River).


DELTA OF
SAN JOAQUIN & SACRAMENTO
RIVERS
LEGEND
LIMITS OF SALINITY ENCROACHMENT OF 100 PARTS PER 100,000
SALINITY OBSERVATION STATIONS
DRAINAGE WATER STA.
SCALE 1 0 1 2 3 4 5 6 7 MILES
DAVIS - SACRAMENTO CAUSEWAY
STOCKTON
LATHROP
PITTSBURG
ANTIOCH
RIO VISTA
WALNUT GROVE
ISLETON
Collinsville
Mayberry Sl.
Emmaton
Jersey
Curtis Ldg.
Brentwood
Byron
Byron Hot Springs
Bethany
Clifton Court Ferry
Herdlin
Whitehall
Williams Bridge
French Camp
Brandts Br.
Garwood Br.
Brack
Glenn
Glennvale
Thornton
New Hope
Courtland
Paintersville Bridge
Vorden
Ryde
Howard Ferry
Sutter Slough
Liberty Ferry
Little Holland Ferry
Junction Pt.
Isleton Br.
Tyler Isl. Ferry
Eagle Tree
Camp 11
Camp 20
Camp 7
Camp 4
So.W. Point
Camp 35
Camp 33
Camp 29
Camp 25
Terminous
Central Ldg.
Webb Pump
Ward Ldg.
Medford Pump
McDonald Pump
Mandeville Pump
Rindge Pump
Holland Pump
Middle River
Mansion House
Williams Bridge
Holt
Byron Hot Springs
Grant Line Canal
Fabian & Bell Canal
Paradise Cut
Salmon Sl.
Mossdale Bridge
FINK & WINLER RANCH
MOREING RANCH
CALIFORNIA IRR. FARMS
FABIAN TRACT
CLIFTON COURT TRACT
BAIRD RANCH
BYRON TRACT
VICTORIA ISL.
UPPER JONES TRACT
LOWER JONES TRACT
ROBERTS ISL. LOWER DIV.
ROBERTS ISL. MIDDLE DIV.
ROBERTS ISL. UPPER DIV.
UNION ISLAND
HONKER LAKE TRACT
ORWOOD TR.
PALM TRACT
VEALE TR.
HOLLAND TRACT
HOTCHKISS TRACT
BETHEL TRACT
FRANKS TRACT
WEBB TRACT
BRANNAN ISL.
TWITCHELL ISL.
BOULDIN ISL.
VENICE ISLAND
EMPIRE TRACT
KING ISL.
BISHOP TRACT
BISHOP HIGHLANDS
RICHMOND-CHASE RANCH
BIGGER & INMAN RANCH
RIO BLANCO TRACT
TERMINOUS TRACT
BRACK TRACT
CANAL RANCH TRACT
PIERSON DISTRICT
GRAND ISLAND
RYER ISLAND
HASTINGS TRACT
EGBERT TRACT
PROSPECT ISL.
HOLLAND TRACT (LITTLE SEA-BORN)
YOLO BY-PASS
SMITH TRACT (R.R. & N.A. SMITH)
STATE FARM
RINDGE TRACT
WRIGHT TRACT
FERN IS.
TULE IS.
SPUD IS.
HOG IS.
RHODE IS.
HENNING TRACT
BACON TRACT
FAY IS.
WOODWARD ISL.
WINDOW ISL.
TRAPPER TRACT
THE POCKET
SOUTH FORK
SOUTH MIDDLE
NORTH MIDDLE
MIDDLE RIVER
SAN JOAQUIN RIV.
SACRAMENTO RIV.
MOKELUMNE RIV.
CONSUMNES RIV.
Dry Cr.
Mayberry Sl.
Dutch Sl.
Rock Sl.
Indian Sl.
Trapper Sl.
Sycamore Sl.
Hog Sl.
Sargent Sl.
Potato Sl.
Seven Mile Sl.
Tomato Sl.
Jackson Sl.
Mound Sl.
Sand Cr.
Marsh Cr.
Kellogg Cr.
Brush Cr.
Cutoff
Sacramento Sl.
Steamboat Sl.
Sutter Sl.
Miner Sl.
Liberty Sl.
Merritt Isl.
Mandalay Isl.
Shoalgrass
Sherman Isl.
Twitchell Isl.
Bradford Isl.
Webb Isl.
Jones Isl.
Rhode Isl.
Bacon Isl.
Woodward Isl.
Window Isl.
Victoria Isl.
Union Isl.
Honker Isl.
Clifton Court Isl.
Fabian Isl.
Bethany Isl.
Mandeville Isl.
Medford Isl.
Holland Isl.
Veale Tr.
Palm Tr.
Orwood Tr.
Orwood Highland
Byron Hot Springs Sta.
Mt. Diablo Base
Mt. Diablo Base Line
Sacramento Nav. Canal
North Canal
Victoria Canal
Stockton Ship Canal
Stockton Channel
Fox Rock Tr.
Smith Tr.
Rindge Tr.
Wright Tr.
Sargent Tr.
Bacon Tr.
Fay Is.
Tule Is.
Spud Is.
Hog Is.
Head Reach Is.
Deadhorse Is.
Disappointment
Deep Water
Pump
Sacramento Nav. Canal
Stockton Ship Canal
Stockton Channel
Stock. Hot. Ch.
Sermon
Sl.
Mile Sl.
Mile Slough
Dutch
Sand
Mound
Kellogg
Brush
Marsh
Cr.
Rv.
Sl.
Canal
Cut
Paradise
Salmon
Grant Line Canal
Fabian & Bell Canal
Mossdale Bridge
Bethany
Herdlin
Byron
Oakley
Neroly
Knightsen
Bixler
Brentwood
E.Contra Costa I.D.
Byron Hot Springs
Clifton Court Ferry
Holland Pump
Veale Tr.
Palm Tr.
Middle River
Mansion House
Williams Bridge
Holt
Garwood Br.
Brandts Br.
French Camp
El Pinal
Lathrop
Whitehall
Bethany
Mossdale Bridge
Fink & Winler Ranch
Moreing Ranch
Clifton Court Ferry
Herdlin
Byron Hot Springs
Byron
Brentwood
Oakley
Neroly
Knightsen
Collinsville
Emmaton
Mayberry Sl.
Blumenberg
Jersey
Curtis Ldg


CUBIC FEET PER SECOND
1500
1000
500
0
DISCHARGE OF SACRAMENTO RIVER AT SACRAMENTO
NEGATIVE FLOW CAUSED BY TIDAL ACTION AND UPSTREAM PUMPING DRAFT
MILES UPSTREAM FROM PAINTERSVILLE BR.
15
10
5
0
PARTS OF CHLORINE PER 100000 PARTS OF WATER
10
50
100
15
20
25
30
5
10
15
20
25
30
JULY
AUGUST

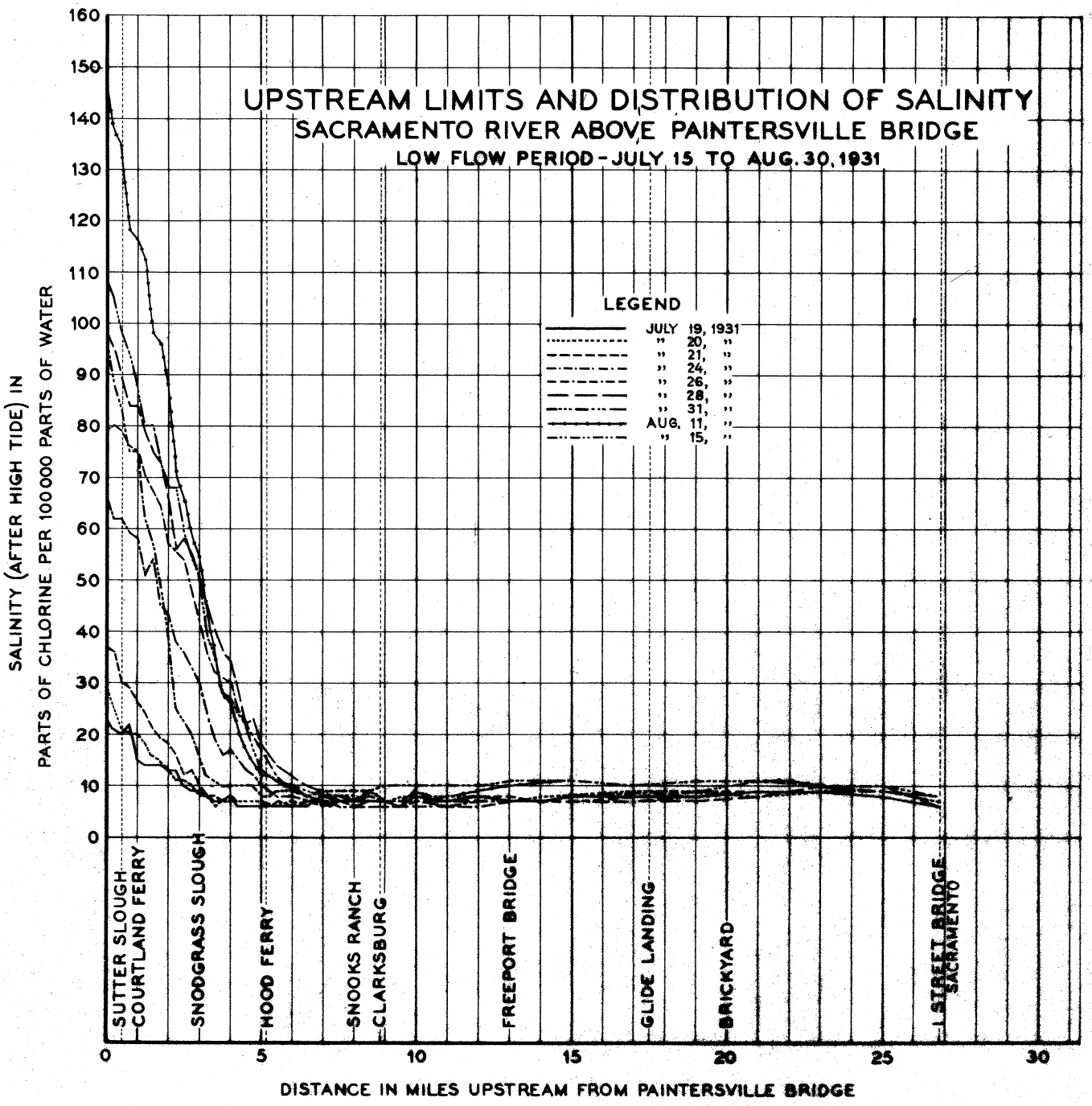
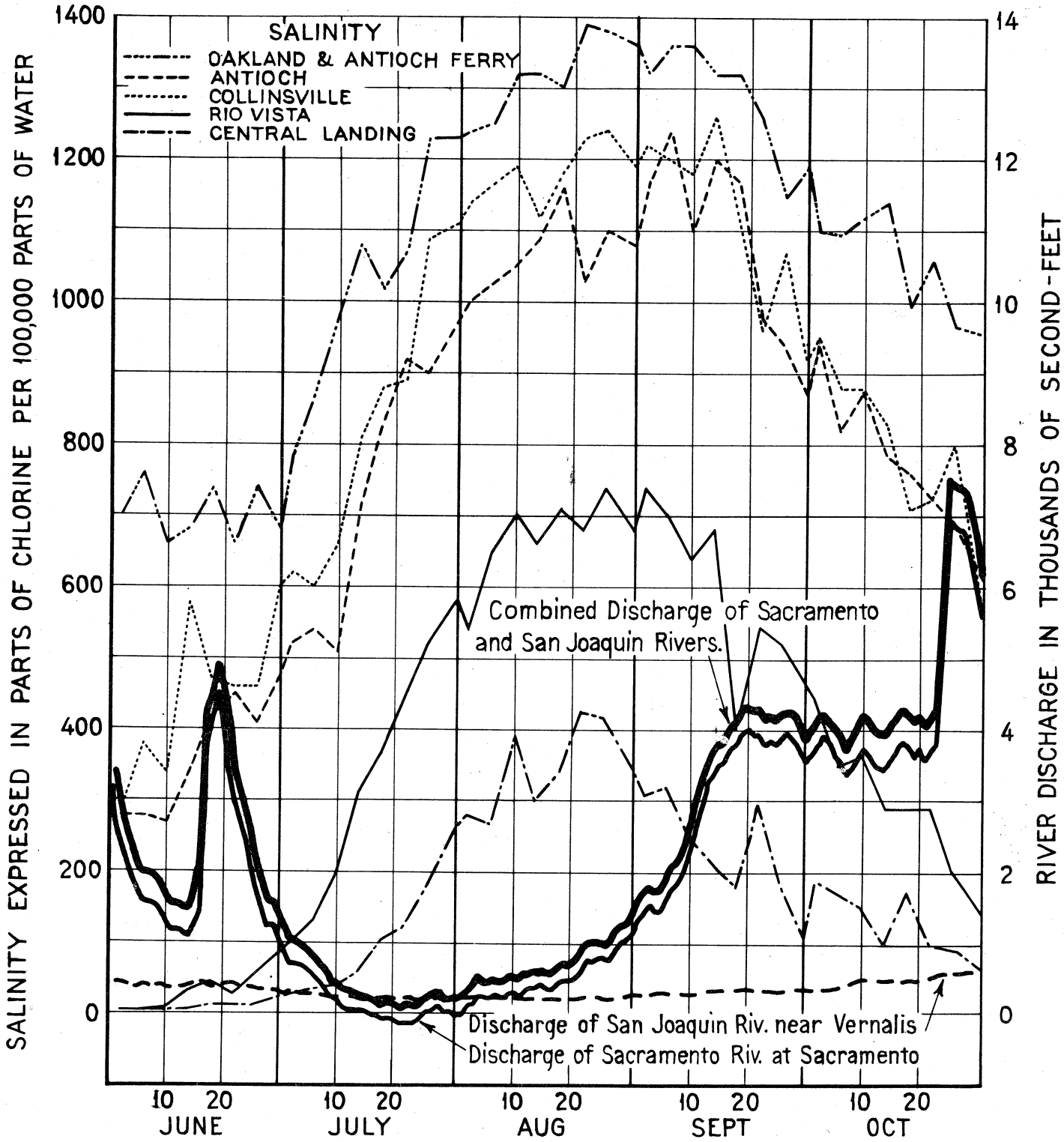

UPSTREAM LIMITS AND DISTRIBUTION OF SALINITY
SACRAMENTO RIVER ABOVE PAINTERSVILLE BRIDGE
LOW FLOW PERIOD - JULY 15 TO AUG. 30, 1931
SALINITY (AFTER HIGH TIDE) IN PARTS OF CHLORINE PER 100000 PARTS OF WATER
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
LEGEND
JULY 19, 1931
" 20, "
" 21, "
" 24, "
" 26, "
" 28, "
" 31, "
AUG. 11, "
" 15, "
SUTTER SLOUGH
COURTLAND FERRY
SNODGRASS SLOUGH
HOOD FERRY
SNOOKS RANCH
CLARKSBURG
FREEPORT BRIDGE
GLIDE LANDING
BRICKYARD
I STREET BRIDGE
SACRAMENTO
0
5
10
15
20
25
30
DISTANCE IN MILES UPSTREAM FROM PAINTERSVILLE BRIDGE

PLATE 8



COMPARISON OF RIVER DISCHARGE AND SALINITY AT BAY AND DELTA STATIONS 1931

TABLE 85

MAXIMUM RECORDED SALINITY AT BAY AND DELTA STATIONS
1924 TO 1931, INCLUSIVE

YEAR	1924		1925		1926		1927		1928		1929		1930		1931	
SEASONAL RUN-OFF TO SAN FRANCISCO BAY IN PER CENT OF NORMAL*	28		83		57		114		80		42		63		29	
STATION (1)	MAXIMUM RECORDED SALINITY IN PARTS OF CHLORINE PER 100,000 AND DATE OF OCCURRENCE															
SAN FRANCISCO, SAN PABLO AND SUISUN BAYS																
POINT ORIENT					9/30	2020	9/10	1880	7/31	1870	9/26	1830	9/10	1780	8/22	1870
POINT DAVIS					8/26	1850	8/26	1510	8/2	1610	8/30	1660	9/22	1620	8/14	1810
BULLS HEAD POINT					8/30	1690	9/2	1330	8/10	1410	9/6	1370	9/6	1380	8/27	1690
BAY POINT					8/23	1400	9/2	950	8/10	1170	9/6	1050	9/6	1060	8/26	1540
O AND A FERRY	8/28	1345	9/26	762	8/26	1100	8/30	510	8/22	750	8/30	830	8/14	800	8/22	1390
INNISFAIL FERRY											9/18	870	8/30	810	8/22	1400
NORTH SAN PABLO BAY																
SONOMA CREEK BRIDGE											9/26	1600	9/26	1670	7/10	1660
GRANDVIEW													9/10	1610	8/26	1870
VALLEJO													9/10	1340	9/18	1700
CUTTINGS WHARF													9/18	1320	9/18	1800
SACRAMENTO RIVER DELTA																
COLLINSVILLE	8/16	1150	9/6	448	9/6	1020	9/10	370	9/2	590	9/2	680	9/2	570	9/14	1260
EMMATON	8/6	802	9/4	136	8/22	540	8/30	65	8/22	156	9/6	310	9/10	250	9/2	1000
THREE MILE SLOUGH BRIDGE	8/30	692	9/6	81	8/26	430	9/10	25	9/2	109	9/6	205	9/10	150	9/2	860
RIO VISTA BRIDGE	8/12	608	9/2	21	8/30	256	9/26	12	8/30	44	9/3	67	8/22	52	8/26	740
JUNCTION POINT											9/6	17	8/10	26	9/2	620
LIBERTY FERRY	8/16	192	9/16	11	8/26	32			9/26	7	7/22	14	7/26	6	9/3	560
ISLETON BRIDGE	8/14	310	9/16	12	8/19	68			8/18	13	9/10	6	8/22	10	8/27	635
HOWARD FERRY	8/16	157			8/6	27					7/14	7			8/18	500
SUTTER SLOUGH	8/8	46									8/10	11			8/14	320
LITTLE HOLLAND FERRY	8/10	48									7/18	11			8/18	300
RYDE											7/18	9			8/3	280
R. D. 2068															9/22	280
WALNUT GROVE	8/10	42			8/19	15					7/18	8			8/14	220
PAINTERSVILLE BRIDGE	8/10	47			9/3	17					7/18	9			8/6	144
HOOD FERRY	8/10	46									7/14	10			7/26	18
FREEPORT BRIDGE	8/16	15									7/10	8			8/22	11
SACRAMENTO											7/2	8	8/2	5	8/26	10

* NORMAL TAKEN AS 40-YEAR MEAN (1889-1929) OF NATURAL RUN-OFF AT FOOTHILL STATIONS OF MAJOR STREAMS TRIBUTARY TO SAN FRANCISCO BAY.
(1) FOR LOCATION AND DESCRIPTION SEE TABLE 89.

TABLE 85 (CONTINUED)

MAXIMUM RECORDED SALINITY AT BAY AND DELTA STATIONS
1924 TO 1931, INCLUSIVE

YEAR	1924		1925		1926		1927		1928		1929		1930		1931	
SEASONAL RUN-OFF TO SAN FRANCISCO BAY IN PER CENT OF NORMAL *	28		83		57		114		80		42		63		29	
STATION (1)	MAXIMUM RECORDED SALINITY IN PARTS OF CHLORINE PER 100,000 AND DATE OF OCCURRENCE															
MOKELUMNE RIVER DELTA																
SOUTHWEST POINT					8/26	65			8/10	23	9/2	9	7/30	9	8/14	390
CAMP 4															8/14	265
CAMP 33	8/30	113			9/6	32			7/30	25	7/18	8	7/30	7	8/26	245
CAMP 7															9/10	230
TYLER ISLAND FERRY	8/8	44			8/2	19					7/22	9	7/30	9	8/14	200
CAMP 11	9/26	96			9/6	23					7/6	7			9/14	134
CAMP 29					9/2	25			8/30	16	7/6	11			9/10	182
EAGLE TREE															10/18	57
CAMP 25	9/24	110			9/14	24					7/30	7			9/14	164
NEW HOPE BRIDGE					9/10	17					7/18	6	7/10	2	10/26	64
CAMP 20					10/10	22					7/18	8			9/27	124
SAN JOAQUIN RIVER DELTA																
ANTIOCH	8/20	1080	9/4	356	8/26	920	9/18	179	9/2	450	8/30	600	9/14	470	9/6	1240
CURTIS LANDING											9/10	450			8/27	1060
JERSEY	8/30	708	9/6	81	8/26	470	9/14	53	9/6	192	9/3	365	8/26	220	9/14	910
WEBB PUMP	9/6	414	9/4	24	8/14	147	9/10	16	8/30	46	8/31	80	8/30	61	9/2	680
CENTRAL LANDING	9/24	288	9/2	10	9/2	98			8/2	19	8/31	20	9/6	15	8/22	425
DUTCH SLOUGH															9/14	510
WARD LANDING											9/26	23	9/14	16	9/14	350
HOLLAND DAM															9/12	330
HOLLAND PUMP	10/4	308	9/22	18	9/2	148			10/10	34	9/22	42	8/26	23	9/26	325
MC DONALD PUMP											10/14	58			9/14	305
MANDEVILLE PUMP					9/30	84			8/2	25	9/26	25	9/14	17	9/10	350
KING ISLAND PUMP	10/2	164			9/28	48			10/12	19	9/26	16			9/22	261
RINDGE PUMP	9/16	126	9/2	35	9/14	50			9/30	28	8/26	28	8/2	16	9/18	198
ORWOOD BRIDGE					9/18	86			9/22	21	9/18	18	9/18	12	10/2	277
EAST CONTRA COSTA I. D.											9/18	16	11/26	17	10/22	200
MIDDLE RIVER P.O.	9/30	186	9/13	13	10/8	69			8/2	21	9/18	17	9/14	13	9/27	270
MANSION HOUSE	10/12	148	9/16	11	9/26	69			9/2	16	9/18	16	9/14	11	10/6	240
STOCKTON COUNTRY CLUB	9/16	108			8/30	48					8/14	36	8/6	18	9/14	122
CLIFTON COURT FERRY	10/2	80			8/30	24					8/18	23			9/18	130
STOCKTON											8/16	200	5/2	120	9/14	132
GARWOOD BRIDGE															9/10	92
BRANDT BRIDGE															8/14	43
WILLIAMS BRIDGE	9/4	42			9/2	18					7/14	12			9/2	118
WHITEHALL											7/14	15			9/2	31
MOSSDALE BRIDGE	9/3	14									7/22	16	7/30	10	7/6	12
DURHAM FERRY BRIDGE															7/10	10

* NORMAL TAKEN AS 40-YEAR MEAN (1889-1929) OF NATURAL RUN-OFF AT FOOTHILL STATIONS OF MAJOR STREAMS TRIBUTARY TO SAN FRANCISCO BAY.
(1) FOR LOCATION AND DESCRIPTION, SEE TABLE 89.

COMPARISON OF
RELEASED DISCHARGE AND SALINITY
MOKELUMNE DELTA 1931

DISCHARGE BELOW WOODBRIDGE
SALINITY AT NEW HOPE BRIDGE AND STATEN ISLAND NORTH FORK STATIONS, EAGLE TREE, CAMPS 11 AND 7 AND SOUTH WEST POINT

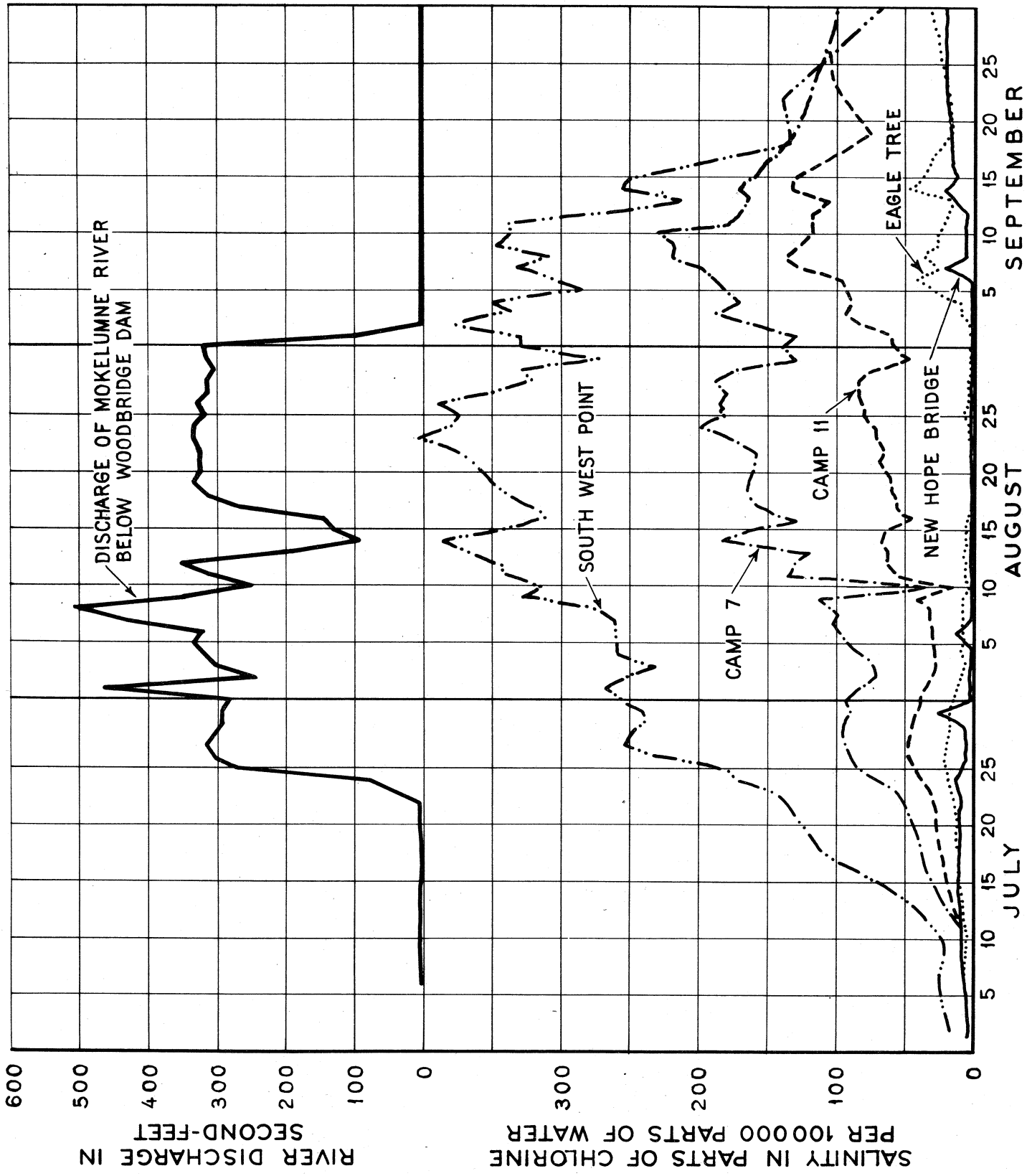


PLATE 10

COMPARISON OF RELEASED DISCHARGE AND SALINITY

MOKELUMNE DELTA 1931

DISCHARGE BELOW WOODBRIDGE PLUS BEAVER SLOUGH
SALINITY AT STATEN ISLAND SOUTH FORK CAMPS 20 AND 25

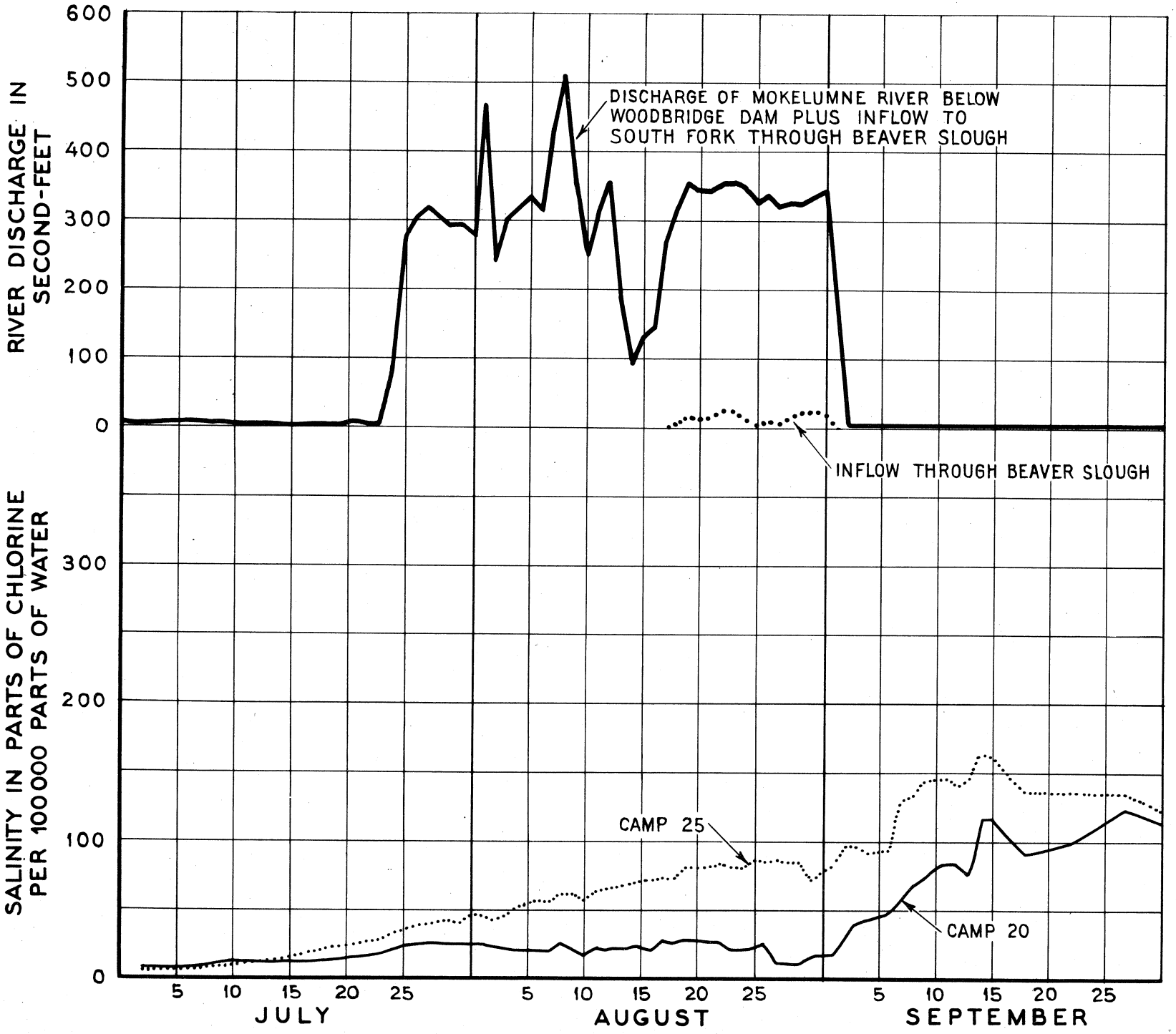


PLATE 11

COMPARISON OF RELEASED DISCHARGE AND SALINITY

MOKELUMNE DELTA 1931

DISCHARGE BELOW WOODBRIDGE PLUS BEAVER AND SYCAMORE SLOUGHS
SALINITY AT CENTRAL LANDING AND
STATEN ISLAND SOUTH FORK CAMPS 33 AND 29

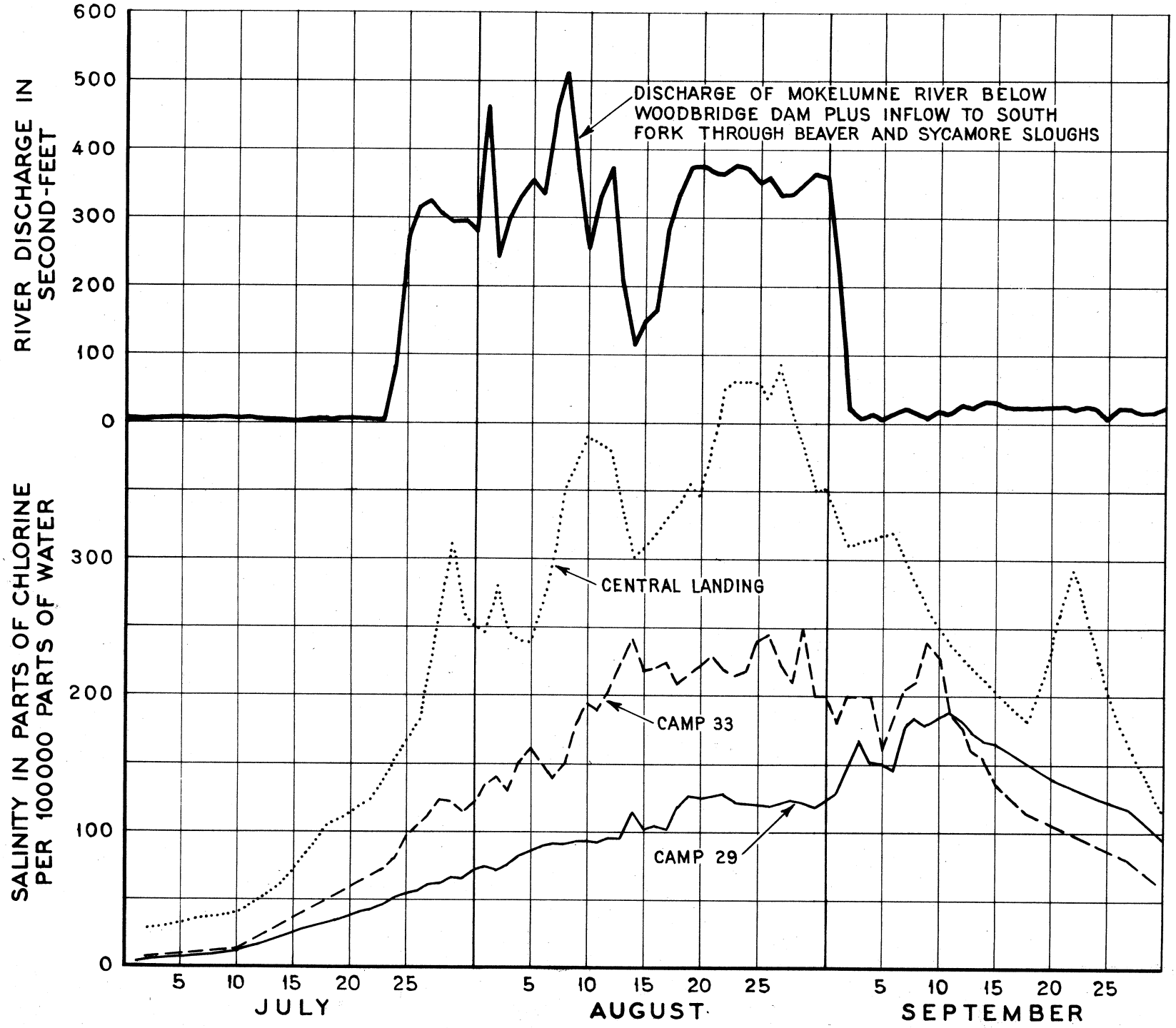


PLATE 12

TABLE 86

DAILY SALINITY OBSERVATIONS, MOKELUMNE RIVER DELTA, 1931
Samples taken by local observers approximately
one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Date	Station													
	Central Landing	Southwest Point	Camp 4 Staten Island	Camp 33 Staten Island	Camp 7 Staten Island	Tyler Island Ferry	Camp 11 Staten Island	Camp 29 Staten Island	Eagle Tree	Camp 25 Staten Island	New Hope Bridge	Camp 20 Staten Island
Jul.												
1					7	8	9		8		7	
2	28*	18		9				8		7		9
3					7		8		9		7	
4												
5												
6	35*	26*		9*		5*		9*		8*		9*
7					8*		8*		8*			
8												
9												
10	40*	22*		13*		5*		11*		11*	8*	14*
11					10*		10*		7*			
12												
13												
14	60*	73*		33*		6*		19*		14*		12*
15											11	
16					35		23		11			
17												
18	104	114		47			25	31	11	21	11	14
19					40							
20												
21												
22	122*										9*	
23		145		72	56	24	31	45	15	29	11	19
24		172		80	71		39	52	18	33	13	22
25		180		96	84		44	54	20	37	12	24
26	180*	230		105	91	31*	49	55	22	38	13	26
27		255		111		37*		60		40		26
28	265	250		123	96	58*	47	62	19	41	9	27
28		121ø		69ø	33ø		18ø	39ø	10ø	17ø	9ø	17ø
29	315	240		122	95	80*	45	66	18	44	6	26
30	260	240		115	90	92	42	65	16	43	25	
31	250	255		122	93	110	40	72		47	4	26

* Low High Tide. ø Low Low Tide.

TABLE 86 - CONTINUED

DAILY SALINITY OBSERVATIONS, MOKELUMNE RIVER DELTA, 1931
Samples taken by local observers approximately
one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Date	Station												
	Central Landing	Southwest Point	Camp 4 Staten Island	Camp 33 Staten Island	Camp 7 Staten Island	Tyler Island Ferry	Camp 11 Staten Island	Camp 29 Staten Island	Eagle Tree	Camp 25 Staten Island	New Hope Bridge	Camp 20 Staten Island
Aug.												
1	245	270		135	88	100	37	75	14	47	3	26
2	280	250		140	72		30	72	10	44	3	23
3	245	230		130	72	130	28	74	7	46	3	
4	240	260	145	150	78	130	29	82	9	52	2	22
5	240	260	148	160	92	175						
6	270					155	31	88	7	56	3	22
7	300	260	154	140	104	175*	34	90	8	56	2	22
8	350	275	160	150	100	160*	34	90	8	62	1	26
9	370	330	185	180	115		44	92	9	61	2	21
10	390	315	90	195	35	175*	16	93	3	56	1	17
11	385	345	201	190	135	195*	58	92	7	64	2	21
12	380	345	235	205	131	235*	63	96	6	65	3	21
13		370	235	225	170	190	64	96	7	67	2	23
14	300*	390	265	240	185		68	115	6	68	2	23
15		345	230	220	165	200	65	102	7	72	3	24
15					20ø							
16		310	205	220	130		46	104	3	72	2	22
17		320	215	225	155	190	56	102	3	74	1	28
18	340*	340	220	210	165	200	58	122	2	73	1	26
19	355	350	230	215	165	170*	62	128	3	82	2	28
20	345							58ø				
21		365	240	230	160	135*	70	127	3	82	1	28
22	425	380	215	220	160	155*	66	128	3	84	1	26
23	430	405	240	215	180	155	71	121	4	82	1	21
24	430	380	250	220	200	135	73	120	4	81	1	22
25	430	375	260	240	180	145	81	119	6	86	1	24
26	415	390	255	245	185	135*	82	119	4	85	1	26
27	445	350	255	225	180		85	121	4	87	1	12
28		320	260	210	190		85	124	4	85	1	12
29		330	260	250	175		74	122	3	85	1	10
30	350	270	200	200	130	62*	48	118	3	72	1	17
30		170ø	100ø	120ø	60ø		2ø	94ø	2ø	32ø	1ø	1ø
31	350	330	200	200	140	64	58	124	3	78	1	18

* Low High Tide. ø Low Low Tide.

TABLE 86 - CONTINUED

DAILY SALINITY OBSERVATIONS, MOKELUMNE RIVER DELTA, 1931
Samples taken by local observers approximately
one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Date	Station												
	Central Landing	Southwest Point	Camp 4 Staten Island	Camp 33 Staten Island	Camp 7 Staten Island	Tyler Island Ferry	Camp 11 Staten Island	Camp 29 Staten Island	Eagle Tree	Camp 25 Staten Island	New Hope Bridge	Camp 20 Staten Island
Sep.												
1		330	190	180	130		58	128	2	82	1	17
2	310*	380	210	200	160	36	82	152	4	96	1	31
3		330	200	200	190		94	168	10	96	1	41
4		350	210	200	170		90	152	10	92	1	44
5		285		160								
6	320*		200		190		96	146	41	94	1	49
7		335	250	205	200		126	180	26	128	23	58
8		310	260	210	220		138	184	37	134	5	68
9		350	250	240	220		128	178	26	144	7	75
10	250*	340	230	230	230		118	182	26	146	6	79
11		340	190	190	180		118	186	22	146	7	85
12		270	180	180	170		116	184	19	140	6	83
13		214	160	162	166		106	172	14	146	11	76
14	212	256	166	156	172	8	134	166	48	164	23	117
15		250	132	136	160		130	164	36	160	14	118
16												
17												
18	180*	134*		116*				148*		136*		91*
19					130*		76*		15*			
20												
21												
22	295*	142*		98*				132*		130*	20*	98*
23					116*		100*		20*			
24												
25												
26	178					3						
27		105*		80*				116*		133*	21*	124*
28					104*		107*		29*			
29												
30	110*	70*		60*		3*		94*		123*	21	114
Oct. 1					99*		91*		33*			

* Low High Tide.

TABLE 87

TIDAL VARIATION OF SURFACE ZONE SALINITY
AT STATEN ISLANDS, CAMPS 7 AND 29, MOKELUMNE RIVER DELTA, 1931
Samples taken at one-foot depth.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Camp 7, Staten Island (Complete Tidal Cycle)				Camp 29, Staten Island (Partial Tidal Cycle)			
Date	Time	Tide Gage Feet	Salinity	Date	Time	Tide Gage Feet	Salinity
August 15th	5 A.M.	4.19	160	August 20th	9 P.M.	3.92	109
	6 A.M.	4.12	180		9:30 PM	4.17	113
	7 A.M.	3.42	150		10 P.M.	4.42	126
	8 A.M.	2.88	130		10:30PM	4.54	130
	9 A.M.	2.39	108		11 P.M.	4.54	133
	10 A.M.	1.79	86		12 M	4.17	123
	11 A.M.	1.21	70	August 21st	1 A.M.	3.50	119
	12 M	0.65	50		2 A.M.	2.83	107
	1 P.M.	0.17	32		3 A.M.	2.25	97
	2 P.M.	0.08	20		4 A.M.	1.71	86
	3 P.M.	0.92	20		5 A.M.	1.08	80
	4 P.M.	1.62	32		6 A.M.	0.67	72
	5 P.M.	2.33	52		7 A.M.	0.00	63
	6 P.M.	2.92	76		8 A.M.	0.00	58
	7 P.M.	3.21	106		9 A.M.	0.71	59
	8 P.M.	3.17	126		10 A.M.	1.42	73
	9 P.M.	2.58	98		11 A.M.	2.08	83
	10 P.M.	1.96	90		11:30AM	2.29	89
	11 P.M.	1.42	72		12 M	2.50	92
	12 P.M.	1.00	56		12:30PM	2.69	97
August 16th	1 A.M.	0.75	42		1 P.M.	2.83	100
	2 A.M.	1.21	34				
	3 A.M.	1.94	48				
	4 A.M.	2.62	78				
	5 A.M.	3.19	100				
	6 A.M.	3.67	130				
	7 A.M.	3.79	154				
	8 A.M.	3.21	144				

TABLE 88

VARIATION OF SALINITY WITH DEPTH AT STATEN ISLAND, CAMPS 7 AND 29, MOKELUMNE RIVER DELTA, 1931
August 30, 1931

Total Depth in Feet	Time	Tide Gage Feet	Salinity in Parts of Chlorine Per 100,000 parts of Water for Depths in Feet Below Surface of 1	5	10	15	20	(1)
Camp 7, Staten Island								
25	6:00 A	6.0	150	150	150	152	154	156
	7:15A(2)	6.0	140	146	152	156	160	162
	8:15 A	5.4	112	140	142	150	150	158
22	12:20 P	2.85	46	54	62	74		88
	1:25P(3)	2.70	26	32	44	56		74
	2:25 P	3.30	20	26	40	56		70
Camp 29, Staten Island								
20	9:45 A		112	112	110	112		114

(1) Two feet from bottom.
(2) High High Tide.
(3) Low Low Tide.

TABLE 89

SALINITY STATIONS AT WHICH OBSERVATIONS WERE TAKEN DURING 1931

Station	Miles from Golden Gate	Time Interval between high tide at Golden Gate and time for taking samples at station		Location
		Hours	Minutes	
				SAN FRANCISCO, SAN PABLO AND SUISUN BAYS
Point Orient*	12.3	2	20	North end San Francisco Bay, east shore, ½ mile south of Pt.San Pablo. Wharf of Standard Oil Company.
Point Davis*	25.2	3	15	East end San Pablo Bay, south shore. Oleum wharf of Union Oil Company.
Bulls Head Point*	34.0	3	50	West end Suisun Bay, south shore. Wharf of Mountain Copper Company.
Bay Point*	39.9	4	15	Suisun Bay, south shore. Bay Point wharf of Coos Bay Lumber Company.
O and A Ferry*	46.5	4	40	Upper end Suisun Bay between Mallard Station and Chipps Island at Sacramento Northern Railroad ferry crossing.
Innisfail Ferry*	47.3	4	50	Montezuma Slough, about 1 mile east of junction with Cutoff Slough, near north end of Grizzly Island.
				NORTH SAN PABLO BAY
Sonoma Creek Bridge*	26.4	3	10	Sonoma Creek entrance at Drawbridge.
Grand View *	27.0	3	10	Petaluma Creek, State Highway Drawbridge near town of Grandview.
Vallejo *	29.1	3	35	Napa River at Sears Point Toll Road Bridge, about one mile from Mare Island Navy Yard Causeway.
Lakeville	33.8	3	40	Petaluma Creek, at town of Lakeville about 7½ miles from mouth of creek.
Cuttings Wharf*	36.7	4	00	Napa River, right bank, opposite north end of Bull Island, near Carneros Station on Southern Pacific Railroad.
Napa	43.7	4	20	Napa River at Third Street Bridge in Napa.
Petaluma	45.7	4	30	Petaluma Creek, at Washington Street Bridge in Petaluma.

* Permanent stations maintained throughout the year.

TABLE 89 - CONTINUED

SALINITY STATIONS AT WHICH OBSERVATIONS WERE TAKEN DURING 1931

Station	Miles from Golden Gate	Time Interval between high tide at Golden Gate and time for taking samples at station		Location
		Hours	Minutes	
				SACRAMENTO RIVER DELTA
Collinsville*	50.8	5	25	Sacramento River, north bank, at junction with San Joaquin River.
Mayberry	54.9	5	40	Sacramento River, south bank, just above Mayberry Slough.
Emmaton *	57.7	5	45	Sacramento River, south bank, lower end of Horseshoe Bend.
Three Mile Slough Br.	60.0	5	55	At junction of slough and Sacramento River.
Rio Vista Bridge	63.5	6	05	At Highway Bridge near northerly limits of Rio Vista.
Junction Point	65.2	6	10	Sacramento River, right bank, just below the junction with Steamboat Slough.
Liberty Ferry	67.6	6	25	Cache Slough at junction with Prospect Slough.
Isleton Bridge	68.7	6	30	Sacramento River, one mile upstream from Isleton.
Howard Ferry	71.4	6	55	Steamboat Slough, 1½ miles below junction with Sutter Slough.
Sutter Slough	72.8	7	00	At junction with Miner Slough.
Little Holland Ferry	73.2	7	05	Back borrow pit of Reclamation District 999, 2 miles above junction with Miner Slough.
Ryde	74.4	7	15	Sacramento River, right bank, at town of Ryde.
Reclamation Dist.2068	74.6	7	15	Haas Slough, at Reclamation District 2068 pumping plant.
Walnut Grove	77.4	7	25	Sacramento River, Highway Bridge, at Walnut Grove.
Paintersville Bridge	77.6	7	25	Sacramento River, 1 mile below Courtland.
Hood Ferry	82.5	7	50	Sacramento River, ½ mile above Hood.
Freeport Bridge	90.2	8	25	Sacramento River below Freeport.
Sacramento *	103.5	9	30	Sacramento River at Southern Pacific Railroad Bridge.

* Permanent stations maintained throughout the year.

TABLE 89 - CONTINUED

SALINITY STATIONS AT WHICH OBSERVATIONS WERE TAKEN DURING 1931

Station	Miles from Golden Gate	Time Interval between high tide at Golden Gate and time for taking samples at station		Location
		Hours	Minutes	
				MOKELUMNE RIVER DELTA
Southwest Point	78.8	7	25	Staten Island, North Fork Mokelumne River, south bank, just above junction with South Fork.
Camp 4, Staten Island	80.0	7	30	North Fork, Mokelumne River; 2 miles from junction with South Fork.
Camp 33, Staten Is.	80.2	7	30	South Fork, Mokelumne River, north bank, 2 miles above North Fork junction.
Camp 7, Staten Island	81.8	7	40	North Fork, Mokelumne River, south bank, approximately 3 miles above South Fork junction.
Tyler Island Ferry	81.9	7	40	On Georgiana Slough, about due east of Isleton.
Camp 11, Staten Is.	83.1	7	45	North Fork Mokelumne River, east bank, 4 miles above South Fork junction.
Camp 29, Staten Is.	83.4	7	50	South Fork, Mokelumne River, north bank, opposite Terminous.
Eagle Tree	85.8	8	05	Staten Island, North Fork, Mokelumne River, south bank, 1¾ miles below Millers Ferry Bridge.
Camp 25, Staten Is.	86.4	8	05	South Fork, Mokelumne River, west bank, 1 mile above Sycamore Sl. junction.
New Hope Bridge	87.0	8	10	North end Staten Island near upper junction of North and South Forks Mokelumne River.
Camp 20, Staten Is.	88.9	8	30	South Fork, Mokelumne River, west bank, ½ mile below Beaver Slough junction.
				SAN JOAQUIN RIVER DELTA
Antioch *	54.9	5	55	San Joaquin River, at City Water Works pumping plant.
Curtis Landing	58.9	6	10	San Joaquin River, right bank, about 3/4 mile above Antioch Toll Bridge.
Jersey *	61.4	6	20	San Joaquin River, left bank, 1 mile below mouth of False River.
Webb Pump	72.0	7	00	False River, 2 miles below Old River junction.

* Permanent stations maintained throughout the year.

TABLE 89 - CONTINUED

SALINITY STATIONS AT WHICH OBSERVATIONS WERE TAKEN DURING 1931

Station	Miles from Golden Gate	Time Interval between high tide at Golden Gate and time for taking samples at station		Location
		Hours	Minutes	
				SAN JOAQUIN RIVER DELTA - CONTINUED
Central Landing *	72.0	7	00	Mokelumne River at Central Landing, Bouldin Island.
Dutch Slough	73.0	7	05	At Bethel Island Bridge.
Ward Landing	79.6	7	35	San Joaquin River near junction with Little Connection Slough on the Southwest side of Empire Tract.
Holland Dam	80.1	7	40	Rock Slough. Below Dam at southeast corner Holland Tract. Dam completed about June 1, 1931.
Holland Pump	80.6	7	40	Rock Slough, north bank, 1½ miles west of Old River junction.
McDonald Pump	82.7	7	50	San Joaquin River, northeast corner of McDonald Island about 1½ miles below Hog Island.
Mandeville Pump	83.0	7	50	Connection Slough, north bank, 1 mile west of Middle River, on south end of Mandeville Island.
King Island Pump	84.2	8	00	Honker Cut at Empire Tract - King Island Ferry.
Rindge Pump*	86.1	8	10	San Joaquin River, north bank, 1 mile below Fourteen Mile Slough junction.
Orwood Bridge	86.3	8	10	Old River, at Santa Fe Railroad Crossing, Orwood.
East Contra Costa I.D.	86.7	8	20	Indian Slough, at East Contra Costa Irrigation District pumping plant.
Middle River, P. O.*	87.7	8	20	Middle River, east bank, at Santa Fe railroad crossing.
Mansion House	88.4	8	30	Victoria Island, Old River, east bank, at junction with North Victoria Canal
Stockton Country Club	90.8	8	45	On Lindley Cut-off (San Joaquin River), north bank, about ¾ mile above Burns Cut-off junction.
Clifton Court Ferry	94.2	9	10	Old River just below junction with Grant Line Canal.

* Permanent stations maintained throughout the year.

TABLE 89 - CONTINUED

SALINITY STATIONS AT WHICH OBSERVATIONS WERE TAKEN DURING 1931

Station	Miles from Golden Gate	Time Interval between high tide at Golden Gate and time for taking samples at station: Hours	Minutes	Location
				SAN JOAQUIN RIVER DELTA - CONTINUED
Stockton	94.8	9	15	Near head of Stockton Channel at wharf of California Transportation Co.
Garwood Bridge	95.3	9	15	San Joaquin River. At Drawbridge 1 mile above Santa Fe Railroad Crossing.
Brandt Bridge	100.6	9	50	San Joaquin River. At Drawbridge 6 miles above Santa Fe Railroad Crossing.
Williams Bridge	101.6	9	55	Middle River, about 4 miles below Salmon Slough junction.
Whitehall	104.8	10	20	Old River, west of junction of Salmon Slough and Paradise Cut. Due north of Tracy.
Mossdale Bridge*	108.5	10	50	San Joaquin River at Lincoln Highway Crossing, about 3 miles southwest of Lathrop.
Durham Ferry Bridge	125.8	No Tide		San Joaquin River, ½ mile below San Joaquin City.
				DRAINAGE WATER STATIONS
Jersey Drain *	61.4	--	--	Jersey Island drainage pump on San Joaquin River, about 1 mile below False River.
Grand Island Drain Steamboat Slough *	68.2	--	--	Grand Island drainage pump on Steamboat Slough, about 3 miles from Junction Point.
Camp 35, Staten Island Drain *	78.7	--	--	Staten Island, drainage pump on South Fork Mokelumne River, 1 mile from junction with North Fork Mokelumne River.
McDonald Drain *	82.7	--	--	McDonald Island drainage pump on Empire Slough about ¾ mile west of Whiskey Slough junction.
Bacon Island Drain *	82.9	--	--	Bacon Is. drainage pump on Old River near junction with Rock Slough.
Mandeville Drain *	83.0	--	--	Mandeville Is. drainage pump on Connection Sl., about 1 mi. from Middle R.
Camp 11, Staten Island Drain *	83.1	--	--	Staten Island drainage pump on North Fork Mokelumne River, 4 miles above junction with South Fork Mokelumne River.

* Permanent stations maintained throughout the year.

TABLE 90

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	JANUARY							
	2	6	10	14	18	22	26	30
	San Francisco, San Pablo & Suisun Bays							
Point Orient	ab1540	1640	1520	1540	1420	1400	1380	1410
Point Davis	1250	1150	1080	940	1100	1020a	810	1020
Bulls Head Point	1150	910	790	900	680	660	700	850
Bay Point	920	650a	320	540	ab	435	325	
O and A Ferry	162	185a	95	118	116	97	87	61
Innisfail Ferry	440b	390	345	270	180b	300	275	155
	North San Pablo Bay							
Sonoma Creek Bridge	1040a	920ab	760ab	850a	770b	640	500	830
Grandview	1230	1250	1200	1170	1160	1080	1050	960
Vallejo	980	930a	820			800	750	800
Lakeville	1380	1330	1190	1160	a	1130	870	960
Cuttings Wharf	900	720	580	680	730a	720	260	390
Napa	150	a	15	74		2		
Petaluma	1080	910	520	590	690a	640	80	230
	Sacramento River Delta							
Collinsville	215	126	30	33	34a	29	8	9
Emmaton				1	2	3	2	2
Sacramento	ab 1a	1	2ab	2a	5a	2	1	2
	San Joaquin River Delta							
Antioch	135	68a	21ab	13	20	14	9	6
Jersey	19	6	6	7	8	6	7	6
Webb Pump	6	6	5	6	6	7	6	5
Central Landing	3	3a	4	2a	4a	2	2	
Holland Pump	7	9	10	11	10	10	11	8
Mandeville Pump	7a	7	8	8	9a	9	10	10
Rindge Pump	9	11	13	13	12a	14	11	12
East Contra Costa I.D.	a	10	12	12a	13a	13a	15	
Middle River P.O.	7a	5	9	9a	8a	10	12	11
Mansion House	ab 5	d	8ab	8	a	9	10	
Stockton	34	76	66	75		101	63	55
Mossdale Bridge	7a	7	9	8a	7a	7	6	6
	Drainage Water Stations							
Jersey Drain	24	26	30	31	48	33	32	34
Grand Is.Dr.(Steamboat)	c 4c	6c	5c	4c	8c	5c	6	
Camp 35 Drain (Staten Is)	7	15	19	19	13	18	23	30
McDonald Drain							b	15
Bacon Island Drain	b 11		11	9	10	9	17b	10
Mandeville Drain	14	13	14	15	14	15	15	14
Camp 11 Drain (Staten Is.)			21	27	46	54	38	38

a, b, c, d, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	FEBRUARY 2	6	10	14	18	22	26
	San Francisco, San Pablo & Suisun Bays						
Point Orient	1550	1470	1540		1330	1320	1360
Point Davis	1080	1020	940:ab	990:ab	760	810	780
Bulls Head Point	700	680	780	840	600:a	280	500
Bay Point	465						300
O and A Ferry	92	66	58	81	31	9	10
Innisfail Ferry	170	190:d	175	190	220	190:d	140
	North San Pablo Bay						
Sonoma Creek Bridge	650:a	770:a	660:ab	760:a	680:a	680	820
Grandview	950:a	930:a	940	910	930	900	980
Vallejo	790	690	730		700	620	680
Lakeville		960	900:a	1020:ad	900		910
Cuttings Wharf	615	460	490	510:a	635	380	400
Napa				93	63		50
Petaluma	460	520	580	:a	600	520	500
	Sacramento River Delta						
Collinsville		20	22	25	7	3	7
Emmaton	:a 2	2					3
Sacramento	:ab 2	2	1:ab	1:a	1	1	1
	San Joaquin River Delta						
Antioch	12	12	11	19	9	6	6
Jersey	6	4	5	7	7	3	5
Webb Pump	6	5	6	7	6	6	8
Central Landing	4	4	2	2		2	4
Dutch Slough					11	10	12
Holland Pump	10	10	10	10	10	12	12
Mandeville Pump	10	10	10	10:a	11	10	10
Rindge Pump	10	11	12	12	14	9	12
East Contra Costa I.D.	12	12	13	:a	13		21
Middle River P.O.	11:a	15	9	:a	9	8	9
Mansion House		9		:a	9		
Stockton	56		61	75		64	66
Mossdale Bridge	6	7:ab	7:ab	7:a	8	7	7
	Drainage Water Stations						
Jersey Drain	34	47	34	35	38	53	37
Grand Is. Drain (Steamboat Slu.)	e 7:e	7:e	5:e	6:e	6:e	5:f	6
Camp 35 Drain (Staten Is.)	41	28	29	28	23	23	30
McDonald Drain	:b 16	17:e	17:c	17:b	15:b	14	17
Bacon Island Drain	10	12	10	10	10	12	9
Mandeville Drain	14	15	11	13	12	13	14
Camp 11 Drain (Staten Is.)	31	57	53	45	38	47	33

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	MARCH							
	2	6	10	14	18	22	26	30
	San Francisco, San Pablo & Suisun Bays							
Point Orient	1490	1460	1420	1340	1440	1230	1240	1210
Point Davis	960	960	860	920	910		580 b	920
Bulls Head Point	710	640	660	450	490	370	200	
Bay Point	a	260 a	235	265	240		75	163
O and A Ferry	12	72	35	48	24	5	3 ab	4
Innisfail Ferry	75 a	85	103	112	a	106	106	79
	North San Pablo Bay							
Sonoma Creek Bridge	760							
Grandview	950 a	980 a	980	990	1020	1060	1050	1020
Vallejo	660							570
Lakeville					910 f	940	880	
Cuttings Wharf	600 a	480	590	540	460 a	410 a	260	300
Napa	67 a	90		3		a	8	
Petaluma	570 a	660	700	520	500 a	520	600	630
	Sacramento River Delta							
Collinsville	6 a	4	11	8	3	1	2	3
Emmaton	1	1 a	1	2	1	1		
Sacramento				1 ab	1	1	1	1
	San Joaquin River Delta							
Antioch	4	6	11	9	7	3	5	5
Jersey	7	4	5	5	6	4	4	5
Webb Pump	7	6	7	6	5	4	6	4
Central Landing	4	4	4 c	3	1	1	3	4
Dutch Slough	a	9	9	9	9		8	11
Holland Pump	10	9	11	10	10	9	11	10
Mandeville Pump	b 10	11	11	10 d	10	10	8	10
Rindge Pump	12	12	12	14	15	17	17	13
East Contra Costa I.D.	14	16	12	9	9	9	9	11
Middle River P.O.	12	9	11	11	14	10	12	13
Mansion House			9	8		7	a	11
Stockton		64	64	71	83	86		67
Mossdale Bridge	ab 9	10	12	15 ab	15	13	ab	13
	Drainage Water Stations							
Jersey Drain	34	48	41	44	34	42	34	40
Grand Island Dr. (Steamboat)	e 7 b	4 e	5 e	6 e	5 e	5 e	4 e	7
Camp 35 Drain (Staten Is.)	20	17	20	21	18	18	20	19
McDonald Drain	16 e	15 c	17 b	17	15 e	17 b	17	18
Bacon Island Drain	11	11	10	10	9	9	10	9
Mandeville Drain	15	13	14	14	15	14	14	15
Camp 11 Drain (Staten Is.)	34	37	15	25	14	24	17	28

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	APRIL 2	6	10	14	18	22	26	30
	San Francisco, San Pablo & Suisun Bays							
Point Orient	a 1520	1580	1420 b	1480 b	1560	1600	1550 b	1620
Point Davis	b 1020	970	920 b	940 b	1120	1340	1250 a	1270
Bulls Head Point	b 550	580	500 b	630 b	730	1000	830 b	970
Bay Point	159 a	218	315 a	370 a	455 a	550	a	600
O and A Ferry	b 39	74	45 b	162 b	275	250 ab	210 a	270
Innisfail Ferry	a 59	70	74	a	98	200	240 a	270
	North San Pablo Bay							
Grandview	a	1050	1110 b	1100 b	1120 a	1180	1190 a	1160
Vallejo	b 590	640	680 b	760 b	840	850	850 b	970
Lakeville	a 870		990 a	950 a	990 d	1020		
Cuttings Wharf	b 320	390	440	410 b	400	440	580 b	770
Napa	a 16		15 a	20				
Petaluma	a 630	660	720 a	760 a	760 d	820	750 a	830
	Sacramento River Delta							
Collinsville	4	37	20 a	16 a	40	92	107 a	81
Mayberry							a	34
Emmaton		3	13 b	1 a	12	4		
Sacramento	b 1	1	1 b	1 b	1	1	1 b	1
	San Joaquin River Delta							
Antioch	a 4	9	9 a	10 a	17	70	78 a	60
Curtis Landing								38
Jersey	3	3	5 a	4 a	4	18	17 ab	20
Webb Pump	d 3	2	4 d	5	3	14	4	5
Central Landing	a 4	3 d	3 a	3 a	1	2	2	
Dutch Slough	a 7	8	9 b	8 b	7		7 b	9
Holland Pump	b 9	7	9 b	7 b	7	7	10 b	9
Mandeville Pump	b 9 d	9	b	12 b	7	6	7 b	6
Rindge Pump	a 22	19	20 b	21 b	16	15	16 a	17
East Contra Costa I.D.			12 a	13 b	10	13	11	
Middle River P.O.	12	12	13 b	12 b	11	12	11 a	11
Mansion House	b 11	11	11 b	10 b	10		b	14
Stockton	a 80	80	b	102 b	98		92	
Mossdale Bridge	b 13 d	12 ab	13 b	12 b	10	11 ab	10 a	10
Durham Ferry Bridge								7
	Drainage Water Stations							
Jersey Drain	b 45	41	32	43	19	28	21	42
Grand Is.Dr.(Steamboat Sl)	e 7	6	6	5	4	4	5	5
Camp 35 Drain (Staten Is.)	18	16	12					
McDonald Drain	18 e	15 b	17	16 e	15 b	14		
Bacon Island Drain	9	8	11 b	11	10	12	10	
Mandeville Drain	b 14	15		b	13	15	5 b	14
Camp 11 Drain (Staten Is.)	21	36	36	33	32	47	43	34

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water

Station	MAY							
	2	6	10	14	18	22	26	30
	San Francisco, San Pablo & Suisun Bays							
Point Orient	a 1540	1610	1600 a	1520 b	1700	1640	1670 b	1690
Point Davis	b 1320	1320	1280 a	1250 a	1280	1330	1410 b	1490
Bulls Head Point	b 1030	1050	900 b	870 b	870	1200	1110 b	1210
Bay Point	a 530 a	600 a	640 a	630	540 a	760 a	700 a	810
O and A Ferry	a 350	360 b	355 b	405 b	420 a	430 b	560 b	600
Innisfail Ferry	a 290	350 a	345 a	350 a	390 a	440 a	450 a	505
	North San Pablo Bay							
Sonoma Creek Bridge					a 1240	1340 b	1380	
Grandview	a 1260 a	1200	a	1270 a	1365 a	1450	1460 b	1420
Vallejo	b 930	950	940		a 1020	1020		
Lakeville	a 1070 d	1090 a	1100		ad 1180 a	1200 a	1230	
Cuttings Wharf	a 770 a	530 a	780 a	750 a	920	920	890 a	900
Petaluma	a 830 a	890 ad	860 a	960 a	970	1040 a	970 a	1070
	Sacramento River Delta							
Collinsville		229	166 a	150 bd	290	280 a	255 a	285
Mayberry	a 41	134 b	95	b	78	200 a	132 a	165
Emmaton	b 4	5 b	4 a	6				
Three Mile Slough Bridge	a	7 a	3 a	6 b	5	14 b	26 a	30
Rio Vista Bridge	a	4 b	1 b	4 b	3	3 b	3 a	5
Junction Point						a	5 a	5
Isleton Bridge						b	3 b	5
Sacramento		a	1 b	1 b	2	2 a	1 b	2
	Mokelumne River Delta							
Southwest Point	b 5 a	11 a	2 a	4		4		
Camp 33, Staten Island	b 2	a	4	ab	3	2		
Camp 7, Staten Island	4	a	4			a	7	
Tyler Island Ferry						b	4 b	4
Camp 11, Staten Island	b 4	4	a	7		a	7	
Camp 29, Staten Island	b 2	a	1	b	4	4		
Eagle Tree	8	a	6			a	7	
Camp 25, Staten Island	b 5	a	4	b	5	4		
New Hope Bridge			ab	3 b	9 b	2 a	9 b	7
Camp 20, Staten Island	b 5	a	6	b	8	5		

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide
Salinity expressed in parts of chlorine per 100,000 parts of water

Station	MAY (CONTINUED)								
	2	6	10	14	18	22	26	30
				San Joaquin River Delta				
Antioch	a 62	144 a	88 a	90 a	70	260 a	150 a	204
Curtis Landing	a 34	78 b	64	b	100	124 a	92 a	137
Jersey	a 9	38 a	6 a	12 a	15	95 a	44 a	43
Webb Pump	4	8 b	6 b	6 d	7	10	11	15
Central Landing	a 4	3	3 a	3 a	4	5 a	5 a	6
Dutch Slough	b 7		a	8 b	10 a	8 a	8	
Holland Pump	b 7	b 7 a	7 b	8 b	10	10 a	9 b	8
Mandeville Pump	b 8	8	a	7 b	7	6 a	7 b	8
Rindge Pump	b 16	19 a	14 b	18	17	22 a	22 b	21
East Contra Costa I.D.		10 a	11 a	10 b	10	9	a	11
Middle River P.O.	a 11	11 a	9 b	10 b	8	7 a	8 a	11
Mansion House		11 a	7 b	9		11	b	11
Stockton		106 b	94 b	96 b	85	85 b	85	
Mossdale Bridge	b 9	8 a	7 b	10 b	10	10 a	10 b	12
Durham Ferry Bridge	6	8	6 c	11		9	10	11
				Drainage Water Stations				
Jersey Drain	31	43	40	19	14	28	16	26
Grand Is.Dr. (Steamboat Sl)	c 6	c 13 c	5 b	8 c	6 c	5 c	8	
Camp 35 Drain, (Staten Is.)	b 5	16 c	4	7 b	7	4	6	
McDonald Drain		12	15	11	13	9		
Bacon Island Drain	9	7	10 b	10	10	9	10	9
Mandeville Drain	b 15	15	14	14 b	12	11	9 b	9
Camp 11 Drain (Staten Is.)	19	25 c	33	8 b	9	14	9	

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	JUNE 2	6	10	14	18	22	26	30
	San Francisco, San Pablo & Suisun Bays							
Point Orient	b 1730	1680	1640	b 1680	b 1710	1720	1740	b 1740
Point Davis	b 1440		a 1380	b 1530	b 1520	1460	1510	a 1540
Bulls Head Point	b 1210	1080	1080	b 1280	b 1300	1200	b 1360	b 1360
Bay Point	a 830	800	a 780	a 920	a 980	a 920	b 1160	a 1000
O and A Ferry	b 700	760	b 660	b 680	b 740	a 660	b 740	a 680
Innisfail Ferry	a 560	600	a 560	a 640	bd 740	a 700	a 710	a 780
	North San Pablo Bay							
Sonoma Creek Bridge			1440	b 1420			1560	
Grandview	a 1440		a 1440		a 1540		1580	
Vallejo			a 1100		ad1220			d 1380
Lakeville	d 1340	1340						
Cuttings Wharf	b 1050		960		a 980		a 980	
Petaluma	ad1140	1080						
	Sacramento River Delta							
Collinsville	a 285	380	a 340	a 580	470	a 460	ad 460	a 600
Mayberry		230						
Emmaton	b 87	a 88	b 170	b 148	b 280	a 192	b 225	b 275
Three Mile Slough Bridge	a 31	45	b 70	a 76	a 100	a 90	a 100	a 155
Rio Vista Bridge	b 6	5	b 10	b 34	b 46	29		b 85
Junction Point	a 5	3	a 5	a 7	a 6	a 8	a 9	a 14
Liberty Ferry					ac	5		a 6
Isleton Bridge	b 4	4	b 4	b 10	b 7	a 5	b 12	b 21
Sacramento	b 1	4	a 4	b 7	b 2	a 1	a 5	b 6
	Mokelumne River Delta							
Southwest Point	b 6	3	a 5	a 8	14	a 10	a 7	20
Camp 33, Staten Island	b 5		a 4		5	a 7	a 6	10
Camp 7, Staten Island	4		a 6	b 5	ab 5	ab 6	b 7	
Tyler Island Ferry	b 4	3	b 3	b 3	b 5	b 3	b 6	a 8
Camp 11, Staten Island			ab 7	b 6	b 5	ab 8	b 9	
Camp 29, Staten Island	b 4		a 4		5	a 6	a 8	8
Eagle Tree		8	a 8	b 8	ab 8	ab 9	b 8	
Camp 25, Staten Island	b 6		a 5		6	a 6	a 9	9
New Hope Bridge	b 6	5	b 9	b 6	b 7	a 6	b 9	b 7
Camp 20, Staten Island	b 8		a 7		6	a 7	a 8	b 10

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	JUNE (CONTINUED)							
	2	6	10	14	18	22	26	30
	San Joaquin River Delta							
Antioch	a 280	280 a	270 a	340 a	420	450 a	410 a	475
Curtis Landing		155		b	234 a	280 a	310	
Jersey	b 118	60 a	42 a	90 b	248 a	160 a	155 a	260
Webb Pump	20	15	26	36 b	49 a	40	76	95
Central Landing		7 a	7 a	8 a	12 a	13 ad	13 a	24
Dutch Slough					acd	29 a	42 b	56
Holland Dam	e	12 ab	8	c	14 b	16 a	15 b	18
Holland Pump	b 7	8 ab	8 b	10 c	10 b	14 a	12 b	17
Mandeville Pump	b 9	9 a	9 b	9 b	11 a	12 a	15 b	19
King Island Pump				b	12 b	11	b	14
Rindge Pump	b 20	19 a	17 b	23 b	17 a	20 a	19 a	19
East Contra Costa I.D.	b 12	10 a	10 b	13 b	12 a	12	a	12
Middle River P.O.	b 11	9 a	9 a	10 b	10 a	10 a	11	13
Mansion House	b 8	a	8	b	12	b	11 b	12
Stockton Country Club		a	28 b	26	a	30		
Stockton	e 76	b	62	b	80 b	80 b	76 b	76
Mossdale Bridge	b 11	11 a	13 b	9 b	9 a	8 a	11	
Durham Ferry Bridge	9	8	10 b	11	9	9	10	8
	Drainage Water Stations							
Jersey Drain	b 27	17	30	29 b	57	56	63	77
Grand Is.Dr.(Steamboat Sl.)	7	6	7	13 ab	4	8	8	9
Camp 35 Dr. (Staten Is.)	b 7	9	8	9	6 b	8 b	10 b	9
McDonald Drain					12	12	13	14
Bacon Island Drain	11	8	10	11	11	11	13	14
Mandeville Drain	b 9	10	9 b	8 b	11	12	17 b	17
Camp 11 Dr. (Staten Is.)	b 8	7	4	7	7 b	7 b	9 b	10

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	JULY 2	6	10	14	18	22	26	30
	San Francisco, San Pablo and Suisun Bays							
Point Orient		1770	1780:b	1780	1770	1820	1830:b	1840
Point Davis	b 1480	1640	1660:b	1670	1680:a	1680:a	1700:b	1740
Bulls Head Point	b 1340	1370	1390:b	1500	1380	1480:b	1610:b	1570
O and A Ferry	a 780	870	980:b	1080	1020	1070:b	1230:b	1230
Innisfail Ferry		840:a	780:a	910:a	1030	1080:a	1140:b	1230
	North San Pablo Bay							
Sonoma Creek Bridge	a 1590		1660					
Grandview	a 1570		1660	a 1670		a 1760		
Vallejo	a 1320	d 1420		b 1560				
Cuttings Wharf	a 1050		1200			ad1340		
	Sacramento River Delta							
Collinsville	d 620	a 600	a 660	a 810	880	a 890	a 1090	a 1110
Mayberry			a	660	a	770		
Emmaton	a 280	a 365	a 470	b 540	560	630		
Three Mile Slough Bridge	b 210	250	a 290	a 430	a 430	500	a 560	a 655
Rio Vista Bridge	b 98	132	b 196	b 315	370	450	b 520	b 580
Junction Point					260	280	a 370	a 390
Liberty Ferry	a	24	ae 22	a 58	a	116		
Isleton Bridge		68	b 83	b 146	230	250	b 360	b 380
Howard Ferry			a	98	170	a 190	a 245	b 342
Sutter Slough					58	a 83	a 135	b 220
Little Holland Ferry						ab	110	a 142
Ryde		d	6	a 29	a 48	a 71	a 109	a 190
R. D. 2068			a	4	5	a 10	a 35	a 74
Walnut Grove			b	21	27	f 76	81	b 130
Paintersville Bridge			b	25	20	b 48	b 92	b 112
Hood Ferry					6	8	18	15
Freeport Bridge			b	7	7	b 8	b 8	b 7
Sacramento	b	6	6	b 7	5	a 5	b 7	b 6
	Mokelumne River Delta							
Southwest Point	18	a 26	a 22	a 73	114	b 145	230	240
Camp 33, Staten Island	9	a 9	a 13	a 33	47	b 72	105	115
Camp 7, Staten Island	b 7	ab 8	ab 10	c 35	b 40	b 56	91	90
Tyler Island Ferry	a	5	a 5	a 6	b	24	a 31	92
Camp 11, Staten Island	b 8	ab 8	ab 10	c 23	25	b 31	49	42
Camp 29, Staten Island	8	a 9	a 11	a 19	31	b 45	55	65

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	JULY (CONTINUED)								
	2	6	10	14	18	22	26	30	
	Mokelumne River Delta (Continued)								
Eagle Tree	b	9:ab	8:ab	7:c	11:	11:b	15:	22:	16:
Camp 25, Staten Island		7:a	8:a	11:a	14:	21:b	29:	38:	43:
New Hope Bridge	b	7:	:a	8:b	11:	11:b	11:	13:	25:
Camp 20, Staten Island		9:a	9:a	14:a	12:	14:b	19:	26:e	26:
	San Joaquin River Delta								
Antioch	a	520:	540:a	510:a	710:	830:	920:a	900:	
Curtis Landing	b	440:a	440:a	425:	:a	640:a	660:ab	830:a	850:
Jersey	b	365:a	325:a	270:a	430:	600:a	500:b	790:b	780:
Webb Pump		102:	146:	168:	245:	310:b	380:	460:	480:
Central Landing	a	28:a	35:a	40:a	60:	104:a	122:a	180:	260:
Dutch Slough	b	78:a	82:a	79:a	116:	:	:	:	:
Ward Landing		:	:	:	:	:	:ac	140:	167:
Holland Dam		:ab	20:a	23:b	53:	60:	61:b	100:b	140:
Holland Pump	b	19:ab	22:a	24:b	38:	46:	51:b	80:b	105:
Mandeville Pump		:ab	19:a	29:b	43:	55:a	65:a	111:b	140:
King Island Pump	b	16:b	17:	:d	24:	:b	47:	:bd	74:
Rindge Pump	b	18:a	22:a	22:b	23:	25:a	28:a	35:b	49:
Orwood Bridge		:	:	:b	25:	31:	:b	61:b	74:
East Contra Costa I.D.	b	12:a	12:a	14:a	15:	19:b	21:a	31:b	39:
Middle River P.O.	bd	13:a	15:b	18:a	22:a	27:a	34:b	57:b	79:
Mansion House	b	10:a	15:a	15:b	24:	26:	:a	25:b	66:
Stockton Country Club	b	22:a	24:	:b	25:e	26:a	29:a	9:b	44:
Clifton Court Ferry		:	:	:b	16:	18:a	19:b	27:b	34:
Stockton	b	76:b	82:	:ab	80:	:b	88:	:	:
Garwood Bridge		:	:	:	:	:	:	:	39:
Brandt Bridge		:	:	:	:	:	:	:	33:
Williams Bridge		:	:	:b	15:	15:b	16:b	20:b	30:
Whitehall		:	:	:	:	:	:	:	16:
Mossdale Bridge	b	8:a	12:a	11:b	10:	9:a	9:	:b	11:
Durham Ferry Bridge		8:	7:	10:	8:	:	8:	8:	8:
	Drainage Water Stations								
Jersey Drain	b	79:	141:	162:	130:	120:	92:b	177:b	180:
Grand Is.Dr.(Steamboat Sl.)	c	8:	:c	11:c	32:c	52:	:c	116:	:
Camp 35 Dr. (Staten Is.)	b	8:b	11:b	14:b	23:	28:	:c	55:	:
McDonald Drain		13:	15:	20:	23:	24:	30:	46:	55:
Bacon Island Drain		15:	18:	21:	29:	:	47:	75:	83:
Mandeville Drain	b	18:	19:	27:b	36:	44:	63:	83:b	115:
Camp 11,Dr. (Staten Is.)	b	8:b	8:b	12:b	19:b	24:	:c	42:	:

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	AUGUST							
	2	6	10	14	18	22	26	30
	San Francisco, San Pablo and Suisun Bays							
Point Orient	1820	1810	1860:b	1860	1840	1870:b	1840	1820
Point Davis	a 1760:a	1770	1770:b	1810:a	1690:a	1780:b	1810:a	1740
Bulls Head Point	e 1660	1610:b	1610:b	1570	1600	1640:b	1690	1560
Bay Point					a	1440:a	1540:a	1450
O and A Ferry	1240	1250:b	1320:b	1320	1300	1390:b	1380	1360
Innisfail Ferry	1180:a	1140:a	1260		1340	1400:a	1380	
	North San Pablo Bay							
Grandview	1820		1820		1800	a	1870	
Vallejo	1620	a	1660					
Cuttings Wharf	1680	a	1700		1570	a	1750	
	Sacramento River Delta							
Collinsville	1140	a	1190:a	1120:a	1180:a	1230:a	1240	1190
Mayberry		a	1010					
Emmaton	870	860:a	870:b	880	930:a	780:a	840:a	930
Three Mile Slough Bridge	a 680:a	760:b	760:b	790	790:b	670:a	840	780
Rio Vista Bridge	540	650:b	700:b	660	710:b	680:b	740	680
Junction Point	a 440:a	470:a	520:a	570:a	550:a	590:a	615:a	600
Liberty Ferry			b	390	ac	490:ab	520:ab	540
Isleton Bridge	420	440:b	510:b	545	b	595:b	635	460
Howard Ferry		380	b	480	500:a	485		460
Sutter Slough	de	260:a	235:b	320	a	225:b	155	120
Little Holland Ferry	198	230:a	235:a	220	300:a	225:b	250	120
Ryde	ab 280:ab	220:ab	230:ab	220:ab	160	a	150:a	80
R. D. 2068	86:a	122:a	137:a	190		a	175	100
Walnut Grove	160:b	180:b	200:b	220	120:b	126:b	120:c	38
Paintersville Bridge	122:b	144:b	139:b	110	63:b	59:b	28	11
Hood Ferry	13	12:a	8:a	8	10:a	11:a	10	10
Freeport Bridge	7:b	8:b	10:b	9	10:a	11:b	10	9
Sacramento	8:a	8:b	8:c	8:a	9:a	9:b	10	7
	Mokelumne River Delta							
Southwest Point	250:b	260	315	390	340	380	390	270
Camp 4, Staten Island	e	148	90	265	220	215	255	200
Camp 33, Staten Island	140:e	160	195	240	210	220	245	200
Camp 7, Staten Island	72:e	92	35	185	165	160	185	130

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	AUGUST (CONTINUED)							
	2	6	10	14	18	22	26	30
	Mokelumne River Delta (Continued)							
Tyler Island Ferry	e 100	155 a	175 ab	200	200 a	155 e	145 b	64
Camp 11, Staten Island	30	31	16	68	58	66	82	48
Camp 29, Staten Island	72	88	93	115	122	128	119	118
Eagle Tree	10	7	3	6	2	3	4	3
Camp 25, Staten Island	44	56	56	68	73	84	85	72
New Hope Bridge	3	3	1	2	1	1	1	1
Camp 20, Staten Island	23	22	17	23	26	26	26	17
	San Joaquin River Delta							
Antioch	1000	a	1050 a	1090	1160 a	1030 a	1100	1080
Curtis Landing	d	770 a	920 ab	1020	990 a	920 b	1060	
Jersey	720	a	700					
Webb Pump	d 460	505 a	520	600	540	600	670	560
Central Landing	280	270	390 a	300 a	340	425	415	350
Dutch Slough	ab	295 ade	300	ac	380			
Ward Landing	165	a	225 a	238	275 a	250 a	310	290
Holland Dam	b 132	143 a	165 b	220 a	220 a	240 b	315	270
Holland Pump	bd 116 a	74 b	180 b	180 a	200 a	240 b	250	230
McDonald Pump	155	140 ad	170	240	a	201	280	260
Mandeville Pump	d 158 a	190 a	220 b	265 a	230 a	280 b	320	300
King Island Pump	b	89	102		150	b	175	200
Rindge Pump	70 a	72 a	86 b	120	112 a	160 b	146	170
Orwood Bridge	82 b	100 b	123 b	144	154 b	182 b	215	200
East Contra Costa I.D.	45 a	54 a	71 b	105 a	102 a	116 b	129	134
Middle River P.O.	92 a	86 a	130 b	180	a	200 a	230	220
Mansion House	77 a	76 b	118	130	a	140 b	170	170
Stockton Country Club	45	53 a	60		a	84 a	97	102
Clifton Court Ferry	39 a	39	56 b	68 a	37 a	81 b	94	80
Stockton	89 b	97			b	106	a	104
Garwood Bridge	a	45 b	55 b	65 a	58 a	66 b	82	80
Brandt Bridge	38 a	35 a	39 a	43	37 a	38 a	34	40
Williams Bridge	31 b	43 b	52 b	58	68 b	84 b	94	100
Whitehall	18 af	16 b	19 b	21 a	24 a	29 b	28	28
Mossdale Bridge	9 a	10 b	10 b	9 a	9 a	10 b	9 b	6
Durham Ferry Bridge	7	8	8	8	9	9	7	6
	Drainage Water Stations							
Jersey Drain	325		125					
Grand Is.Dr.(Steamboat Sl.)	el 54 e	160 e	155 e	180 e	260 e	240 e	150 e	130
Camp 35 Dr.(Staten Is.)	43		e	66			85	80
McDonald Drain	64	87	78					
Bacon Island Drain	92	48	75	126	180	180	158	170
Mandeville Drain	130	171	180 b	210	240	215 b	220	180
Camp 11 Dr. (Staten Is.)	30		e	54			58	10

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	SEPTEMBER							
	2	6	10	14	18	22	26	30
	San Francisco, San Pablo and Suisun Bays							
Point Orient	1800	1820:b	1780	1800	1760	1800	:b	1790
Point Davis						1750	:a	1730
Bulls Head Point	1620	1660:b	1580	1620	1640:b	1600	1500	1550
Bay Point	1520	1500:a	1460	1520:ab	1440:a	1440	1420	1440
O and A Ferry	1320	1360:b	1360	1320	1320:b	1260	1150:b	1190
Innisfail Ferry	1360	1360:a	1340	1380:a	1380:a	1390	1390:b	1390
	North San Pablo Bay							
Grandview	1820	:a	1740		1820		1835	
Vallejo		:a	1680	:a	1700		1640	
Cuttings Wharf	1600	:a	1780		1800		1740	
	Sacramento River Delta							
Collinsville	:a 1220	:a 1200	:a 1180	1260:a	1120:a	960	1070:a	920
Emmaton	1000	955		970	:a	660	680:a	540
Three Mile Slough Bridge	:a 860	820:a	840	740:a	680:b	600	585:a	410
Rio Vista Bridge	740	700:b	640	680	400:b	545	520	
Junction Point	:a 620	:a 600	:a 430	600:a	310:a	440	435	
Liberty Ferry	:b 560	:ab 460	:ab 400:a	540	280:a	350	315:a	200
Isleton Bridge	560	480:b	440	460	230		42:b	198
Howard Ferry	:a 480	:a 210	:a 37	50	18:a	4		
Sutter Slough	:a 48	:b	12:a	7:a	5	:ab	4:a	4
Little Holland Ferry	:a 90:b	88		27:a	11:a	8	4:a	5
Ryde	:a 42	19	12	8:a	5:a	3:a	4:a	3
R. D. 2068	160	:a 150	:a 128		:a	280	238:a	270
Walnut Grove	28	:b	10	8			3	
Paintersville Bridge	:e 10:b	10:b	7	8:ab	4:b	3	4	
Hood Ferry	:a 9:a	9:a	7	:a	4:a	4	3:a	3
Freeport Bridge		:b	7	6:b	4:b	3	3	
Sacramento	:a 8:a	5:a	5:a	5:a	4:b	2:ab	3:a	3
	Mokelumne River Delta							
Southwest Point	380	:e 285	340	256:a	134:a	142:ab	105:a	70
Camp 4, Staten Island	210	200	230	166				
Camp 33, Staten Island	200	:e 160	230	156:a	116:a	98:ab	80:a	60
Camp 7, Staten Island	160	190	230	172:ab	130:ab	116:ac	104:ab	99
Tyler Island Ferry	36			8			3:a	3
Camp 11, Staten Island	82	96	118	134:ab	76:ab	100:ac	107:ab	91
Camp 29, Staten Island	152	146	182	166:a	148:a	132:ab	116:a	94

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	SEPTEMBER (CONTINUED)							
	2	6	10	14	18	22	26	30
	Mokelumne River Delta (Continued)							
Eagle Tree	4	41	26	48:ab	15:ab	20:ac	29:ab	33
Camp 25, Staten Island	96	94	146	164:a	136:a	130:ab	133:a	123
New Hope Bridge	1	1	6	23	:a	20:ab	21:a	21
Camp 20, Staten Island	31	49	79	117:a	91:a	98:ab	124:a	114
	San Joaquin River Delta							
Antioch	1160:a	1240:a	1100	1200	1170:a	980	940:a	870
Curtis Landing	1060	:a	910	1040	1060:a	930	860:a	760
Jersey	800	:a	800	910	:	:	690	:
Webb Pump	680:b	640:b	620	660	600	545	490	470
Central Landing	:a 310:a	320:a	250	212:a	180:a	295	178:a	110
Dutch Slough	:	:	:	510:a	440:a	485	450:b	408
Ward Landing	320:a	330:a	330:a	350:a	320:a	320	310:a	325
Holland Dam	:a	300	:f	330:ab	315:b	310:b	315:b	326
Holland Pump	:a	250	:f	270:ab	280:b	290:b	325:b	282
McDonald Pump	:ab 270:ab	280:ab	246:ab	305:ab	270:ab	290:b	290:b	263
Mandeville Pump	:a 325:a	330:a	350:a	350:a	340:a	345	340:a	315
King Island Pump	:	:	:	:	:b	261	230	235
Rindge Pump	:a 160:a	170:b	180:a	174:a	198:a	188	196:a	187
Orwood Bridge	230:c	230:b	230	246:b	250:b	255	260:b	253
East Contra Costa I.D.	:a 140:a	156:b	150:a	160:a	174:a	180:ab	174	:
Middle River P.O.	:e 210:a	240:a	250:a	240:a	262:a	255:ab	270:a	265
Mansion House	190:a	190:b	220:a	210:a	200:a	220	220:a	235
Stockton Country Club	:a 98:a	120	:a	122:a	110:a	118	:a	89
Clifton Court Ferry	94:a	110:b	100:a	128:a	130:a	130	130	:
Stockton	:	:	:a	132	:	:	114	:
Garwood Bridge	:a 80:ab	80:b	92	:a	46:b	70	69:a	10
Brandt Bridge	:a 27:a	14:a	10:a	8:a	7:a	7	8:a	8
Williams Bridge	118:b	80	:	96:a	60:b	50	42	:
Whitehall	:a 31:a	24:b	23:a	24:a	16:b	16	:a	12
Mossdale Bridge	:a 8:a	7:b	8:a	9:a	8:b	7:b	9:a	8
Durham Ferry Bridge	7	6	7	7	6	6	6	6
	Drainage Water Stations							
Jersey Drain	70	:	70	72	:	:	74	:
Grand Is.Dr.(Steamboat Sl.)	124	130	140	130	86	98	58	61
Camp 35 Dr. (Staten Is.)	30	9	17	16	13	13:c	91	109
Bacon Island Drain	110:f	110	160	180	150	118	124	125
Mandeville Drain	190	190	200	210	190	210	200	194
Camp 11 Dr. (Staten Is.)	8	6	6	8	9	18:c	23	75

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	OCTOBER 2	6	10	14	18	22	26	30
	San Francisco, San Pablo and Suisun Bays							
Point Orient	1800	1800	1800:b	1795	1780	1770	1765	1760
Point Davis		1760	1790:a	1690	1705	1700:ab	1655:a	1550
Bulls Head Point	1615	1600	1550	1510	1485	1475	1390	1455
Bay Point	a 1380:a	1300	1365	1410	1320	1315	1275	1190
O and A Ferry	1100	1095	1120:b	1140:a	995	1060	965	855
Innisfail Ferry	1380:a	1335	1300:a	1290	1230	1210	1240	1010
	North San Pablo Bay							
Grandview	1800		1835		1765		1750	
Vallejo	1620							
Cuttings Wharf	a 1790		1800		a 1745		ad1760	
	Sacramento River Delta							
Collinsville	950:a	880	880:a	830:a	710	725	800	560
Emmaton	e 450		:b	475	385	517	310:a	272
Three Mile Slough Bridge	545:a	417	457:a	375:a	425	435	225:a	227
Rio Vista Bridge	440:b	350	365:b	292		291	200	142
Junction Point	360:a	200	265:b	145	85	188	125	133
Liberty Ferry	acd190:c	212	151:b	156	111	120	75	68
Isleton Bridge	238:b	116	114	177	5	118	3	4
Howard Ferry	a 9			a	2		2	2
Sutter Slough	a 4:a	3	2					
Little Holland Ferry	6:a	4	:a	3:a	3		2	
Ryde	a 3							
R. D. 2068	a 180:a	188	158:a	148:a	108	154	192:a	134
Walnut Grove	3							
Paintersville Bridge	3							
Hood Ferry	a 4							
Freeport Bridge	3							
Sacramento	e 4:b	2:ab	1:a	2:a	2:ab	1:ab	1:a	1
	Mokelumne River Delta							
Southwest Point	a 76:a	111	90:b	76:a	76	62:a	24:a	20
Camp 33, Staten Island	a 61:a	70	66:b	43:a	38	37:a	22:a	16
Camp 7, Staten Island	ab 87:ab	91:b	78:a	71:a	63:b	59:ab	54:a	42
Tyler Island Ferry	3:a	3	2:b	1:a	2	1	2	2
Camp 11, Staten Island	ab 94:ab	86:b	82:a	77:a	72:b	69:ab	64:a	60
Camp 29, Staten Island	a 87:a	74	75:b	65:a	56	55:a	44:a	37
Eagle Tree	ab 36:ab	39:b	50:a	53:a	57:b	56:ab	55:a	57

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	OCTOBER (CONTINUED)							
	2	6	10	14	18	22	26	30
	Mokelumne River Delta (Continued)							
Camp 25, Staten Island	a 116	a 100	92 b	89 a	83	78 a	68 a	67
New Hope Bridge	a 22	a 30	50	37		b	64 a	45
Camp 20, Staten Island	a 116	a 114	110 b	104 a	102	96 a	91 a	89
	San Joaquin River Delta							
Antioch	945	a 820	875 a	785	760	725	690	610
Curtis Landing		a 695	705 b	635	660	660 ab	475 a	465
Jersey		a 600		a	430	532	435 a	390
Webb Pump	390	b 430	405	400	332	327	292 a	260
Central Landing	188		151 a	99 a	172	98	93 a	62
Dutch Slough	a 410	a 384 ab	387			348	337	323
Ward Landing	278	a 225	270 a	216 a	246	185	212	132
Holland Dam		a 328	305 bd	310 a	303	302	292	282
Holland Pump		a 292	290 bd	283 a	279	270	263	256
McDonald Pump		e 266 ad	269 e	219 e	197 e	215 e	201 e	187
Mandeville Pump	a 320	a 311	304	a	283	276	287 a	255
King Island Pump	220	a 216	224 a	230 b	223	200	199	191
Rindge Pump	e 172	a 187	183 b	155 a	141	130	133 a	106
Orwood Bridge	277	b 268	272 cd	254 b	259	244	235 d	232
East Contra Costa I.D.	a 180	a 187	199 b	189		200	197	
Middle River P.O.	a 260	a 268 ab	268 a	229 a	257	253 ab	215 a	232
Mansion House	a 236	a 240	237 b	220		234 ab	195	
Stockton Country Club	a 87	ac 91 ab	89 a	80		49		
Clifton Court Ferry	109	a 112	125 b	66 a	103	69	61	21
Stockton	130	b 76	74	b	84	89	73	51
Garwood Bridge		a 46	43 a	13 a	19	25	17 a	13
Brandt Bridge	a 9	a 8	8 a	8 a	8	8	8 a	8
Williams Bridge	a 21	b 19	24 b	11 c	11	8	8	11
Whitehall	a 11	a 12	8 b	8 b	8	8	8 a	9
Mossdale Bridge	a 8	a 8	8 b	8 a	7	8 ab	8 a	9
Durham Ferry Bridge	7	c 5 c	6 c	6 c	6	7	8	9
	Drainage Water Stations							
Jersey Drain		78			63	60	60	83
Grand Is.Dr.(Steamboat Sl.)		e 62 e	63 e	52 e	19 e	25	e	13
Camp 35 Dr. (Staten Is.)	b 119	b 112 b	99	93	80	91 b	59	59
Bacon Is.Drain	133	191	190	204	255	247	206	182
Mandeville Drain	195		196	187	188	186	191	187
Camp 11 Dr. (Staten Is.)	b 100	b 102 b	95	79	48	34 b	58	45

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	NOVEMBER							
	2	6	10	14	18	22	26	30
	San Francisco, San Pablo and Suisun Bays							
Point Orient	1755		1785	1761	1735	1780	1720	1770
Point Davis		1490	1590	1510	1515	1455	1470	1370
Bulls Head Point	1345	1300	1360	1385:a	1040	1010	1230	1080
Bay Point		ab1095:b	1155	1070:a	930	850	970	840
O and A Ferry	825	740	780	815	595	655	640	610
Innisfail Ferry		1030	945	935	985	1015:a	870	720
	North San Pablo Bay							
Grandview	a 1775		1740		1650		1690	
Cuttings Wharf	1640		1585		1500		a 1470	
	Sacramento River Delta							
Collinsville	a 520	510	590:a	525	455	380:a	255:a	282
Emmaton		253	289:a	253	163	85	153	100
Three Mile Slough Bridge	270:ab	202	231	246	113	84:a	44	75
Rio Vista Bridge	153	128	132	128	28	32	19	11
Junction Point	a 68		76:a	30	13	7	4	4
Liberty Ferry	66	57	39:a	29	21	10	10	10
Isleton Bridge	3	18	37	4	2	1	4	1
R. D. 2068	a 167	145	127		76	82		80
Sacramento	a 2	1:ab	2:a	1	1:ab	2:a	2:a	2
	Mokelumne River Delta							
Southwest Point	a 41	42:a	24:a	28	19	6:a	13:a	5
Camp 33, Staten Island	a 14	14:a	9:a	10	11	9:a	6:a	6
Camp 7, Staten Island	ab 38:ab	31:ab	30:ae	32:b	27:b	24:ab	23:ab	31
Camp 11, Staten Island	ab 59:ab	52:ab	49:ae	52:b	45:b	38:ab	41:ab	46
Camp 29, Staten Island	a 28	21:a	19:a	20	17	17:a	12:a	21
Eagle Tree	ab 60:ab	57:ab	57:ae	59:b	56:b	53:ab	53:ab	51
Camp 25, Staten Island	a 52	55:a	44:a	42	37	40:a	33:a	40
New Hope Bridge	a 48	48:ab	48:a	48	47	52	:a	32
Camp 20, Staten Island	a 85	78:a	75:a	72	62	62:a	53:a	57

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	NOVEMBER (CONTINUED)							
	2	6	10	14	18	22	26	30
	San Joaquin River Delta							
Antioch	560	485	560	535	430	333	375	
Curtis Landing	a 430	465	390 a	430	365 ab	215	305 a	215
Jersey	a 360				ab	245		
Webb Pump	221	216	235	185	169	132	128	109
Central Landing	a 76	71	45 a	73	15	72	74 a	18
Dutch Slough	a 290	282	280 a	247			a	185
Ward Landing	201	146	163 a	139	154	148	136	132
Holland Dam	a 267	261	253 a	241				
Holland Pump	a 253	241	229 a	217				
McDonald Pump	190 d	171 d	175 d	149	152	b	170	
Mandeville Pump	a 237	234	225 a	203	201	201	a	168
King Island Pump	172	151 ab	167	140	130 ab	143	123	114
Rindge Pump	a 76	106 a	107 a	84	82	88	74 a	57
Orwood Bridge	223	210	209	199	181 c	171	163	150
East Contra Costa I.D.	a 172	159	154 a	133		126 a	99 a	100
Middle River P.O.	a 221 ab	205	212 a	198	181 ab	172 a	168 a	153
Mansion House	a 170	185	184 a	188		114	a	120
Stockton Country Club					ab	25 a	26	
Clifton Court Ferry	a 12		a	15	28	18	13 a	11
Stockton		71	55	58	58		45	
Garwood Bridge	a 12	16	12 a	15	17	14 a	11 a	9
Brandt Bridge	a 9	10	12 a	9				
Williams Bridge	20	11	14	11	11	9	11	7
Whitehall	a 9	9	10					
Mossdale Bridge	a 11	10 d	10 a	9	8		8 a	10
	Drainage Water Stations							
Jersey Drain	68				b	94		
Grand Is.Dr.(Steamboat Sl.)	21	21	22	17		21	16	17
Camp 35 Dr. (Staten Is.)	b 54	b 61	b 53	e 54	b 51	50	b 62	46
Bacon Island Drain	175	168	160	96	111	96	68	63
Mandeville Drain	184	180	180	176	176	172		165
Camp 11 Dr. (Staten Is.)	b 74	b 62	b 64	e 59	b 73	60	b 51	48

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	DECEMBER							
	2	6	10	14	18	22	26	30
	San Francisco, San Pablo and Suisun Bays							
Point Orient	bd1750	1660	1820	1680	1660	1650	1680	1350
Point Davis	1390	1400a	1500	1320	1310	1415	a	385
Bulls Head Point	a 1020	1220	1235	975a	965	1235	1020	95
Bay Point	880	960		730a	690	950		45
O and A Ferry	500	480	460			635	20b	20
Innisfail Ferry	820b	700	750	775	690	665	480	290
	North San Pablo Bay							
Sonoma Creek Bridge				a 1385				
Grandview	1740		1660		1640		1300b	400
Vallejo	b 1270		1210			c	432	
Cuttings Wharf	a 1320		d 1400		1275		440	
	Sacramento River Delta							
Collinsville	290	320	370a	245	222	293	96	21
Emmaton	110		164	68	49d	88a	10a	4
Three Mile Slough Bridge	a 64	60						
Rio Vista Bridge	22	18	19	5	3	3	1	2
Junction Point	5							
Liberty Ferry		8						
Isleton Bridge	1	1						
R. D. 2068	54	72a	58					
Sacramento	1ab	1a	1a	2	3ab	1a	1	1
	Mokelumne River Delta							
Southwest Point	21	28e	63ae	11	16			
Camp 33, Staten Island	6	4						
Camp 7, Staten Island	b 16b	10						
Camp 11, Staten Island	b 30b	26	21a	42e	8			
Camp 29, Staten Island	11	7e	6ae	12	11	7		
Eagle Tree	b 48b	44						
Camp 25, Staten Island	38	24						
New Hope Bridge	30		44a	30	32	a	2	
Camp 20, Staten Island	51	43e	39ae	44	44	40		

a, b, c, d, e, f, See footnotes last page of this table.

TABLE 90 (CONTINUED)

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS, 1931
Samples taken by local observers approximately one and one-half hours after high high tide.
Salinity expressed in parts of chlorine per 100,000 parts of water.

Station	DECEMBER (CONTINUED)							
	2	6	10	14	18	22	26	30
	San Joaquin River Delta							
Antioch	268	300	390	250	220	273	113	34
Curtis Landing		237	239	173	164	161	104	
Jersey	150		a	98		134	82	
Webb Pump	b 102	94	92 a	91	76	66	57	
Central Landing	20	34 a	34	31	56	26 a	11	13
Dutch Slough		154 a	138		122	79		
Ward Landing	122	116	80 a	72	71		52	32
Holland Dam	160	167 a	155 a	147 ab	131	121 a	89	92
Holland Pump	177	150 a	137 a	123	99	96	86	58
McDonald Pump	e 84 e	146 de	140 e	117 e	104 e	97		
Mandeville Pump	165	150 a	144 a	134	129	116 a	97	61
King Island Pump		108	130		93	84	73	63
Rindge Pump	64	56	56 a	48	28	33 a	7	3
Orwood Bridge	130	128	119 b	82	72	72	63 a	29
East Contra Costa I.D.	86	82	70 a	62	54	51 a	43	31
Middle River P.O.	145 b	124	110 a	100	88	91	72	51
Mansion House	e 94 ab	98	99 a	98	128 a	53	13	16
Stockton Country Club		22 a	22 a	19		18 a	12	
Clifton Court Ferry	9	10	12 a	9	10	9	8	9
Stockton				ab	47 a	38	40	
Garwood Bridge	10	10						
Mossdale Bridge	11	6 a	8		7	8 a	8	2
	Drainage Water Stations							
Jersey Drain	77			96		90	83	
Grand Is.Dr.(Steamboat Sl.)	c 24 c	18	c	14		10 c	15	
Camp 35 Dr. (Staten Is.)	b 43	38	46	24	48			
Bacon Island Drain		42	33	53	60	45	50	49
Mandeville Drain	162	160	162	155	149	143	128	114
Camp 11 Dr. (Staten Is.)	b 55	56	50	29	63			

(a) Low high tide.
(b) Taken on following day
(c) Taken two days later.
(d) Over one hour off scheduled time.
(e) Taken on preceding day.
(f) Taken two days earlier.

CHAPTER VIII

LOSSES IN THE SACRAMENTO VALLEY AND DELTA DUE TO 1931 WATER SHORTAGE

At the close of the 1924 season and other past seasons when a water shortage has been experienced in the Sacramento-San Joaquin area, there has always been considerable inquiry as to the extent of losses which may have been sustained due to the water shortage and, in the case of the Delta, the resulting salinity. These questions could not be answered because no investigation had been made in any of those seasons to determine the losses, and approximations were difficult. Early in 1931, therefore, with all indications pointing to a serious water shortage, plans were made for an investigation and determination of the losses which it appeared would be inevitable. This investigation was conducted throughout the season and the results are presented in this chapter. The losses fall naturally under two classifications: those in the territory served by the Sacramento River above Sacramento and those in the Delta due to salinity; and they are so reported.

LOSSES IN THE SACRAMENTO RIVER AREA ABOVE SACRAMENTO

Losses directly chargeable to the water shortage in the area served by the Sacramento River above Sacramento may be classified as follows: (1) Crop Losses - under which fall losses due to (a) abandonment of preliminary work or of plans for planting because of threatened shortage, (b) changes from rice plantings to crops requiring less water (c) abandonment of crops because of water shortage and (d) reduced yields because of insufficient water; (2) Losses represented by expenditures required to rearrange and lower pumping installations, (3) Losses due to the increased cost of pumping under greater lifts.

Crop Losses

In the investigation of these losses, great difficulty was encountered in obtaining definite data. It may have been very evident that a loss under one or more of the classifications outlined had been sustained but the water user was either reluctant or unable to place an estimate upon it. Also, where estimates were obtained, it was found impracticable to segregate them to the definite classifications given. Although a representative of practically every diversion on the river was interviewed, and in the larger districts many of the individual water users were canvassed, the total of the definite figures obtained for crop losses was $6620.

Additional Expenditures for Lowering and Changing Pump Installations

On many sections of the river in 1931 the water receded to record low levels and many pump owners found that such levels had apparently not been anticipated when their pumps were installed. In frequent instances the water fell below the suction pipes or the suction lift was so greatly increased that the pump would not operated. This necessitated expenditures to lengthen the suction pipes and lower the pumps. Various other pumping plant repairs incident to the low river levels were also required. All of the river plants were included in the investigation of these expenditures and the total reported to have been spent was $7425.

Increased Pumping Costs

In order to determine the increase in 1931 pumping costs due to the low river levels, the pumping lifts of 1931 were compared to those of 1927. The seasonal stream flow of the Sacramento River at

TABLE 91

COSTS OF PUMPING THE DIVERSIONS OF 1931 IN EXCESS OF THE COSTS FOR PUMPING THE SAME DIVERSIONS WITH 1927 RIVER STAGES.
SACRAMENTO RIVER, RED BLUFF TO SACRAMENTO

MONTH	AVERAGE AMOUNT RIVER WAS LOWER IN 1931 THAN IN 1927 — FEET	1931 DIVERSIONS ACRE-FEET	COSTS OF 1931 PUMPING IN EXCESS OF COSTS FOR PUMPING THE 1931 DIVERSIONS WITH 1927 RIVER STAGES — DOLLARS
RED BLUFF TO BUTTE CITY			
APRIL	8	83268	14000
MAY	5	110128	5890
JUNE	2	91596	3010
JULY	2	105271	1920
AUGUST	1	92878	1510
SEPTEMBER	1	43005	40
OCTOBER	1	18015	1110
TOTAL		544161	27480
BUTTE CITY TO COLUSA			
APRIL	18	14700	2150
MAY	10	19836	1100
JUNE	7	17800	1200
JULY	5	19499	830
AUGUST	5	12324	620
SEPTEMBER	3	3790	150
OCTOBER	3	1438	100
TOTAL		89387	6150
COLUSA TO KNIGHTS LANDING			
APRIL	19	80989	20700
MAY	14	74677	11600
JUNE	9	68530	7220
JULY	5	63270	6400
AUGUST	3	53283	2850
SEPTEMBER	2	24494	0
OCTOBER	2	6847	110
TOTAL		372090	48880
KNIGHTS LANDING TO VERONA			
APRIL	18	4371	1060
MAY	16	3978	860
JUNE	10	3964	740
JULY	6	4014	390
AUGUST	3	3020	220
SEPTEMBER	4	1021	90
OCTOBER	3	531	160
TOTAL		20899	3520
VERONA TO SACRAMENTO			
APRIL	17	20326	6910
MAY	14	26938	5700
JUNE	10	24147	2670
JULY	4	28380	810
AUGUST	3	25920	580
SEPTEMBER	3	7946	220
OCTOBER	2	2718	10
TOTAL		136375	16900
TOTAL — RED BLUFF TO SACRAMENTO			
APRIL		203654	44820
MAY		235557	25150
JUNE		206037	14840
JULY		220434	10350
AUGUST		187425	5780
SEPTEMBER		80256	500
OCTOBER		29549	1490
TOTAL		1162912	102930

Red Bluff in 1927 exceeded the mean for the forty-year period 1889-1929 by seventeen per cent. It was considered, therefore, that the departure of the 1931 river levels from those of 1927 would furnish a fair basis for the computation of increased pumping costs in 1931 chargeable to the water shortage and low river levels of that season. A comparison of the minimum river levels of 1927 and 1931, Sacramento to Red Bluff, is shown on Plate 1, Chapter II.

The monthly records of kilowatt hours consumed in 1931 were available for each pumping plant and from these the 1931 pumping costs were derived by application of the appropriate rate schedule. The power that would have been required to pump the 1931 diversions under the pumping heads of 1927 was then computed and the rate schedule applied to derive the comparative 1927 costs. The resulting figures for the difference between the 1927 and 1931 costs are given in Table 91. This shows that from Red Bluff to Sacramento the total increased cost of pumping chargeable to the 1931 water shortage and low river levels was $102,930.

Other Probable Losses

The losses that have been enumerated total $117,000 but this figure probably represents the very minimum of the direct losses and takes no account of other less tangible losses. Instances of the latter were evident throughout the course of the investigation but it was not possible to define them in terms of money. In general, however, such losses were represented by the many and varied additional activities and expenditures required to meet the conditions of curtailed water supplies and to effectively enforce conservation and waste prevention measures.

LOSSES IN THE SACRAMENTO-SAN JOAQUIN DELTA DUE TO ENCROACHMENT OF SALINITY FROM SAN FRANCISCO BAY

Outline of Investigation

Since the beginning of salinity observations in the Sacramento-San Joaquin Delta it has been recognized that in years of deficient Spring and Summer stream flow to the Delta, the resulting extensive encroachment of salinity from San Francisco Bay has caused damage in the Delta. In 1930, 1924, and 1926, but particularly in 1924, the magnitude of the encroachment was such as to leave no doubt that damage must have been sustained. But just what the extent of the damage or the total of crop and other losses might have been, was not determined. In the Spring of 1931 it was plainly evident that the stream flow to the Delta would probably be as low if not lower than it was in 1924 and that a salinity encroachment as great if not greater than in that year could be expected. With this expectation, therefore, the investigation to determine the losses in the Delta due to salinity or to at least derive an approximate definition of the relation between salinity encroachment and losses, was planned as the major activity of the loss investigations.

Procedure and Field Methods

As described in Chapter VI, an engineer is detailed each season to obtain a complete Delta census of the irrigated and non-irrigated crops, and the acreages of aquatic growths, weeds, bare lands, water surfaces, etc., and it was considered that the additional Delta investigation of losses in 1931 could be most advantageously handled as a part of the same detail. Much more time was going to be required,

however, and accordingly beginning in July, an additional assistant was assigned, to devote his entire time to the Delta census and investigation of losses.

At the outset it was recognized that crop losses would represent the greatest item of damage and perhaps the only one possible of definite valuation. Forms, to be used in the field, covering every item with respect to crops which might conceivably be needed in the valuation of crop losses, were, therefore, prepared and used. No fixed forms for reporting items of loss other than those connected with crops were used and such other items were reported only in a general way or by special report. The first field form provided for a detailed report of acreage, irrigation methods, dates of planting and harvest, production, unit value, total value, and record of the dates of irrigation, for each crop. The irrigation record was particularly important for use in conjunction with maps prepared later from which the degree of salinity at a given location for any particular time could be determined. A second form was used in reporting the data with respect to losses. If a loss were reported for any item of the first form, detail data with respect to this item were entered on the second form, such as, the date irrigation was stopped because of high salinity or the dates when water of greater than 100 parts chlorine was used, the effect on growth and yield of use of water of high salinity or of curtailment of irrigation, the loss in production and its value, acreage abandoned or not planted on account of high salinity and the amount of this loss, etc. The investigation required that these two forms be filled in from data obtained by actual contact with the owners, lessees or water users and/or by the engineer's own field observations,

for each individual subdivision of every island or tract in the Delta.

Instructions to Field Men

The field men were instructed, insofar as possible, to obtain all data by direct observation and not from hearsay. Information from landowners although essential was to be considered more or less supplemental, especially in connection with such items as crop growth, damage and yield. Estimates from owners and growers were to be carefully checked and substantiated insofar as possible. Detail observations were to be made of crop growth and all conditions affecting it, with particular attention to be paid to the comparative growth, as between areas of high and low salinity, of like crops under conditions otherwise similar. Especial emphasis was placed upon the necessity for observation and recognition of factors other than salinity such as insects, poor farming, sunburn, etc., likely to affect crop growth and yield.

Segregation of Losses

This report of losses in the Sacramento-San Joaquin Delta due to salinity in the 1931 season falls into two major segregations, "Crop Losses" and "Other Losses". Crop Losses may be further segregated to what might be called "Tangible" and "Intangible" losses. Under tangible losses is classed the actual loss in production of crops in 1931 due to (1) the curtailment of irrigation when the salinity of the irrigation water became too high, (2) the actual application of irrigation water of too high salinity, and (3) the abandonment of a crop, or plans for it, because of high salinity. The classification of intangible losses will be considered subsequently.

Tangible Crop Losses

To arrive at the tangible losses as outlined, all of the data of the field forms were thoroughly reviewed, summarized by islands and crops and compiled as shown in Table 92. Under the three classifications of tangible crop losses, this table shows, segregated by crops, the total losses, in production and money. It is to be noted that the estimates of loss in money represent the market value of the lost production and as such might be termed the gross loss as distinguished from net loss represented by the net profit which the grower might have realized had he been able to market the crops lost. As shown by Table 92, the market value of the Delta crops estimated to have been lost because of salinity in 1931 totals $1,263,716. Of this amount, $890,906, or 70 per cent of the total, is the loss estimated to have resulted from curtailment of irrigation, $357,640 or 29 per cent, the loss due to actual application and use of water of too high salinity and $15,170 or one per cent, the loss due to destruction of permament plantings and to abandonment of crops or plans therefor because of high salinity.

Detail Check of Reported Losses

In the review of the losses reported for each of the individual subdivisions all estimates were carefully checked by comparison with average figures for production and unit prices throughout the Delta, and if it appeared that the estimated loss in production had been based upon a total production expectancy out of proportion to the average or normal figures, the estimates of loss were correspondingly reduced. In addition, the degree of salinity corresponding to the reported

TABLE 92

SUMMARY, BY CROPS, OF 1931 CROP LOSS IN THE SACRAMENTO-SAN JOAQUIN DELTA DUE TO SALINITY. LOSS EXPRESSED IN PRODUCTION AND DOLLARS

CROP	LOSS EXPRESSED IN PRODUCTION – P MARKET VALUE $	ESTIMATED LOSS DUE TO			TOTAL LOSS IN DOLLARS
		CURTAILMENT OF IRRIGATION	USE OF WATER OF TOO HIGH SALINITY	DESTRUCTION OR ABANDONMENT OF PLANTINGS	
ALFALFA	P $	9135 TONS 90460	400 TONS 4000	347 ACRES 5400	99860
ASPARAGUS	P $	275 TONS 16515		149 ACRES 3100	19615
BEANS	P $	53377 SACKS 171078	620 SACKS 1508		172586
BEETS	P $	22957 TONS 150920	820 TONS 6150		157070
CELERY	P $	325 CARS 80945	618 CARS 255626		336571
CORN	P $	4503 TONS 95330	886 TONS 18175	318 ACRES 4660	118165
FRUIT	P $	315 TONS 9300	8 TONS 400	2 ACRES 500	10200
GRAIN HAY	P $	356 TONS 3560			3560
ONIONS	P $	20720 SACKS 29710			29710
PASTURE	P $	1116 ACRES 2380	205 ACRES 100	280 ACRES 660	3140
POTATOES	P $	306200 SACKS 220500	70800 SACKS 54821		275321
SEED	P $	181 ACRES 3530	*13700 SACKS 10200		13730
TRUCK	P $	** 16678	252 TONS 6660	34 ACRES 850	24188
TOTAL LOSS IN DOLLARS		890906	357640	15170	1263716

* POTATOES.

** USE OF BOTH TON AND ACREAGE UNITS PRECLUDES TOTAL.

irrigation period was checked to determine whether or not the reported loss might reasonably be assumed to have resulted from salinity or from other causes, and to define where possible, the degree of salinity causing damage to various crops under different conditions. The check of the salinity at the various Delta tracts for different times and periods of the season was accomplished by using maps similar to those shown on Plate 7 (Chapter VII) but to a larger scale. As a result of the detailed check of all figures as outlined, it is considered that the total of the tangible crop losses as shown by Table 92 represents a conservative estimate.

Comparison of Crop Losses and Total Production Value

Table 93 shows the estimated value of the actual 1931 irrigated crop production, segregated by crops, and indicates a total for the Delta of $22,657,663. In the compilation of the actual production and its value, the data on the field forms were not always complete and it was necessary in frequent instances to partially estimate either production, or the unit price to apply to the given production. This was done by comparison with known data for similar crops in adjoining tracts, due consideration being given to any modifying factors noted in the reports or known to exist.

For reasons explained later it was desirable in this compilation to make a segregation with respect to the Delta area within the limits of the maximum encroachment during the season of salinity of 100 parts of chlorine per 100,000 parts of water, and this segre-

TABLE 93

SUMMARY, BY CROPS, OF IRRIGATED ACREAGE, VALUE OF ACTUAL PRODUCTION, AND CROP LOSS DUE TO SALINITY, FOR TOTAL SACRAMENTO-SAN JOAQUIN DELTA AREA AND AREA WITHIN 100 PART SALINITY ENCROACHMENT, 1931

LOSS EXPRESSED IN DOLLARS AND IN PER CENT OF VALUE OF TOTAL PRODUCTION (INCLUDING LOST PRODUCTION) IN (1) TOTAL DELTA AREA AND (2) AREA WITHIN 100 PART SALINITY ENCROACHMENT

CROP	ENTIRE DELTA			AREA WITHIN 100 PART SALINITY ENCROACHMENT		CROP LOSS IN PER CENT OF VALUE OF TOTAL IRRIGATED CROP PRODUCTION**	
	IRRIGATED ACREAGE	VALUE OF ACTUAL PRODUCTION IN DOLLARS	* CROP LOSS DUE TO SALINITY IN DOLLARS	IRRIGATED ACREAGE	VALUE OF ACTUAL PRODUCTION IN DOLLARS	WITHIN AREA OF 100 PRT. SALINITY ENCROACHMENT	ENTIRE DELTA
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ALFALFA	26882	1352621	99860	12651	542711	15.54	6.88
ASPARAGUS	70580	7254899	19615	55549	5695349	0.34	0.27
BEANS	26992	775794	172586	14296	404286	29.92	19.21
BEETS	30915	3128314	157070	17362	1820595	7.94	4.78
CELERY	6303	1640043	336571	6125	1564193	17.71	17.03
CORN	55798	1360921	118165	50081	1224840	8.80	7.99
FRUIT	10775	1364724	10200	7075	1011006	1.00	0.74
GRAIN & HAY	65086	900034	3560	46126	616338	0.57	0.39
ONIONS	3769	982244	29710	2068	512778	5.48	2.94
PASTURE	12748	66284	3140	10254	50614	5.84	4.52
POTATOES	18042	2802585	275321	17747	2788710	8.99	8.94
SEED	8967	499188	13730	3547	150666	8.35	2.68
TRUCK	6498	530012	24188	2110	199316	10.82	4.36
TOTALS	343355	22657663	1263716	244991	16581402	7.08	5.28

* PRACTICALLY ALL WITHIN AREA OF 100 PART SALINITY ENCROACHMENT (SEE PLATE 13).
** INCLUDING VALUE OF LOST PRODUCTION.

gation is shown in Table 93. For each crop, this table shows for the total Delta area and for the area within the 100 part salinity encroachment, the acreage irrigated and the estimated value of the actual production. It shows also, for each crop, the estimated total loss due to salinity, in dollars and in per cent of the total value of production (1) in the area within the 100 part salinity encroachment, and (2) in the total Delta area. It should be noted that the total value or production used in deriving these percentages is the value of the actual production plus the value of the production estimated to have been lost. In the case of the percentage of total production value for the area within the 100 part salinity encroachment, the assumption was made that the total Delta loss in production, as given, occurred entirely within this area, and as shown by Plate 13 and later consideration, this assumption is essentially correct. From Table 93, then, it is seen that the tangible crop losses in 1931 amounted to 5.28 per cent of the total value of the Delta's irrigated crops or 7.08 per cent of the value of the irrigated crops within the area of 100 part salinity encroachment.

Intangible Crop Losses

As to the crop losses termed herein as intangible, it is only possible to outline their character. These are losses which the field evidence and analysis would indicate must surely have been sustained or may yet be suffered but for which the data are insufficient to form any definite estimate. Probably the most important loss of this character is that to be expected due to the effects of 1931 salinity on the crops of 1932 and even subsequent years. Because of high

salinity considerable acreages supporting permanent crops such as fruit, asparagus, etc., were not irrigated when they should have been. As a result it is claimed that buds were not properly formed for next year's crop in the case of fruit and the proper development to produce the desired quantity and quality of next season's spears was retarded in the case of asparagus, etc. Normally, considerable grain land is flooded in the Fall preparatory to planting. This was prevented by high salinity in the Fall of 1931 and may effect the yields of 1932. Perhaps as serious as the effects of non-irrigation in 1931 may be the reduction in future yields of all crops due to impregnation of the soil with water of high salinity and the deposits of salt. Where flooding and drainage facilities are at hand to flush the soil after Winter stream flow has caused the salinity to recede, this may be overcome. In the case of early season crops in the lower Delta, however, and where the flushing cannot readily be accomplished the accumulated salt will remain as a source of considerable damage to future yields. As a minor loss, perhaps, the probable reduction in 1932 yields because certain peat lands could not be burned over in the Fall of 1931, has been noted. It is the practice on some peat areas to burn off two inches or so of the surface to kill nematodes and other pests and this has resulted in greatly increased yields in the following season. To extinguish the fires the island or tract is flooded through the irrigation system or by opening flood gates in the levees. Because of the high salinity of the water in the Fall of 1931 it was not advisable to use the water for this purpose, entailing the danger of depositing salt on the land, and the burning operations were accordingly foregone.

In some of the asparagus and other areas where interplanting

is generally practiced, it was claimed as a loss due to salinity, that it was necessary to refrain from interplanting in 1931. Although the asparagus or the permanent crop might survive successfully the non-irrigation because of high salinity, the grower feared to risk the planting and necessary irrigation of the intercrop.

Other Than Crop Losses

Of the items of 1931 damage from salinity, other than to crops, noted but not defined, may be mentioned: The killing in some areas of the willows which form bank protection along the levees. With this protection gone the banks are subject to damage from wave action, etc. Damage in the nature of extra expenditures required to obtain fresh water supplies by drilling wells, buying water, etc. A great many instances were noted where the growers put down new wells and utilized this source of water for irrigation during the period of high salinity. In some cases the well water was used to dilute the channel supply. Expenditures for new or supplemental domestic and municipal water supplies were required. Dairymen were obliged to obtain fresher water for their stock to drink. In a case noted where the cows had been drinking water from the channel, the dairyman was notified that his percentage of milk solids had dropped below the permissible amount. He was advised by a chemist that the drinking of saline water would cause the milk solids to decrease, and immediately put down wells to supply the dairy with water. Within a week the reports indicated that the milk had returned to standard specifications. Numerous instances were reported of sickness of all kinds of stock due to the drinking of water of too high salinity and in most cases it

was necessary to resort to the use of well water to remedy the conditions.

ESTIMATE OF PAST CROP LOSSES DUE TO SALINITY

It has been stated that no comprehensive investigation of Delta losses due to salinity in years previous to 1931 was ever made. However, with the data of 1931 and the complete salinity and crop data for all years beginning with 1924 available, it appeared that reasonably correct estimates of the losses in these past years might be possible, and the remainder of this chapter gives the results of a study which was made to derive these estimates for the years 1924 to 1930.

Method and Assumptions in Estimating Past Losses

Briefly stated, the method followed to estimate the crop losses due to salinity in past years, was to apply the 1931 relation between losses and total production value within the area of 100 part salinity encroachment to the corresponding total production value in past years. This application involved the assumptions, first, that the area, crop acreage and corresponding production value within the area of 100 part salinity encroachment can be taken as proportionate to, or as close indices of the losses due to salinity, second, that in each past year the loss for each crop in per cent of the total value of its production within the area of 100 part salinity encroachment would have been the same as in 1931 and, third, that the value of production per acre for each crop would have been uniform throughout the Delta had there been no loss due to salinity.

Area Within 100 Part Salinity Encroachment as Crop Loss Index

The facts in support of the first assumption were brought

out when, in comparing the 1931 position of various degrees of salinity at different periods of the season with the Delta area in which salinity losses were reported, it was found that as far as areas are concerned, probably the best index of crop losses due to salinity is the area or irrigated acreage within the maximum seasonal encroachment of 100 parts of salinity. This is well shown by the close approach to coincidence of the two limits shown on Plate 13. The heavy dotted line is the limit of the 100 part salinity encroachment into the Delta in 1931 and the heavy solid line is the limit or boundary of the area in which crop losses due to salinity were reported in 1931. As indicated by this plate, the Delta area within 100 part salinity encroachment may practically be taken as the area within which crop losses due to salinity are confined.

Equation for Deriving Past Losses

Under the second assumption of the method outlined for the estimate of losses in past years, the percentages of Column 7, Table 93 were to be applied to the production value within the area of 100 part salinity encroachment for each past year to derive the loss for that year by each crop. It was required therefore to obtain for past years the best possible estimates of the value of the actual crop production within the area of 100 part salinity encroachment. Investigation proved that it would be very difficult to obtain these data but, as later outlined, it was found that satisfactory estimates of the value of the actual production in the entire Delta could be derived for the years 1924 to 1930, inclusive. It then became essential to establish the relation between these data and the production values

within the area of 100 part salinity encroachment in order that the percentages of Column 7, Table 93 might still be applied to derive the losses. The ratio, for each crop, of the acreage within the area of 100 part salinity encroachment to the acreage in the entire Delta, was needed. The acreage data for the entire Delta were available from the Water Supervisor reports and it was possible from large scale maps showing, similar to Plate 6 (Chapter VII), the position of the 100 part salinity encroachment each year 1924 to 1931, and from the detail crop data in the Water Supervisor reports for the same period, to tabulate for each irrigated crop and for each year, the acreage within the 100 part line. These data are shown in Table 94. With the ratios thus established and using the third assumption that production value per acre for each crop would be the same throughout the Delta if there were no loss due to salinity, it can be shown that the value of the actual production within the area of 100 part salinity is derived from the following equation:

$$V_s = V\frac{A_s}{A} - L + L\frac{A_s}{A} \qquad (I)$$

where V_s = Value of actual production within area of 100 part salinity

V = Value of actual production in entire Delta

A = Acreage of crop in entire Delta

A_s = Acreage of crop within area of 100 part salinity

L = Crop loss due to salinity - Assumed to be all in area A_s

But according to the loss computation method adopted and the second assumption:

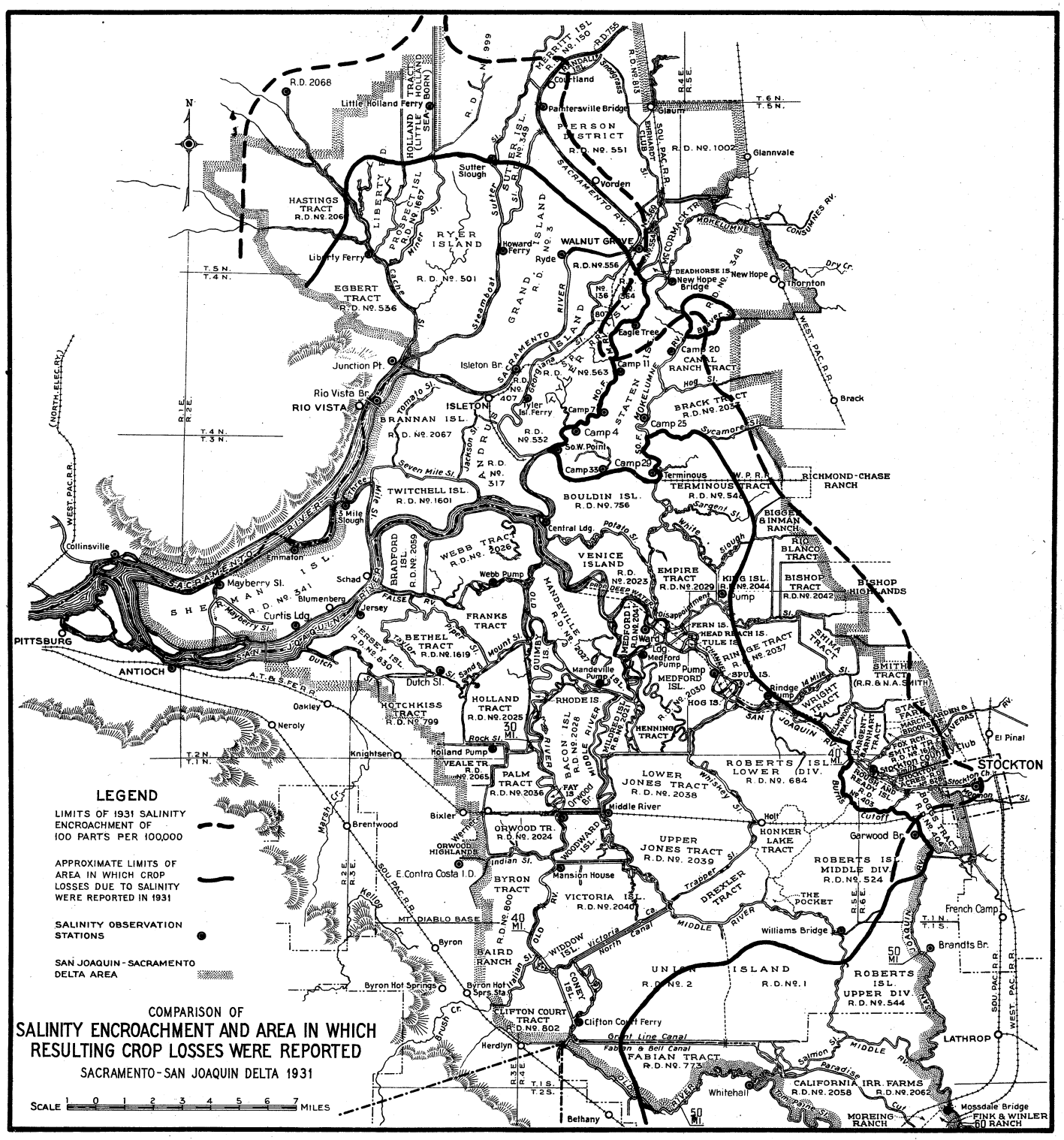

LEGEND
LIMITS OF 1931 SALINITY ENCROACHMENT OF 100 PARTS PER 100,000
APPROXIMATE LIMITS OF AREA IN WHICH CROP LOSSES DUE TO SALINITY WERE REPORTED IN 1931
SALINITY OBSERVATION STATIONS
SAN JOAQUIN-SACRAMENTO DELTA AREA
COMPARISON OF
SALINITY ENCROACHMENT AND AREA IN WHICH RESULTING CROP LOSSES WERE REPORTED
SACRAMENTO-SAN JOAQUIN DELTA 1931
SCALE 0 1 2 3 4 5 6 7 MILES
PITTSBURG
ANTIOCH
STOCKTON
RIO VISTA
ISLETON
WALNUT GROVE
Courtland
Pantersville Bridge
Vorden
Glanvale
Sutter Slough
Howard Ferry
Ryde
Liberty Ferry
Little Holland Ferry
Junction Pt
Isleton Br
Rio Vista Br
Collinsville
Emmaton
Mayberry Sl.
Schad
Blumenberg
Jersey
Curtis Ldg
Dutch Sl.
Oakley
Neroly
Knightsen
Brentwood
Bixler
Holland Pump
Middle River
Mansion House
Byron
Byron Hot Springs
Clifton Court Ferry
Herdlyn
Belhany
Whitehall
Williams Bridge
Garwood Br.
Holt
Brandts Br.
French Camp
LATHROP
Mossdale Bridge
Brack
Thornton
New Hope
Eagle Tree
Camp 20
Camp 11
Camp 7
Camp 4
So.W. Point
Camp 33
Camp 29
Camp 25
Terminous
Central Ldg
Webb Pump
Mandeville Pump
Medford Pump
Rindge Pump
Fay Is.
Orwood Br.
Tyler Isl. Ferry
Dutch Sl.
Sand Sl.
Rock Sl.
Mount Sl.
Taylor Sl.
Jackson Sl.
Seven Mile Sl.
Potato Sl.
Sycamore Sl.
Sargent Sl.
Hog Sl.
Steamboat Sl.
Sutter Sl.
Cache Sl.
Tonato Sl.
Georgiana Sl.
Indian Sl.
Trapper Sl.
Salmon Sl.
Paradise Cut
Victoria Canal
North Canal
Great Line Canal
Fabian & Bell Canal
Old River
Middle River
Whiskey Sl.
Dutch Sl.
Kellogg Cr.
Marsh Cr.
Brush Cr.
Mokelumne R.
Cosumnes R.
Dry Cr.
Sacramento R.
San Joaquin R.
Sacramento Ship Channel
Stockton Ch.
Stockton Sl.
Rindge Pump
14 Mile Sl.
Cutoff
Bypass
Paradise Cut

TABLE 94

DETAIL, BY CROPS, OF IRRIGATED ACREAGE, ESTIMATED VALUE OF ACTUAL PRODUCTION AND ESTIMATED LOSS DUE TO SALINITY, SACRAMENTO-SAN JOAQUIN DELTA, 1924-1931

CROP	IRRIGATED ACREAGE: ENTIRE DELTA	IRRIGATED ACREAGE: WITHIN 100 PART SALINITY ENCROACHMENT	ESTIMATED VALUE OF ACTUAL PRODUCTION IN ENTIRE DELTA	ESTIMATED CROP LOSS DUE TO SALINITY IN DOLLARS
1924				
ALFALFA	31034	3105	2917200	46000
ASPARAGUS	54129	32219	3783800	7700
BEANS	36459	14162	2296000	301200
BEETS	21375	4665	1974200	34800
CELERY	4065	2901	1336500	193500
CORN	27392	18627	1023400	65300
FRUIT	16180	1574	5346000	5200
GRAIN AND HAY	92362	54489	4271300	14400
ONIONS	3886	2568	835800	31400
PASTURE	1035	572	5200	200
POTATOES	27872	21335	5058700	373300
SEED	930	40	129300	500
TRUCK	4021	560	804200	12300
TOTALS	320740	156817	29781600	1085800
1925				
ALFALFA	26011	390	1927900	4500
ASPARAGUS	51974	3560	3944900	900
BEANS	37590	0	2892400	0
BEETS	16685	690	883100	2900
CELERY	5330	40	1879200	2500
CORN	24029	200	944000	700
FRUIT	12772	0	3652800	0
GRAIN AND HAY	84307	3400	2185500	500
ONIONS	5989	0	2050000	0
PASTURE	5273	660	26400	200
POTATOES	22071	0	8475000	0
SEED	3459	0	418500	0
TRUCK	4737	0	829000	0
TOTALS	300227	8940	30108700	12200
1926				
ALFALFA	26108	1910	1631800	18800
ASPARAGUS	55601	16358	4016100	4000
BEANS	51802	5136	2921500	89100
BEETS	7936	1100	841800	9400
CELERY	7392	1585	2835000	112300
CORN	23955	4581	766500	13100
FRUIT	17771	685	3731900	1400
GRAIN AND HAY	77319	14052	1567400	1600
ONIONS	5810	310	1142900	3300
PASTURE	4161	1650	20800	500
POTATOES	21503	2948	5463900	68300
SEED	2883	293	320000	2700
TRUCK	6471	1252	1035400	22200
TOTALS	308712	51860	26295000	346700
1927				
ALFALFA	26348	180	1678400	1800
ASPARAGUS	47897	2100	5182400	800
BEANS	47678	60	1931000	700
BEETS	14527	144	1289900	1000
CELERY	7888	0	3443000	0
CORN	26944	300	972000	1000
FRUIT	17261	0	4660500	0
GRAIN AND HAY	75774	1594	1926900	200
ONIONS	4340	0	1367100	0
PASTURE	2736	0	13700	0
POTATOES	28422	0	6476000	0
SEED	3526	0	416000	0
TRUCK	3590	0	610300	0
TOTALS	306931	4378	29967200	5500

TABLE 94 (CONTINUED)

DETAIL, BY CROPS, OF IRRIGATED ACREAGE, ESTIMATED VALUE OF ACTUAL PRODUCTION AND ESTIMATED LOSS DUE TO SALINITY, SACRAMENTO-SAN JOAQUIN DELTA, 1924-1931

CROP	IRRIGATED ACREAGE		ESTIMATED VALUE OF ACTUAL PRODUCTION IN ENTIRE DELTA	ESTIMATED CROP LOSS DUE TO SALINITY IN DOLLARS
	ENTIRE DELTA	WITHIN 100 PART SALINITY ENCROACH-MENT		
1928				
ALFALFA	26783	458	1968600	5300
ASPARAGUS	53971	7618	6773100	3300
BEANS	38429	332	2550100	6600
BEETS	14722	2808	1882400	28900
CELERY	7813	0	1148700	0
CORN	40268	2100	1452700	6700
FRUIT	15763	150	3546700	300
GRAIN AND HAY	72038	1670	1744600	200
ONIONS	3668	0	1371100	0
PASTURE	6284	575	31400	200
POTATOES	24914	316	3014600	3400
SEED	6453	7	671100	100
TRUCK	5909	475	886400	7800
TOTALS	317015	16509	27041500	62800
1929				
ALFALFA	27158	911	2216100	11600
ASPARAGUS	62044	10086	6456600	3600
BEANS	32315	250	1978600	4600
BEETS	21553	1619	2109500	12700
CELERY	8721	190	2043300	7900
CORN	40855	2345	1473800	7500
FRUIT	14935	75	4122100	200
GRAIN AND HAY	76100	3014	1777600	400
ONIONS	4159	0	998200	0
PASTURE	2746	2050	13700	600
POTATOES	18046	170	5887500	5000
SEED	9515	5	1056200	0
TRUCK	7678	60	1228500	1000
TOTALS	325825	20775	31361700	55100
1930				
ALFALFA	26930	480	1504300	4200
ASPARAGUS	70269	9392	7173700	3200
BEANS	29166	270	1249600	3500
BEETS	24058	468	2259000	3500
CELERY	5969	30	975800	900
CORN	54533	1500	1715000	4200
FRUIT	14504	70	2101600	100
GRAIN AND HAY	72932	1272	1789700	200
ONIONS	4341	0	873800	0
PASTURES	7686	0	38400	0
POTATOES	18839	75	4700400	1700
SEED	5352	0	545900	0
TRUCK	15334	0	2223400	0
TOTALS	349913	13557	27230600	21500
1931				
ALFALFA	26882	12651	1352621	99860
ASPARAGUS	70580	55549	7254899	19615
BEANS	26992	14296	775794	172586
BEETS	30915	17362	3128314	157070
CELERY	6303	6125	1640043	336571
CORN	55798	50081	1360921	118165
FRUIT	10775	7075	1364724	10200
GRAIN AND HAY	65086	46126	900034	3560
ONIONS	3769	2068	982244	29710
PASTURE	12748	10254	66284	3140
POTATOES	18042	17747	2802585	275321
SEED	8967	3547	499188	13730
TRUCK	6498	2110	530012	24188
TOTALS	343355	244991	22657663	1263716

$$L = p\ (V_s + L) \qquad \text{(II)}$$

where p = the 1931 loss in per cent of the value of the actual 1931 production within the area of 100 part salinity plus the loss. (Column 7, Table 93).

The value of V_s from (I) can therefore be substituted in (II) giving:

$$L = V \left(\frac{\frac{pA_s}{A}}{1 - \frac{pA_s}{A}} \right) \qquad \text{(III)}$$

and the loss for each crop, each year, can be derived directly from (III) without making an intermediate computation of the value of the production within the area of 100 part salinity encroachment. Following this procedure it remained only to obtain the estimates of the actual crop production in the Delta in past years.

Crop Production and Value 1924-1930

It was manifestly impossible to obtain complete data of this character for the entire Delta but the endeavor was made to obtain the records for as many years as possible, beginning with 1924, for a number of the larger and representative tracts. Tabulations of statewide price and production figures for all crops in the period 1924 to 1931 were obtained from the office of the Federal-State Cooperative Crop Reporting Service. The data secured by interviews with and questionnaires sent to various Delta organizations and individuals were not entirely complete but were sufficient to account for a considerable Delta acreage and to establish satisfactorily the relation, in the various

years, between Delta production and price figures and the statewide figures obtained from the Federal-State office. A previous reference has stated that the Water Supervisor Reports supplied the necessary data on the acreage of each Delta crop irrigated, 1924 to 1931. As derived, the seasonal totals for the irrigated acreages are greater than those given in the Water Supervisor Reports by the amount of grain, hay and pasture acreages which, although below Elevation 5.0, U.S.G.S., were not classed as irrigated in the Water Supervisor Reports. Later, as explained in Chapter VI, it was determined that, normally, practically all areas below Elevation 5.0 are benefitted from sub-irrigation and should be classified as irrigated.

From all of these assembled data the figures and estimates were derived to show for each year, 1924 to 1930, and for each crop, the acreage irrigated, the total actual production, and the total value of that production. The acreage and value of production figures are shown in Table 94.

Estimated Crop Losses 1924-1931

Having derived the estimates of the value of production as outlined, the crop loss due to salinity each year, 1924 to 1930, inclusive, was computed by solving equation (III) for each crop. The results of these computations are shown in detail in Table 94 and summarized in Table 95. The 1931 data shown in these tables are, of course, the results previously given of the actual survey in that year rather than estimates as derived for the years 1924 to 1930, inclusive. Table 95 gives the estimated losses in per cent of the total value of the Delta's irrigated crop production (including the

TABLE 95

ACREAGE IRRIGATED, ESTIMATED VALUE OF ACTUAL PRODUCTION AND ESTIMATED LOSS DUE TO SALINITY, SACRAMENTO-SAN JOAQUIN DELTA CROPS, 1924-1931

YEAR	ACREAGE IRRIGATED	ESTIMATED VALUE OF ACTUAL PRODUCTION IN DOLLARS	ESTIMATED CROP LOSS DUE TO SALINITY	
			DOLLARS	PER CENT OF TOTAL VALUE OF CROP PRODUCTION*
1924	320740	29781600	1085800	3.52
1925	300227	30108700	12200	0.04
1926	308712	26295000	346700	1.30
1927	306931	29967200	5500	0.02
1928	317015	27041500	62800	0.23
1929	325825	31361700	55100	0.18
1930	349913	27230600	21500	0.08
1931	343355	22657663	1263716	5.28
TOTAL	2572718	224443963	2853316	
AVERAGE	321590	28055500	356700	1.25

* INCLUDING VALUE OF LOST PRODUCTION.

value of the lost production).

As shown by these figures, the estimated tangible crop losses due to salinity in the period 1924 to 1931 varied from a minimum in 1927 of $5500 or 0.02 per cent of the total value of the Delta's irrigated crop in that year to a maximum in 1931 of $1,263,716 or 5.28 per cent of the total crop value. The average annual loss for the period was $356,700 or 1.25 per cent of the average total irrigated crop value.

Future Losses - Conclusion

It is to be noted that the magnitude of the loss in the Delta due to salinity is dependent upon many variables such as stream flow, the period of low flow, production, unit prices, etc., and that the correctness of estimates of the tangible crop loss in past years is only commensurate with the degree to which the variables involved have been correctly evaluated and with the verity of the assumptions required in the computations. If, for example, the Delta's average unit prices of 1924 had prevailed in 1931, the value of the actual production in the latter year would have been forty seven per cent greater, increasing the losses correspondingly to $1,858,000 so that the average annual loss 1924 to 1931 would then have been $431,000. Similarly, if the maximum of the average unit prices 1924 to 1931 had prevailed in 1931 the value of the actual production would have been about seventy per cent greater, the losses $2,136,000 and the average annual loss 1924 to 1931, $466,000 or close to one-half million dollars. The difficulties attendant upon predicting with accuracy what the future losses may be, are, therefore, apparent. However, considering all data as presented, it is believed to be a fair conclusion that if the future Summer stream flow reaching the

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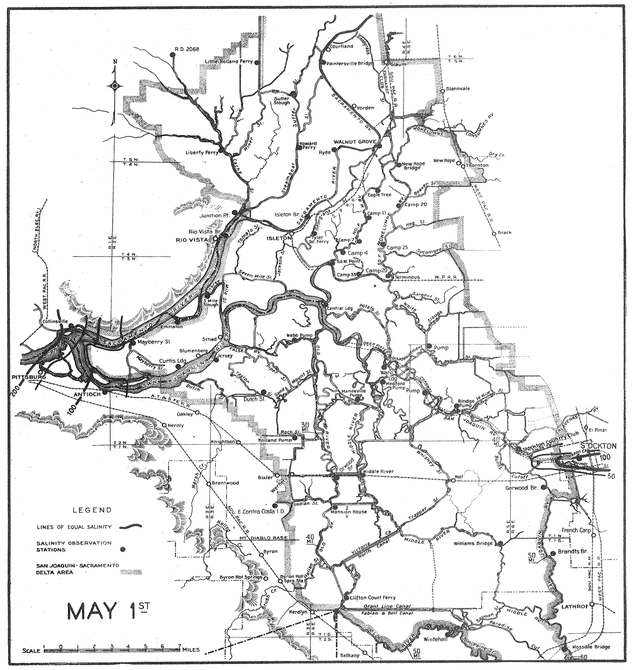
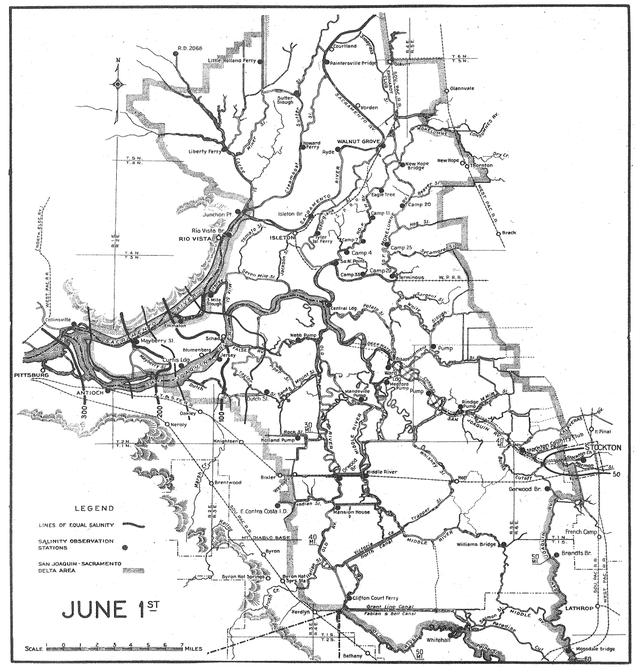
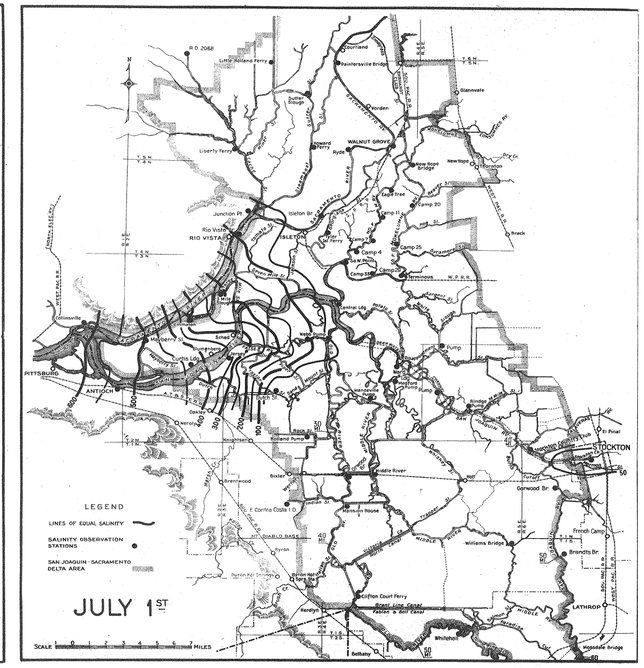
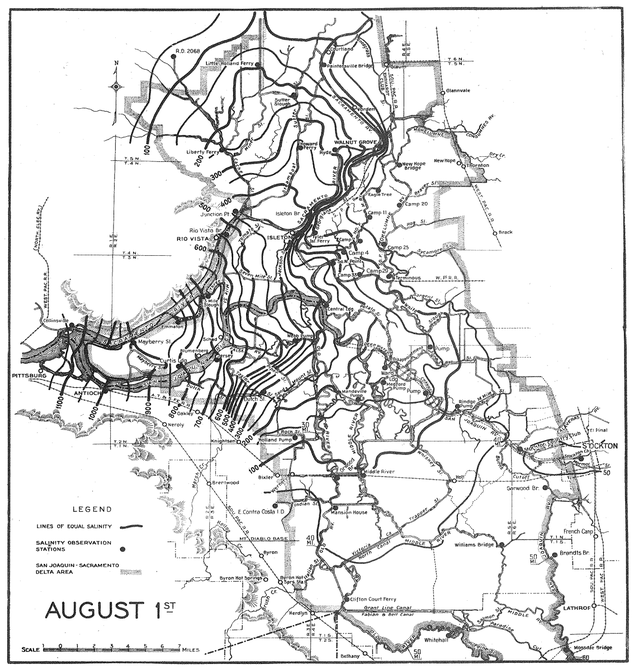
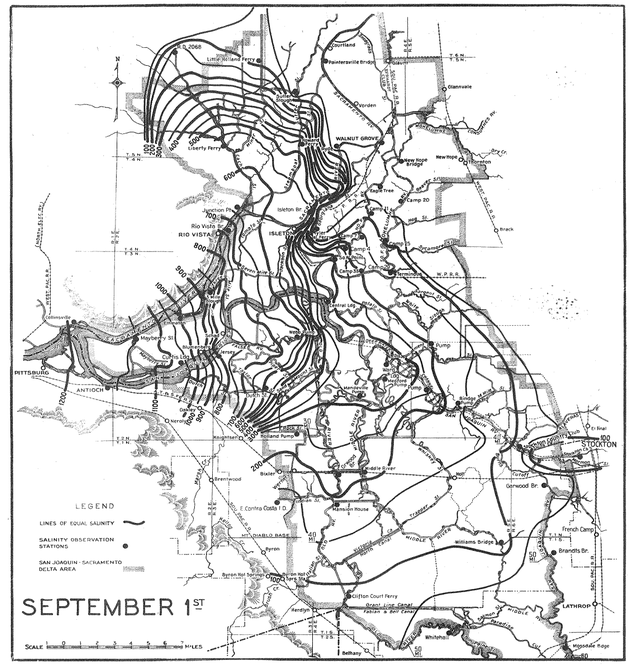
Delta is similar in amount and distribution to that of the last decade, a future average annual tangible crop loss due to salinity varying from $350,000 to as much as one-half million dollars is to be anticipated; that if allowance were made for further increase in development and use of water upstream from the Delta, some increase in this estimate would be necessary; and that if, in addition, the crop and other losses previously outlined as intangible were taken into consideration, the estimate would necessarily be further increased.

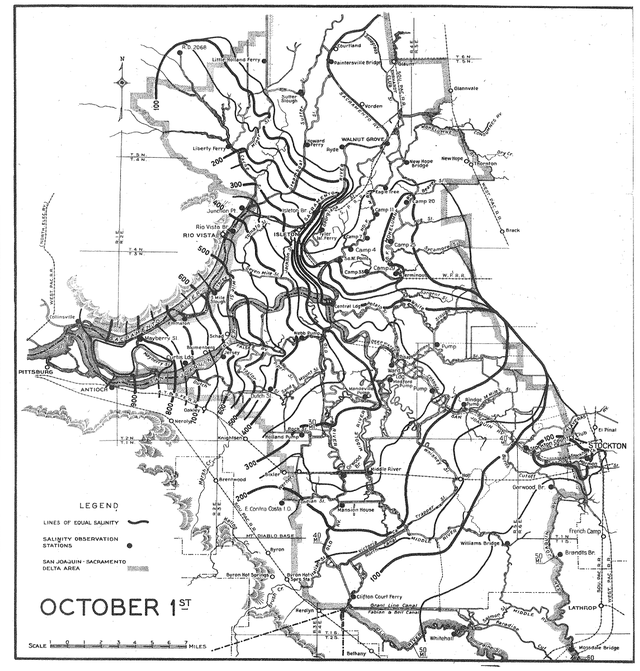


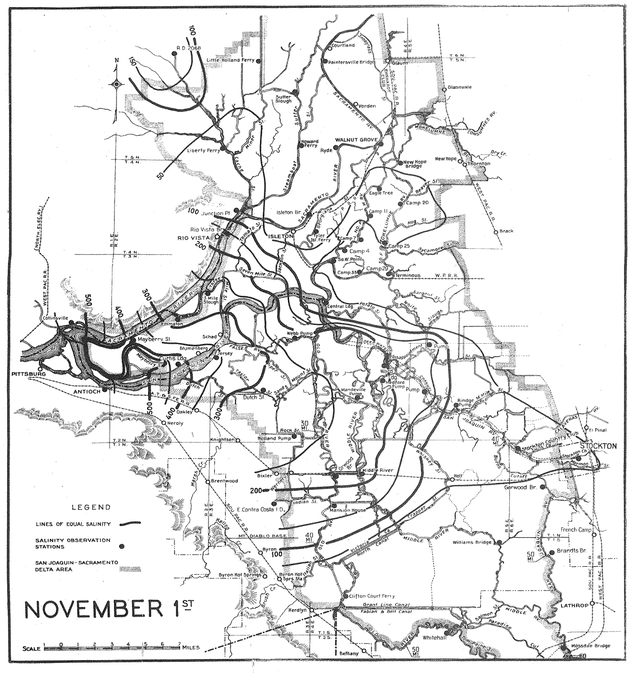


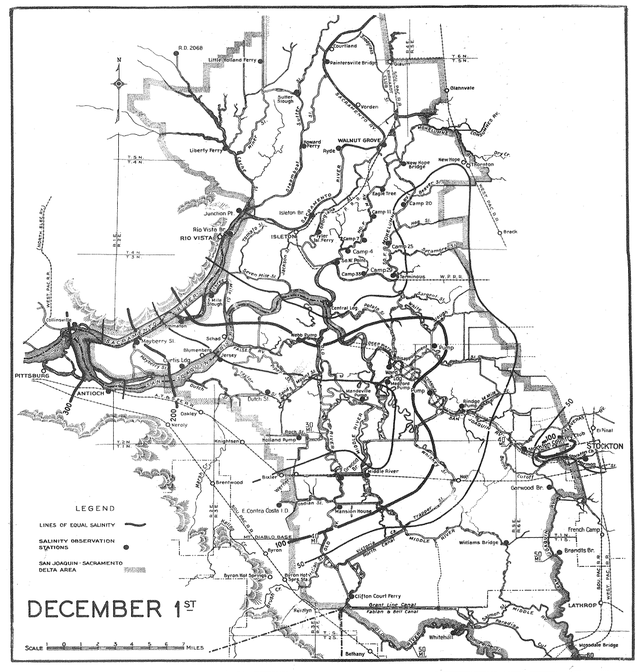












VARIATION OF SALINITY
SACRAMENTO-SAN JOAQUIN DELTA

MAY TO DECEMBER 1931

AS SHOWN BY

LINES OF EQUAL SALINITY AT INTERVALS OF

50 PARTS OF CHLORINE PER 100 000 PARTS OF WATER

PLAT