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REPORTS OF THE
DIVISION OF ENGINEERING AND IRRIGATION
EDWARD HYATT, State Engineer

BULLETIN No. 21

IRRIGATION DISTRICTS IN CALIFORNIA

By
FRANK ADAMS

1929

CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO, 1929

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Looking over a portion of Alta Irrigation District toward Dinuba.

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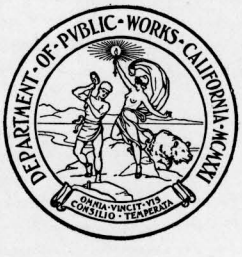

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FOREWORD

The information presented in this bulletin has been gathered under cooperative agreement between the Division of Engineering and Irrigation, California Department of Public Works; Division of Irrigation Investigations and Practice, University of California Agricultural Experiment Station; and the Division of Agricultural Engineering, Bureau of Public Roads, United States Department of Agriculture. The work has been done under the direction of and the report has been written by Frank Adams, irrigation economist, University of California, and irrigation manager, United States Department of Agriculture. Mr. Adams' long experience with and close knowledge of the history and management of the irrigation districts in this state have made it possible to publish in this volume historical summaries and analyses of the California districts which could not otherwise have been as fully and accurately presented. An earlier report on this subject by the same author covered the situation up to 1915, and was published as Bulletin 2 of the State Department of Engineering. This report, together with Bulletin 2, presents the most complete information it has been possible to obtain concerning irrigation districts and the irrigation district movement in California.

The investigation reported herein is an enlargement of a study outlined February, 1926, by the late state engineer, Wilbur F. McClure, and cooperating agencies. Work on the project was suspended in 1927 but was resumed early in 1928 at the request of the California Economic Research Council, whose committee on irrigation economics prepared the schedule used in the field investigation. The personnel of this committee included Frank Adams (chairman), A. E. Backman, Paul Bailey, A. M. Barton, P. A. Ewing, W. A. Hutchins, Edward Hyatt, W. W. McLaughlin, W. R. Parkhill, G. H. Russell, W. G. Vincent, W. W. Weir and C. H. West. Mr. E. C. Eaton, while irrigation engineer in the State Department of Public Works, contributed materially to the early outlining of the investigation.

In addition to the California Economic Research Council, the project has been supported by the executive research committee of the California Development Association, which assisted in obtaining state funds; the California Bond Certification Commission, which contributed funds for publication; the California Irrigation Districts Association, which gave the project its endorsement; and the officers and employees of the various districts, who gave hearty cooperation in the field work.

The principal assistants in making the field survey of California irrigation districts reported herein have been Vernon Givan, junior irrigation engineer, University of California Agricultural Experiment Station, and John H. Peaslee, assistant hydraulic engineer, Division of Engineering and Irrigation, California State Department of Public Works. Additional assistance has been rendered by Martin R. Huberty, assistant irrigation engineer, and Jerald E. Christiansen, junior irrigation engineer, University of California Agricultural Experiment Station, who have each covered a number of districts. In addition to field work, Mr. Givan and Mr. Peaslee have assisted in checking the material prepared for publication, and in the compilation of statistical summaries.

IRRIGATION DISTRICTS IN CALIFORNIA

By Frank Adams*

CHAPTER I

INTRODUCTION

The irrigation district is the most important form of organization that has been developed in the United States for the ownership and operation of community irrigation works. With the exception of the United States Bureau of Reclamation, which deals only with Federal reclamation projects, it is also our most important institution for financing their construction.

In the form generally used in this country, the irrigation district had its origin in the Wright irrigation district act passed by the legislature of California in 1887. The irrigation district idea, however, did not originate in California. Prior to the passage of the Wright act, Italy, France, and Spain had provided for neighborhood irrigation systems to which the district plan is somewhat similar. The first irrigation district legislation in the United States was passed by Utah in 1865. That legislation provided that county clerks, on application of a majority of the landowners in areas proposed to be organized, should create districts. Taxes for district purposes could be levied but there was no provision for the issuance of bonds. The landowners of the districts were the electors, if land taxes were to be levied, or taxpayers were the electors in the case of general property taxes. A large number of districts were formed under this act, but they were short-lived and nothing important was accomplished. The law was repealed in 1897.

The first California irrigation district law was passed in 1872.† It was entitled "An act to promote irrigation" and provided for the formation of irrigation districts by owners of lands susceptible of one mode of irrigation or drainage, all of such owners being required to sign the petition to the county supervisors which initiated the organization, rather than a majority, as provided in the later Wright act. If the supervisors found that no land had been 'improperly' included or excepted they were required to approve the petition; and from and after the approval the district was duly formed.

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* Irrigation economist, University of California Agricultural Experiment Station, and irrigation manager, Division of Agricultural Engineering, U. S. Department of Agriculture.

† Statutes of 1872, p. 945. An earlier law, passed May 15, 1854 (Statutes of 1854, p. 76), while in no sense relating to public irrigation districts, created, or authorized the creation of boards of commissioners in certain counties to regulate water courses "and upon petition of a majority of the persons liable to work upon ditches," to lay out and construct ditches as set forth in the petitions for the election of such commissioners. The area affected was the township, rather than a 'district,' and taxes to cover the cost of work done were to be levied on the persons benefited. There was some activity under this law in several southern counties. See Wm. Ham. Hall, "Irrigation in Southern California."

After approval of their petition the petitioners were authorized to make by-laws "for the future appointment of trustees and to effect the works of irrigation or drainage, keep the same in repair or operation, and for the control and management thereof, by the votes or consent of a majority of the owners of the lands within the district." The trustees were required to report to the county supervisors the plans of works and estimates of costs, and the supervisors were to appoint commissioners to apportion costs proportionate to benefits. All assessments levied by the commissioners were to be paid within the period fixed by the trustees, in default of which the district attorney of the county was required to proceed by civil action to collect them. The trustees were given the right to acquire needed property by condemnation. No authority was given to issue bonds or levy taxes, although additional assessments after the first one were authorized. The last section of the act exempted from its provisions the counties of Fresno, Kern, Tulare, and Yolo. The law was inoperative.

A second irrigation district act was passed by the legislature of California in 1874.* It was entitled "An act to promote irrigation in the county of Los Angeles." A county superintendent of irrigation was provided for, among his duties being to promote "an efficient, and, as nearly as possible, a uniform system of irrigation throughout the county," superintend, advise, and direct the water commissioners "of each and every irrigation district in said county," and "to visit the different parts of the county whenever he may deem it advisable, for the purpose of inspecting and initiating works of irrigation of any kind or description" and "take needful steps to improve the same." Irrigation districts within the county were to be created by the superintendent of irrigation on petition of a majority of the owners of the lands to be included and after a finding by the superintendent of irrigation that the proposed district was feasible. A majority vote of the owners of property "paying a tax or which is liable to be taxed for irrigation purposes in the district" was necessary in the election of district water commissioners and in authorizing taxes to pay for works. With the approval of the superintendent of irrigation, the district water commissioners were authorized to acquire water and works, using condemnation if necessary.

Besides setting up the machinery for the creation of districts, the law sought to establish certain principles of water administration, which seem even at that early date to have been considered necessary. For instance, section 10 of the act provided, among other things, for the apportionment of water in times of scarcity and stipulated that "no more water shall be apportioned than shall be necessary, without

* Statutes of 1873–74, p. 312.

waste, to irrigate the actual amount of land under cultivation, or bearing crops to be benefited by such apportionment." The section further provided that "all waters from rains, rivers, or streams, which can be applied to irrigation purposes, are hereby declared the property of the people, to be held for their use, and so utilized as to confer the greatest possible good upon the greatest number." It is further interesting to note that the act was not to apply to the City of Los Angeles or to Los Angeles River.

Two other early irrigation district acts were passed by the California legislature, one, in 1876, creating West Side Irrigation District,* and one, in 1878, creating Modesto Irrigation District.†

West Side Irrigation District included lands in Contra Costa, Alameda, San Joaquin, Stanislaus, Merced, Fresno, and Tulare counties, and extended from Suisun Bay, near Antioch, to Tulare Lake. It was formed "for the purpose of providing for the irrigation of the land lying in said district, and furnishing the means of transportation, by a canal to be constructed from Tulare Lake on the south, and extending northerly along the foothills of the Diablo Range of Mountains to a point on the south shore of Suisun Bay." Construction of this canal was to be financed by twenty-year 8 per cent bonds in the amount of $4,000,000, to be paid by annual tax on the property in the district. Title to all property acquired was to vest in the state, but the state was not to be liable for any debt or liability incurred by the district.

The law creating West Side District was supplemented by another brief act approved on the same day as the original act.‡

A law approved March 25, 1878,§ the exact intent of which is not clear, created a similar district within the counties of San Joaquin, Stanislaus, Merced, and Fresno. In a still later law‖ approved April 1, 1878, the original and supplemental acts of April 3, 1876, were repealed so far as they related to the counties of Contra Costa and Alameda.

The various changes in this legislation relating to West Side Irrigation District indicate that there was no clear conception of the feasibility of the proposed undertaking, and in any event, it was not carried forward and the legislation became inoperative. The original act is of great interest historically, however, because it set forth the framework and much of the verbiage of the general irrigation district legislation to follow in 1887.

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* Statutes of 1875–76, p. 731.
† Statutes of 1877–78, p. 820.
‡ Statutes of 1875-76, p. 885.
§ Statutes of 1877-78, p. 468.
‖ Statutes of 1877-78, p. 887.

The law creating Modesto Irrigation District, although also inoperative, throws further light on the ideas regarding irrigation districts prevalent before the passage of the Wright act, particularly on conceptions about financing. The area included was that lying between Stanislaus and Tuolumne rivers and between San Joaquin River and the western boundary of Tuolumne County.

The district created by the act was not itself to construct an irrigation system, that function being left to corporations or individuals who might wish to undertake it; nor was the district to issue any bonds for construction, that responsibility being left to Stanislaus County. The principal purposes of the legislation seem to have been to set out an area within which taxation on the increased value of land due to the construction of an irrigation system might be applied to the payment of bonds issued to pay for that construction, and to authorize Stanislaus County to issue those bonds. The bonds authorized to be issued were limited to $500,000. Section 5 provided that "the net revenue, including both state and county taxes derived from the increased value of the land, owing to the irrigation works herein provided for, shall be applied exclusively to the payment of the interest and principal of said bonds, for the period of two years; and the faith of the state is hereby pledged to make such appropriation, for the purpose of paying said bonds, for eighteen years more, unless said bonds are sooner paid." Stanislaus County was not to become "in any manner liable for either the principal or interest of said bonds, except as herein provided, nor beyond the extent of the revenue derived by reason of the increased value of the property in the district, for the period of twenty years."

Another interesting feature of the Modesto act was its provision giving to every landowner within the district the right, at any time, to subscribe for and receive as many shares, without paying anything therefor, as such landowner had acres of land, and that all shares so subscribed for should belong to such land.

In the light of the experience of the last fifty years it is not surprising that nothing resulted from either the Modesto district act of 1878 or the West Side district acts of 1876 and 1878. Nevertheless, without the passage of those acts and the demonstration of their impracticability, those interested in irrigation district development probably would not have been prepared to draft the Wright act some ten years later. As a matter of fact, those early legislative enactments were part of a contest then being waged between riparian owners and appropriators, which culminated in the well-known case of *Lux* vs. *Haggin*.*

* 69 Cal. 255.

CHAPTER II

FORMS OF DISTRICTS FOR IRRIGATION OR WATER CONSERVATION AUTHORIZED BY THE CALIFORNIA STATUTES

While this bulletin will deal chiefly with irrigation districts organized under the California irrigation district act, which is the present-day development from the orginal Wright act of 1887, brief reference will also be made in the later pages to other types of districts for irrigation or water conservation purposes authorized by the California statutes. It seems well, therefore, at this time to list the various types of districts that have been formed, or for which there is statutory authority, and to outline briefly the laws, other than the California irrigation district act, under which districts have been, or may be, organized.

Irrigation districts.

Irrigation district is the name applied to all districts organized under the California irrigation district act, or under the original Wright act of 1887. Six districts organized under the original Wright act are still in existence, but they are, of course, now operating under the California irrigation district act. The first general revision of the Wright act of 1887, adopted in 1897,* was for some time known as the "Bridgeford act" or the "Wright-Bridgeford act," but the law was definitely designated as the "California irrigation district act" by the legislature of 1917.†

County water districts.

County water districts are formed under an act approved June 30, 1913, to which amendments were made by succeeding legislatures.‡ A large number of county water districts have been formed, but mainly for domestic purposes. County water districts are not subject to the state engineer or other state officer, and consequently there is no central record of their activities. As nearly as it has been possible to ascertain by correspondence with or visits to the county clerks of the various counties, very few of these districts are concerned in an important way with irrigation.§

A county water district is formed by petition to the county supervisors, signed by registered voters within the proposed district equal in number to at least 10 per cent of the votes cast within such boundaries for the office of Governor at the last preceding general election; provided that where one or more municipal corporations, or parts

* Statutes of 1897, p. 254.
† Statutes of 1917, p. 769.
‡ Statutes of 1913, p. 1049, amended by Statutes of 1915, p. 26; 1917, p. 225; 1919, p. 816; 1923, p. 312; 1925, p. 530; 1927, p. 290.
§ For data regarding county water districts organized wholly or partly for irrigation purposes, see page 371.

thereof, are included, the petition must be signed by at least 10 per cent of the qualified electors of each such municipal corporation or part thereof, and of the unincorporated territory so voting at such election for Governor. The portion of a county proposed to be included must have a population of not less than one thousand.

If the supervisors find that the petition complies with the provisions of the statute, the question of organization is submitted at an election in which all electors qualified under the general election laws of the state are entitled to vote, an affirmative majority vote being required for approval. If the organization election carries, a subsequent election is called for the election of five directors. If the district includes both unincorporated territory and any incorporated municipality or municipalities, one additional director shall be appointed by the mayor or president of the trustees of each municipality, and one shall be appointed by the county supervisors. The board of directors is the governing body of the county water district.

Bonds may be issued by a county water district when authorized by more than a two-thirds vote, every elector under the general election laws of the state being qualified to vote at the election. The board of directors is required to fix such water rates as will pay the operating and other expenses of the district, including the interest and principal of outstanding bonds, but if the revenues of the district are inadequate for that purpose, the board of supervisors must levy taxes sufficient to pay them, these taxes to be collected at the same time and in the same manner and form as county taxes are collected.

Water districts.

In 1913 the legislature passed a law providing for the organization and management of water districts, the sponsors of the law having in mind the organization of a district mainly embracing entered government lands in Chuckawalla Valley and on Palo Verde Mesa, in eastern Riverside County. No district covering that area was formed, but the law has been used by the owners of land in the northern end of the Imperial Irrigation District not provided with a distribution system, the district formed by them being known as Niland Water District (see page 376). The law was amended in 1917 and again in 1921 and 1927.*

A water district is formed on petition to the county supervisors signed by the holders of title or evidence of title to a majority in area of the lands proposed to be included. Such a water district may be organized within the boundaries of an irrigation district, provided

* Statutes of 1913, p. 815; amended by Statutes of 1917, p. 1408; 1921, p. 1142; 1927, chapters 11 and 785.

that 80 per cent of the land within the boundaries of the proposed water district is not at the time of its formation under irrigation from the works of such irrigation district. After a hearing, a special election is called by the supervisors for determining the question of organization and for electing a board of directors and an assessor, a majority affirmative vote being necessary for organization. Voters are limited to holders of title or evidence of title to land within the proposed district, and each elector has one vote for each one dollar's worth of land in, or to be included in, the district to which he holds title or evidence of title.

After organization, the directors must adopt by-laws for the government and control of the district, which must be approved in writing by the county supervisors. Land within the district is assessed by the district assessor for district purposes at its full cash value, and assessments are levied by the county supervisors and collected by the county tax collector. Bonds may be issued if authorized by a two-thirds vote at a special election. No bonds can be sold, however, unless approved by a board of engineers of which one member shall be appointed by the Governor, one by the district, and one jointly appointed by the Governor and the district; nor unless the total proceeds of the bonds shall be at least 85 per cent of the total amount of the issue. Approval by the board of engineers above referred to must carry a finding of at least two members that the cost of acquiring water rights and the system of works will not be in excess of the amount of bonds issued.

A water district organized under this act may either construct irrigation works or contract for their construction with an irrigation or drainage district. It may also sell or lease or contract for the sale of any property or rights belonging to the district, or may contract with the United States or the State of California, or with any political subdivision of the state, for the storage, regulation, control, development, and distribution of water for the irrigation of land within the water district, or for the use, control, and distribution of any drainage waters within the district, or for the construction, extension, operation, control, maintenance, and management of any works or other property constructed or acquired by the district, or for providing or furnishing hydro-electric power. In any such contract, it may be provided that upon execution of the contract, the lands included within the water district shall be entitled to become part of such irrigation or drainage or reclamation project, and shall be entitled to receive water, electric power, and drainage service from such project. All such contracts and transfers as mentioned must, however, first be approved by the state superintendent of banks upon recommendation of the board of engineers above referred to.

County water works districts.

The original act under which county waterworks districts are formed was passed in 1913 * to provide a means by which the city of Los Angeles might organize the then unincorporated area of San Fernando Valley for the purpose of utilizing water from the Los Angeles aqueduct. At that time the aqueduct was nearing completion and it was desired to make the water from Owens Valley available to the large area in San Fernando Valley which it was proposed to annex to the city of Los Angeles. This original act provided that districts formed under it should be known as county irrigation districts, but at that time irrigation district bonds were not in a favorable position in the investment markets. In an amendment to the act in 1915, therefore, the name of the districts formed under the act was changed to county waterworks districts.†

The main portion of San Fernando Valley lying north of Glendale, with the exception of the municipality of San Fernando and what is known as the "Mission District," was duly formed into Los Angeles County Waterworks District No. 3. Since that time, a number of other smaller county waterworks districts have been organized in southern California, of which four serve water for irrigation as well as for domestic purposes.‡

County waterworks districts may be formed in any portion of a county containing unincorporated territory, or the whole or any portion of one or more incorporated cities and contiguous unincorporated territory. Organization is effected by petition to the county supervisors signed by not less than 50 freeholders, resident within the proposed district. The petition must include a general description of the improvements proposed and an estimate of their cost. After hearing protests, if any, and finally fixing the boundaries, the board of supervisors calls a special election at which the qualified electors under the general election laws of the state are called upon to vote on the formation of the district and the incurring of the proposed bonded indebtedness, a majority vote being necessary to carry each proposition.

Title to property constructed by county waterworks districts vests in the county in which the district is located, except that when the territory in such district is included within a municipal corporation owning works for supplying its inhabitants with water, title to such works passes to such municipality. The county or the municipality,

* Statutes of 1913, p. 785.

† Statutes of 1915, p. 1188.

‡ For more complete data regarding county waterworks districts serving water for irrigation, see page 377.

as the case may be, has control of the construction and operation of the works and has power to make and enforce rules and regulations necessary for the administration and government of the district; also, to levy a tax on the taxable property in the district sufficient to pay interest and principal of bonds and also the expenses of maintaining, operating, extending, and repairing the waterworks of the district. The board of supervisors, or the municipality, also has power to fix and collect water rates.

Municipal improvement districts.

An act approved April 20, 1915,* provides for the formation within municipalities of municipal improvement districts for the acquisition or construction of public improvements, works, and public utilities therein, and for the issuance of bonds to meet the cost of such improvements. Some amendments to this act were made in 1919.†

A municipal improvement district is formed on petition to the legislative body of the municipality within which the district is to be formed, this petition to be signed by not less than 10 per cent of the qualified electors residing in the proposed district. Among other things, the petition must include a general description of the proposed improvements and an estimate of their cost. After the hearing of protests, if any, and the final fixing of the district boundaries and determination of the nature and extent of the proposed improvement work, an election is called on the question of issuing bonds, a two-thirds affirmative vote being necessary to carry the election. Necessary taxes are levied by the governing body of the municipality, the act also giving the municipality full control over the operations of the district.

A large number of municipal improvement districts have been formed in California, several of which serve water largely for irrigation purposes. Such a district, known as Municipal Improvement District No. 2, has been formed to cover the "Mission District" in San Fernando Valley, which is now a part of the city of Los Angeles. Municipal Improvement District No. 9, covering Hansen Heights, lying east of Tujunga Wash in San Fernando Valley, and Municipal Improvement District No. 27, embracing Lankershim, also in San Fernando Valley, have likewise been formed by the city of Los Angeles, these two areas, along with the "Mission District," not having

* Statutes of 1915, p. 99.
† Statutes of 1919, p. 670.

been included within the original annexation to Los Angeles. These districts were all organized to finance works for the distribution of water from the Los Angeles Aqueduct.*

Water storage districts.

Four water storage districts have been organized in California, viz., San Joaquin River Water Storage District, Kern River Water Storage District, Buena Vista Water Storage District, and Tulare Lake Basin Water Storage District. In general, the purpose of these districts is to store water for irrigation, and to distribute water among the owners of lands within the districts in accordance with "such priorities in the right to water between the different consumers of water as may legally exist." In the case of San Joaquin and Kern River districts, the objective in organizing was to harmonize water rights on San Joaquin and Kern rivers, and to bring about maximum economic utilization of San Joaquin and Kern rivers through storage at the Millerton and Isabella reservoir sites. On San Joaquin river the principal interests are those of Miller and Lux and Madera Irrigation District. In the case of Kern River District, the principal interests are centered in the Kern County Land Company and a number of separate canal companies, all more or less controlled by Kern County Land Company. These interests control a substantial portion of the water rights on Kern River. The remaining principal rights on Kern River are controlled by Miller and Lux, which company has organized the Buena Vista Water Storage District. Tulare Lake Basin Water Storage District has been organized by landowners who have been chiefly dependent upon Tulare Lake for a water supply.**

The California water storage district act was approved June 3, 1921, and has been amended by succeeding legislatures.† The original act, intended generally for purposes similar to those underlying the California water storage district act, was approved June 4, 1915, and was known as the "California irrigation act."‡ It was drawn in the interests of the Iron Canyon Association as a step toward the construction of the so-called Iron Canyon Project on Sacramento River near Red Bluff. Nothing was done under the act toward the formation of

* The works built by Municipal Improvement District No. 27 are primarily used for domestic purposes. Data regarding districts 2 and 9, which are used largely for irrigation, are included in the discussion of county waterworks districts on page 379.

**For more complete data regarding these water storage districts, see page 380.

† Statutes of 1921, p. 1727; amended by Statutes of 1923, p. 941, and Statutes of 1927, chapter 707.

‡ Statutes of 1915, p. 1173.

a district on Sacramento River, but the act was amended in 1917,* and reenacted in 1919 † with a view to making it applicable to the formation of a large district on Kings River for the purpose of constructing storage at the Pine Flat storage site. Before organization of this large district was attempted, however, efforts to organize under the act were made in Madera County, when an application was presented to the state irrigation board for the formation of five small districts, with a view to keeping the lands in these proposed small districts from being included in Madera Irrigation District, then under organization under the California irrigation district act. As a result of litigation involving the formation of these five districts, the California irrigation act was declared unconstitutional ‡ and the act was cleared from the statute books through being repealed by the California water storage district act. The latter act was, therefore, drawn as a substitute act, its sponsors having been those primarily interested in the formation of the large district on Kings River.

Water storage districts are formed by petition to the state engineer, rather than to the county supervisors, as in the case of irrigation districts. For the purposes of carrying out the water storage act the Governor is authorized to name two executive directors to assist the state engineer. A petition for the formation of a water storage district must be signed by a majority in number of the holders of title or evidence of title to lands already irrigated or susceptible of irrigation from a common source and by the same system of storage and irrigation works and representing a majority in value of said lands; or the petition may be signed by not less than 500 holders of title or evidence of title to lands therein representing not less than 10 per cent in value of all the lands within the proposed district. The state engineer determines "the practicability, feasibility, and utility of the proposed project set forth in said petition," and for that purpose is authorized to make, or cause to be made, all necessary studies, examinations, surveys, plans, and estimates of cost, provided that the "cost thereof shall not in the aggregate exceed a sum in dollars equal in amount to one-fourth the number of acres in such proposed district." Upon his final hearing the state engineer divides the district into five, seven, nine, or eleven divisions "in such manner as to segregate into separate divisions lands possessing the same general character of water rights or interests in and to the waters of" the common source specified in the petition for organization.

* Statutes of 1917, p. 1068.
† Statutes of 1919, p. 671.
‡ *Mordecai* vs. *Board of Supervisors*, 183 Cal. 434.

After the hearing by the state engineer, the matter of organization is submitted by the state engineer to an election at which only the holders of title or evidence of title to lands within the district are entitled to vote, every such holder of title or evidence of title being entitled to vote in each precinct in which any of the lands owned by him are situated, and to cast one vote for each hundred dollars or fraction thereof worth of land in such precinct owned by him. A majority of the votes cast is necessary to carry the election.

After a water storage district is organized as above outlined, the board of directors chosen at the organization election makes such surveys and examinations as are necessary to prepare a plan of works. Recommendations of the directors regarding proceeding with the project are filed with the state engineer. If the board of directors recommends that the project be abandoned, the state engineer makes such further examinations as he deems desirable and may approve the recommendation for abandonment and declare the project abandoned, or he may submit the matter to a vote of the electors. If the board of directors recommends that the project be carried out, an election is called by the state engineer to determine the matter, a two-thirds vote for completion of the project being necessary if it is to go forward.

If the project is approved at the election, the state engineer appoints three commissioners to assess the cost of the project "in accordance with the benefits that will accrue to each tract of land held in separate ownership in said district, by reason of the expenditures" proposed to be made. The apportionment by these commissioners, after being equalized, and after being filed with the county treasurer, becomes the basis for assessments, subject to later revision, on request or petition, at the expiration of five years and thereafter at periods of not less than five years.

Assessments levied are payable within thirty days, or if not paid within thirty days, bear interest at 7 per cent per annum, and thereafter are payable on call of the directors, unless later covered by bond issues. Bonds may be issued in an amount equal to an assessment or such part of an assessment as remains unpaid, if authorized by a majority vote at an election called for that purpose, only electors that have been assessed being qualified to vote at that election.

The construction of works by water storage districts and the management of the district are under the direction of the board of directors, but during the construction of any works reports must be filed with the state engineer. The directors are given generally the powers necessary to carry out the purposes of the act, and they may submit propositions relating to the project to the qualified electors at any general or special election.

Water conservation districts.

There are two laws in California relating to organization of water conservation districts. The first of these, known as the "California water conservation district act," was approved June 18, 1923, and has been amended by the two succeeding legislatures.* This act was drafted primarily for organizing the various groups which obtain water from Kings River for the purpose of storing water on Kings River at the Pine Flat site, and incidentally for accomplishing an adjustment of the complicated water-right situation on that stream. The second act, known as the "water conservation act of 1927," was approved April 11, 1927, and was drafted in the interest of various irrigation companies and irrigators which obtain water from Santa Clara River, in Ventura County, and relates largely to the conservation of water by spreading. A conservation district under the California water conservation district act is in process of formation on Kings River, and conservation districts have been formed on Kaweah and Santa Clara rivers.†

California Water Conservation District Act.—Conservation districts are organized under the California water conservation district act on petition to a special board known as the state irrigation board, which is composed of the state engineer and the two executive directors provided for in the California water storage district act. The state irrigation board has the power to unite into single districts "irrigation districts, water storage districts, reclamation districts, drainage districts, and other political subdivisions of the state organized to promote irrigation, reclamation, or drainage."

Organization of such a district can be initiated by three or more such units which can use a common system of works and within which all the land will be benefited by such works. The petition for organization presented to the state irrigation board "shall designate by name, or otherwise, the units joined in such petition and the water to be stored, used, or acquired, and shall outline generally the character and location of the proposed works * * *." Upon hearing, the state irrigation board may "pass upon and decide any question under consideration at said hearing."

Before making a final order creating a conservation district, the state irrigation board makes, or causes to be made, examinations, surveys, and estimates of cost "to ascertain and estimate the requirements and works necessary for the purpose of said water conservation district * * *." After such examinations and surveys, the state

* Statutes of 1923, p. 978 amended by Statutes of 1925, p. 555, and 1927, chapter 240.

† For additional information regarding these water conservation districts, see pages 386 and 387.

irrigation board prepares a report setting forth the character and nature of the proposed works and other relevant matter; it must also, before making its final order creating the district, "apportion to each constituent district, or unit of said water conservation district, the portion to which it is entitled of all the water storage capacity in the proposed reservoir, the waters stored, or to be stored, or diverted, or to be diverted, by such project for the irrigation of the lands of the water conservation district and all power developed or to be developed incidental thereto * * *."

In making such apportionment, the board "must take into consideration the present water rights and the additional water necessary to perfect the irrigation of the lands of each unit, and the apportionment of power to each unit shall be in the same proportion to the whole as its apportionment of capacity in the reservoir, which proportion of such water and power shall forever be applied to the purpose and for the benefit of such constituent district or unit." The board also must apportion to each constituent unit its proportion of costs and expenses of the proposed project.

After making its apportionment of water, power, and costs, the state irrigation board must direct the governing board of each constituent unit of the conservation district to call an election, at which a vote must be taken both on whether the water conservation district shall be formed and whether bonds necessary to pay the cost of construction shall be voted. A majority vote in each constituent unit is necessary to carry the election in said unit, the qualified electors in each unit being as provided in the laws governing elections in such unit. Following the election, the State Irrigation Board "shall enter an order that a conservation district is established, comprising only those districts which have voted both in favor of the organization of such conservation district and in favor of the bonds * * *," provided "that such districts represent eighty-five per cent or more of the apportionment of the project * * *." In the same order, the state irrigation board must apportion to each of the constituent units voting in favor of organization and of the bonds its proportion of the water storage capacity to be provided and of the power developed or to be developed.

Water conservation districts organized under this act are governed by a board of directors consisting of one director for each subdivision established by the state irrigation board in its order establishing the district. There may be three, five, seven, nine, or eleven of such subdivisions, "as is most practicable."

After organization, the board of directors of a water conservation district makes necessary examinations, surveys, plans and specifications, and estimates of costs, and prepares a report setting forth in detail the character and nature of the proposed works. It must determine the amount of money required out of the total sum originally voted by the constituent units. If the amount originally contributed is insufficient, it must determine and apportion the additional costs. The board of directors also determines and apportions the costs of maintenance, repair, operation, and management of any works built by the district, these costs being directly levied and collected by the constituent units, or covered by bonds of such constituent units.

Water stored by a water conservation district is distributed to the several units in accordance with their respective rights "at the point of diversion from the stream," and power generated by the district is to be distributed by the directors "at the place where it is generated."

Water conservation act of 1927.—Districts under this act are organized on petition of fifty or more owners, or the owners of more than half of any body or bodies of land within and comprising the whole or part of the watershed of any unnavigable stream, or lying adjacent thereto, or deriving its water supply in whole or in part from such stream, or the subterranean waters therefrom. The petition is presented to the supervisors of the county in which the lands of the proposed district or the greater proportion thereof are situated.

After a hearing by the supervisors, the matter of organization is submitted by the supervisors to an election, at which directors are also voted on. Qualified electors under the act are owners of land within the district, and each such owner is entitled to one vote for each acre of real estate owned by him in the district. A majority vote is necessary to carry organization of the district.

Funds needed by a conservation district organized under this act are raised by taxes levied by the county supervisors, the tax levied in any one year being limited to 1.5 mills on each dollar of the assessed values of the lands within the district, together with the improvements thereon, according to the last assessment rolls. Special assessments up to three mills on each dollar of assessed valuations of lands and improvements may be authorized at special elections by majority vote. The issuance of bonds is not provided for in this act.

As previously indicated, this conservation district act was drawn primarily in the interests of landowners along Santa Clara River, in Ventura County, who desired to conserve water by spreading. Important additional purposes of the act were to appropriate, acquire, and conserve water and water rights and to take "any and all actions and proceedings that may be necessary or advisable to conserve and protect

the waters or water rights within the district used or useful for any purpose of the district, or of common benefit to the lands situated therein, and to prevent interference with or diminution of the natural flow of any stream or unnavigable river, including the natural subterranean supply of waters therefrom."

Conservancy districts.

An act was passed by the legislature of 1919 providing for the formation of conservancy districts which includes in its purposes the spreading and sinking of flood water, the building of reservoirs and canals, and disposal of waters which have been conserved for irrigation.* The primary purposes in view, however, related to flood protection, regulating storm waters, and reclaiming wet, swamp, and overflow lands, and no districts have been formed under the act for irrigation purposes.

Reclamation districts.

Although not irrigation districts in the sense treated in this report, a number of the reclamation districts in California have constructed irrigation works.† Section 3455 of the Political Code of California includes the provision that "the term 'works of reclamation' as used in this chapter shall include not only such public works and equipment as are necessary for the unwatering of lands in reclamation districts, but shall also include such like works as may be necessary to water or irrigate the same lands in such districts." Furthermore, Section 3467 of the Political Code provides that "in all reclamation districts where plans have been adopted by the trustees of the district for the irrigation of the lands in said district, the trustees of the district shall have power to adopt rules and regulations for the distribution of water and adopt a schedule of rates * * *, and shall have the right to collect the same * * *."

Excepting in the case of the Sacramento and San Joaquin Drainage District, which is under the jurisdiction of the State Reclamation Board, which board exercises certain police powers in directing reclamation,‡ no general administrative control is exercised by the state over reclamation districts. There is, therefore, no central office of record for information regarding them, and no general investigation

* Statutes of 1919, p. 559.

† The term 'reclamation' as used in California generally refers to the unwatering and protection from floods or overflow of swamp and overflow lands. This, of course, is a much more limited meaning of the word than that applied to it generally in the western United States.

‡ The State Reclamation Board exercises certain police powers over reclamation along Sacramento and San Joaquin rivers, having authority to direct reclamation "so that it may not interfere with flood control or unnecessarily injure the safety of the existing reclamation in the Sacramento and San Joaquin valleys." (Report of the Reclamation Board of California, 1916, p. 2; also Section 3455 of the Political Code of California, subdivision 4).

has been made of them in connection with the study reported herein. In most cases, irrigation within reclamation districts is carried on by individual landowners, in a few cases it is under mutual water companies, and some reclamation districts include land that is in irrigation districts.

Palo Verde Irrigation District.

While this district is classified in this report along with the districts organized under the California irrigation district act, it was organized and operates under a special act of the legislature adopted in 1923, and amended in 1925 and 1927.* The special features of the act are outlined in the statement regarding Palo Verde Irrigation District appearing later in this report (p. 327). It is sufficient to state here that the Palo Verde irrigation district act was passed because of somewhat unusual conditions existing within the area to be included. Prior to the formation of the district, irrigation water was supplied by the Palo Verde Mutual Water Company and there were already organized within the area Palo Verde Joint Levee District of Riverside and Imperial counties and Palo Verde Drainage District, both of which districts had outstanding bonds. Palo Verde Irrigation District is, therefore, a consolidated irrigation, protection, and reclamation district.

Santa Clara County irrigation district act.

The legislature of 1921 passed an act initiating the creation of a conservation and irrigation district embracing practically the whole of Santa Clara Valley in Santa Clara County, to be known as Santa Clara County Irrigation District. However, the final creation of this district was subject to approval of the electors within the district at a special election to be called by the county board of supervisors.†

The act fully set up the procedure to be followed by the district in financing and constructing or acquiring irrigation works, the essential differences from procedure followed under the California irrigation district act being the following: assessment of costs on a 'benefits' rather than on an ad valorem basis; provision that county rather than district officers should levy and collect assessments and otherwise handle the funds of the district; and provision that assessments or bonds for constructing or acquiring works or for acquiring rights and other property should be authorized by property owners, rather than by electors possessing the qualifications prescribed in the general election laws of the state. In elections called for passing on such

* Statutes of 1923, p. 1067; Statutes of 1925, p. 353; Statutes of 1927, chapter 583.
† Statutes of 1921, p. 1523.

matters each property owner was authorized to cast one vote for each dollar's worth of property shown on the district assessment roll.

At an election held on September 27, 1921, organization of the district was disapproved and the act creating the district thereupon became inoperative. The law was, however, reenacted in slightly amended form by the legislature of 1923,* the southern portion of the previously proposed district having been eliminated. Furthermore, the new act provided that an election approving formation should only be called by the county supervisors on petition of one thousand electors. At an election under this revised act March 16, 1925, organization was again disapproved by the decisive vote of 6085 to 960. It is now proposed to submit to the legislature of 1929 an entirely new act, to be patterned generally after the water conservation act of 1927.

Improvement districts within irrigation districts.

The legislature of 1927 passed an act providing for the organization of improvement districts within irrigation districts.† The purpose of forming such districts is to construct works of benefit only to particular areas within an irrigation district. Organization of such a district is formed on petition to the board of directors of the district signed by two-thirds in number of the holders of title, or evidence of title, to any tract or contiguous tracts within any district organized under the California irrigation district act, and susceptible of irrigation by a system of works separate and apart from the main system of the district. The petition must state the plan of proposed improvement.

If the directors of the irrigation district find after survey that the plan of improvement is feasible, they prepare plans and specifications and an estimate of cost, together with a statement and assessment of the amount of such costs apportioned to each tract of land in the proposed improvement district. This assessment is to be made according to benefits. If at the hearing more than one-third in number of the landowners in the proposed improvement district object to its formation and to the proposed assessment, the petition is denied. Otherwise at the final hearing, after the directors have made such changes as they consider proper, the petition and the apportionment of benefits are approved. Assessments are payable in not to exceed ten annual installments.

The irrigation district issues warrants for the amount of each assessment, these warrants to be payable at times corresponding substantially to the payments of installments by the landowners within the improvement district. The warrants are payable only out of funds

* Statutes of 1923, p. 1215.
† Statutes of 1927, chapter 748.

derived from the improvement district assessment. Construction of the works of an improvement district is done by or under contracts let by the irrigation district and the irrigation district is given authority to levy additional improvement district assessments if the original assessment proves to be insufficient to pay the whole cost of improvements made.

Improvement districts have not yet been extensively organized within California irrigation districts. However, at this writing (November, 1928), twenty-one have been formed or are in process of formation in Turlock District, and five are in process of formation in Modesto District. The improvement district act has been held constitutional by the superior court of Stanislaus County in *Forbes* vs. *Turlock Irrigation District,* but is to be taken to the state supreme court.

CHAPTER III

THE IRRIGATION DISTRICT MOVEMENT IN CALIFORNIA SINCE 1897

In a publication previously issued there was presented a history of the early irrigation movement in California and an outline of irrigation district development in California to 1915,* and the reader is referred to that publication for more detail than is included herein regarding the situation up to 1915.

Organization under the amended act of 1897.

The unfortunate history of irrigation districts formed under the Wright act of 1887 led to the general conclusion that the irrigation district form of organization was a failure. In the minds of many this opinion persisted for some years. In repealing the Wright act and enacting a substitute law, the legislature of 1897 had the impression that it was imposing conditions so severe that further district organization was not likely to recur for some time. This proved to be the case for twelve years, when the movement again started with the organization of South San Joaquin and Oakdale districts. Since 1909 the district law has undergone many changes and there have been very important additions, and these two decades have added many to the number of both active and inactive districts in the state.

When South San Joaquin and Oakdale irrigation districts were organized in 1909 the general feeling in the state, and particularly in the investment markets, was still against irrigation districts and irrigation district bonds, and these two districts met with many difficulties in marketing their bonds. Through the initiative of these two districts, and after much public discussion, the legislature was induced, in 1911, to pass a law creating a state commission for the investigation and certification of irrigation district bonds as legal investments for trust funds and for the funds of insurance companies, banks, and trust companies, and for state school funds; also as legal security for public funds or for the performance of any act.† This legislation created a better situation and the succeeding bond issues of these and other districts were disposed of somewhat more advantageously. The law and the public discussion of the question at issue undoubtedly changed the public attitude toward irrigation districts, although there was no marked activity in organization until several years later.

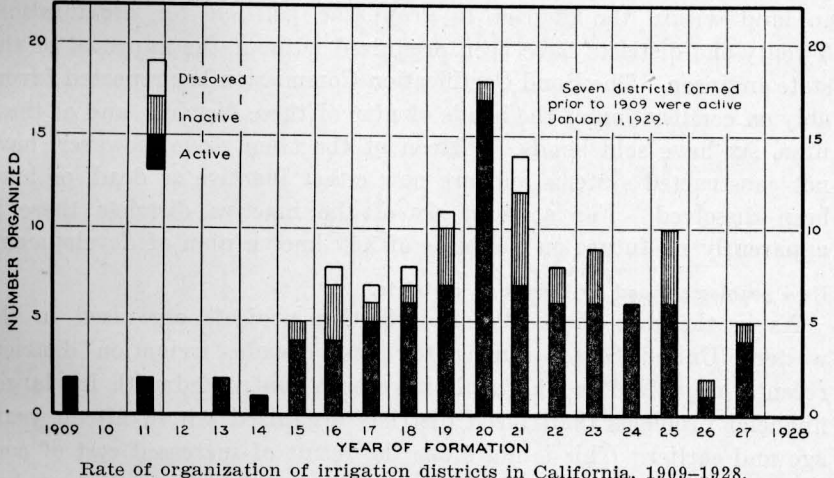
In 1911 Imperial and San Ysidro districts were formed, followed in 1913 by La Mesa, Lemon Grove, and Spring Valley, and Waterford

* State Dept. of Eng., Bul. 2 (available only in libraries). See also U. S. Dept. of Agr., Dept. Bul. 1177, Irrigation District Operation and Finance, by Wells A. Hutchins.

† Statutes of 1911, p. 322; amended special session of 1911, p. 3; 1913, p. 778.

districts. Anderson-Cottonwood District came next, in 1914. Beginning in 1915, what might be termed a new irrigation district movement started in the state, and for the next eleven years at least five new districts were organized annually, the peak coming in 1920 and 1921 with the formation of 18 and 14 districts, respectively. (Plate II.) The marked increase in district organization shown by the diagram to have begun about 1915, really had its inception several years earlier, and was a direct reflection of the optimism which then prevailed regarding the increased immigration that would follow the opening of the Panama Canal. Then came the great war-time demand for more food, followed in turn by general optimism as to the future. Under these abnormal conditions and influences communities turned to irrigation development which had not previously seriously considered it in any organized way. The only practical method of financing construction was through the district form of organization. Irrigation district bonds shared the investment market with the many other kinds of bonds that were offered after the liberty loan issues had made this form of investment popular on a wide scale. It is not surprising, therefore, that this rapid expansion in California irrigation districts took place, nor was it other than the natural result of such circumstances that some of these enterprises were unable to withstand the stress of the deflation period which followed.

PLATE II



Rate of organization of irrigation districts in California, 1909–1928.

At this writing, few new irrigation districts are being organized in California, and those that are being organized are very carefully scrutinized both by the state engineer and the bond certification commission, and also by the public, and the economic outlook of each proposed district is being carefully weighed.

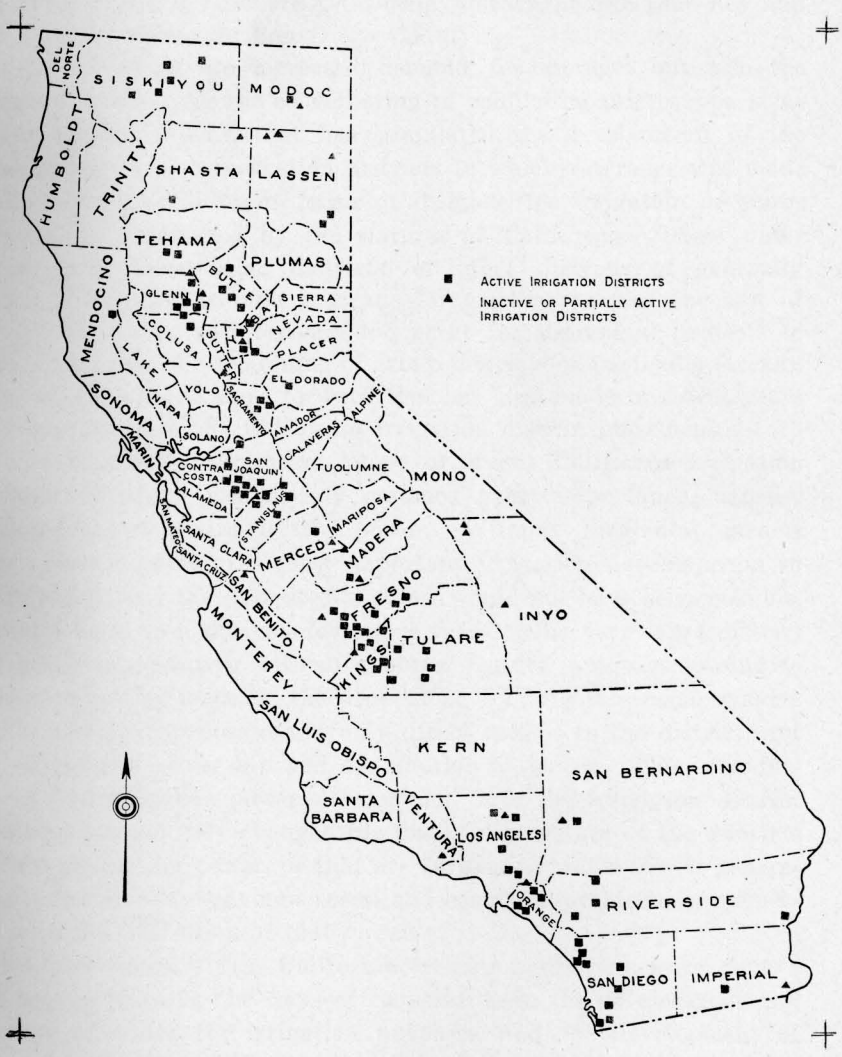
Judging from past experience in California and in other states, it seems inevitable that some irrigation districts should be formed that will never become active enterprises. It has generally been the feeling of the state engineer's office that an area of good land having available a satisfactory water supply should be permitted to organize as an irrigation district, and be given an opportunity to make its case for financing before the Bond Certification Commission, provided existing information indicates that the project can be built at a reasonable cost. Action by the state engineer on petitions for organization is, of course, in most cases, given in advance of the main engineering and economic investigations, and therefore must necessarily be subject to revision after the facts determined by those investigations have been made available. These facts may change the outlook of the district to such an extent that approval by the Bond Certification Commission is not justified. Organization of a number of such districts has been approved by the state engineer's office, only to have request for bond certification denied with the inability of the district promoters to demonstrate feasible projects.

An important factor which has led to the organization of some districts in California that are still on the inactive list, or have been dissolved, is the provision in the law permitting a district to organize after adverse report by the state engineer, provided the supervisors are petitioned by three-fourths of the holders of title or evidence of title to land within the district to grant the petition for organization. Twenty-one districts have been organized without the approval of the state engineer. The Bond Certification Commission has reported favorably on certification of the bonds of nine of these districts, and of these nine, six have sold bonds. Fifteen of the twenty-one, however, have not constructed systems and are now either inactive or dead, or have been dissolved. For at least six of the inactive districts there is apparently no future on the basis of any known plan of development.

New problems faced by irrigation districts.

As in the case of nearly all irrigation projects organized in the western United States during the past decade, irrigation districts recently organized in California have been confronted with far larger financial problems than faced districts organized ten to fifteen years ago and earlier. This is not alone the result of increased cost of construction, due to higher prices of labor, material, and equipment, but it is also due to the fact that most all recent projects have involved storage for a substantial portion of their water supplies. Some of the districts formed in California during the past ten years, particularly some of those in the Kings River and San Joaquin River areas, have, in fact, had as their principal objectives the construction of storage.

Plate III.



Sketch map showing location of California irrigation districts, 1928.

The contemplated storage on these two streams has not yet been built, but on several other streams important and expensive storage dams have been constructed, notably on Stanislaus, Tuolumne, and Merced rivers in central California, on the Yuba, Shasta and Pit rivers and Stony Creek in northern California, and on the San Luis Rey and San Dieguito rivers, in San Diego County.

It is not alone the increased demand for storage, but also the increased demand for the coordinating of conflicting interests on some of our larger streams, that has stimulated the development of the water storage and conservation districts to which reference was made in discussing the different forms of districts for irrigation or water conservation authorized by the statutes of California. These water storage and conservation districts, or other districts of generally similar form, seem to offer a means for meeting part of the cost of storage when that cost becomes too great for individual projects to carry. This plan for combining of group interests on particular streams is one of the marked steps forward that has been made in recent years in connection with the California irrigation district movement.

There is another significant phase of recent California irrigation development which has already assumed great importance, namely, development of hydro-electric power. Without incidental income from power, some of the most important irrigation developments in California during the past decade either would not have been possible, or would have been delayed for many years. One very large district that has been operating without a power feature is now proposing to develop power by utilizing the drop along its extensive canal system. In this case the purpose is not only direct income to the district, but also community ownership and distribution of power. This introduction of hydro-electric power development into the irrigation district movement has not only changed the financial structure of the districts that are generating power, or that are furnishing water for its generation; it has also brought new social and economic problems in connection with the utilization of that power.

The landowners within California irrigation districts have gone a long way in learning the ways of cooperation in the development and handling of water for irrigation purposes, and the development of hydro-electric power has brought some of the districts to a decision as to whether they will distribute this power cooperatively, as they have the irrigation water, or leave its distribution to other agencies organized specifically for that purpose.

Of the six California irrigation districts that are now generating hydro-electric power, or furnishing water for its generation, Modesto and Turlock districts have chosen to include hydro-electric distribu-

tion as a district enterprise, while Merced, South San Joaquin, Oakdale, and Nevada districts have made arrangements under which the power available from district works is either both generated and distributed, or at least distributed by public utility power companies. No attempt is made in this report to discuss the general problem of hydro-electric development in California irrigation districts, but those interested in essential facts with reference to what the districts have done and are doing in this field will find the more important data in the descriptive statements pertaining to these districts presented later.

Irrigation district development in California during the past decade has brought with it still other economic and social problems—those connected with the settlement of the areas to which irrigation water has been made available. In early days, construction of irrigation works frequently did not greatly outrun the demand for land, particularly when constructed as neighborhood, rather than as commercial, enterprises. Furthermore, construction costs per acre were low, so that interest-carrying charges were not a large factor, and were frequently offset by increase in the value of land. During the past twenty or twenty-five years, however, and especially during the past ten to fifteen years, construction costs have increased so much, and so many new enterprises have been started, that the development and settlement of lands not previously irrigated, but for which water has been made available, have become the outstanding problem in land reclamation. The situation has, of course, been made more troublesome in recent years by the inflation and deflation period associated with the war. The finding of better means of getting land more rapidly into production after water has been made available is now, therefore, one of the pressing needs connected with California irrigation districts, as it is with irrigation development in most parts of the West.

When it is realized that land in the districts is assessed at least for district bond interest, and generally also for maintenance and operation, regardless of whether it is irrigated, it is very clear that the presence in any district of large areas that are unirrigated results in great hardship. Obviously the first necessary step in eliminating that hardship is to get the land into production under irrigation, and in most cases this requires more farmers with sufficient means to carry the farm development and operation costs while waiting for the larger income irrigation and more intensive development make possible. Even a considerable lag in settlement is to be expected, but the difficulties resulting from an excessive lag constitute one of the problems that must be counted on, along with the problems of construction and finance, when planning new irrigation district development.*

* Questions relating to land settlement in California irrigation districts are very ably discussed by David Weeks and Charles H. West in "The Problem of Securing Closer Relationship Between Agricultural Development and Irrigation Construction," Bulletin 435, University of California Agricultural Experiment Station, September, 1927.

CHAPTER IV

DEVELOPMENT OF THE CALIFORNIA IRRIGATION DISTRICT LAW SINCE 1897 *

As previously indicated, there have been many changes in and additions to the California irrigation district law since its re-enactment in 1897. The larger number of these changes and additions have related, more or less, to matters of detail. Each succeeding legislature adds to these changes and additions, as one district or another finds some section or sections of the law unsuited to, or inadequate for, its needs.† There have, however, been amendments and additions, as well as supplemental acts, of such basic importance as to affect vitally irrigation development under the act. These have related chiefly to organization, issuance of bonds, and development and distribution of hydro-electric power. Other important changes or supplemental acts have had to do with assessments, improvement districts within irrigation districts as already mentioned, consolidation of districts, and drainage by irrigation districts. There have also been several important amendments to the constitution of the state in the interest of irrigation districts.

In the following pages the more important of the amendments and additions and supplemental acts will be briefly discussed.

Organization.‡

Petition for organization.—Under the original Wright act of 1887, fifty, or a majority, of the owners of lands within any proposed irrigation district could petition the board of county supervisors for its organization. This easy way of initiating the formation of a district resulted in the organization of many districts that were entirely unjustified. A very definite step in advance was made when the amended act of 1897 required the organization petition to be signed by "a majority in number of the holders of title, or evidence of title, to lands susceptible of irrigation from a common source and by the same system of works, such holders of title, or evidence of title, representing a majority in value of said lands * * *."

One other change in the sections of the law relating to organization made in 1917 has been of importance to the more populous areas, particularly those embracing cities of considerable population in which

* Following the close of each biennial session of the legislature of California, the Division of Engineering and Irrigation, State Department of Public Works, issues in bulletin form the principal irrigation district laws, with amendments to date. See State Dept. of Eng., Bul. 6 (1919); State Dept. of Public Works, Div. of Eng. and Irrig., Bul. 1 (1921); Bul. 7 (1923); Bul. 10 (1925); Bul. 18 (1927).

† In most cases amendments to the California irrigation district act are drafted or approved by the Irrigation Districts Association of California, in which all irrigation districts in the state are eligible to membership, and of which practically all active districts are members.

‡ See, also, State Dept. of Eng., Bul. 2, pp. 47, 50, 51; also chiefly sections 1, 2, 2-a, 3, 4, 5, 6, 7, 8, and 9 of the California irrigation district act.

the requirement that organization petitions must be signed by a majority of the landowners representing a majority in value of the lands proposed to be included, imposed undue hardship. This change gives an alternative requirement that petitions may be signed by not less than five hundred resident electors or landowners holding title or evidence of title to not less than 20 per cent in value of the lands in the proposed district. This amendment was originally drawn by interests seeking to bring about organization of Merced Irrigation District.

Report by state engineer.—With some amendment the above provision controlled until 1913 when, following Idaho, sections 2 and 3 of the California district act were amended to provide for report by the state engineer, on receiving a copy of the petition for organization of any district, as to "whether any condition or conditions exist that would justify him in reporting against the organization of the proposed district." *

The supervisors were authorized to change the plan of the proposed district in accordance with the recommendations of the state engineer, but if the state engineer reported unfavorably and the plan was not changed, the supervisors were required to deny the petition unless petitioned in writing by three-fourths of the holders of title, or evidence of title, to lands within the proposed district.

The provision that an adverse report on organization by the state engineer could be set aside by a three-fourths petition still persists in the law, but the provision relating to the report by the state engineer now requires the preliminary examination by that official to be made "with a view to determining the feasibility of the project proposed to be undertaken," rather than merely "whether any condition or conditions exist that would justify him in reporting against" organization. Furthermore, the state engineer is now allowed ninety days, which can be extended another like period, for his report, instead of a total of only one month, as given him in the 1913 amendment.

The above amendments to the law have now effectively overcome one of the principal deficiencies of the acts of 1887 and 1897, viz., lack of state investigation and report prior to organization of districts. The preliminary investigations of proposed districts by the state engineer have been both thorough and helpful. In some cases the advice of the state engineer prior to organization has resulted in making infeasible proposed projects feasible; in others it has led proponents of feasible districts to revise their boundaries and their plans in such manner as greatly to improve their chances for success.

* Statutes of 1913, p. 993.

Votes necessary for organization.—An important change with reference to organization of irrigation districts, made when the Wright act of 1887 was repealed and the act of 1897 substituted, was to require a two-thirds vote to carry an organization election, rather than merely a majority vote—another evidence of the intent of the legislature to stop 'wild-catting' in irrigation districts. With the requirement that the petition for organization must be signed by a majority in number of the landowners representing a majority in value of the lands to be included in a proposed district, and the further condition that the organization election must show a two-thirds affirmative vote, it became practically impossible to create an irrigation district unless the project had almost unanimous support of the community involved.

As irrigation came to be better understood, and especially after provision was made for investigation by the state engineer, the necessity for requiring a two-thirds affirmative vote on organization became less. Accordingly, but only after a bitter legislative controversy, the legislature of 1919 * changed the requirement to a majority vote. This amendment was held up on referendum but was adopted at the general election in November, 1920.

Inclusion of lands already irrigated.—Prior to 1917 there was some question whether, at the time of organization, lands already irrigated could be included within an irrigation district against the opposition of the owner or owners of such land. To make certain that such lands could be included the legislature of 1917 added to section 2 of the act the provision that "lands already irrigated and riparian lands may be included in the district if in the judgment of the board of supervisors such land will be benefited, or if the water used thereon or the rights to the use of the water thereon should, in the judgment of the board of supervisors, be taken or acquired for the district." †

Issuance and refunding of bonds.‡

Initiating bond issues and vote required to authorize them.—The ease with which bonds could be issued by irrigation districts under the Wright act of 1887—the boards of directors were authorized to call bond elections and to acquire water rights and works and property practically without restriction—led to a condition which, along with

* Statutes of 1919, p. 714.

† Statutes of 1917, p. 752.

‡ See also State Dept. of Eng., Bul. 2, pp. 47 and 48-51; also chiefly sections 30, 30-a, 30-b, 30-c, 30-d, 30-e, 31, 32, 32½, and 33 of the California irrigation district act, and the act creating the Bond Certification Commission (Statutes of 1913, p. 778; Statutes of 1915, p. 692; Statutes of 1917, p. 582; Statutes of 1919, p. 1207; Statutes of 1921, p. 1198), and the refunding acts approved April 1, 1897 (Statutes of 1897, p. 394, amended by Statutes of 1901, p. 514), and May 25, 1919 (Statutes of 1919, p. 1004).

the matters relating to organization already discussed, the legislature of 1897 sought to correct in the substitute irrigation district act which it passed. The new act provided that a petition signed by a majority of the landowners, representing a majority in value of the lands—identical with the requirement for organization—should precede the calling of any bond election and any purchase of works or other real property at a price exceeding $10,000. This requirement was changed in 1919 * to give the directors authority on their own initiative to call bond elections, with the condition that at an election so called, a two-thirds affirmative vote shall be necessary to carry the bonds. At the same time, however, authority was given the district to issue bonds on an affirmative majority vote, provided the directors have been requested to call a bond election in a petition signed by a majority of the holders of title to lands in the district, representing a majority in value of such lands, or by at least five hundred resident electors or landowners representing not less than 20 per cent in value of the lands.

Examination by Bond Certification Commission.—The most fundamental advance that has been made in connection with the issuance of bonds by irrigation districts since the passage of the irrigation district act of 1897 concerns the steps required prior to calling bond elections and the certification of irrigation district bonds by the state controller.

Under the irrigation district act as now in force, before the directors of a district may call an election for the issuance of bonds for the purpose of constructing or acquiring works or for acquiring other property, it must submit its plans, together with an estimate of the cost of the works proposed to be constructed or of the works or property to be purchased, and of the amount of bonds it desires to issue, to the State Bond Certification Commission. This commission, first authorized in 1911,† is composed of the state engineer, the attorney general of the state, and the state superintendent of banks. Originally, this commission was to pass on proposed bond issues after they had been voted, all examinations of proposed construction plans being left to the state engineer. The law creating this commission was revised and reenacted in 1913 and has been amended on numerous occasions since then.‡

In passing on applications by irrigation districts to issue bonds, the Bond Certification Commission states generally its conclusions

* Statutes of 1919, p. 660.

† Statutes of 1911, p. 322 amended special session 1911, p. 3.

‡Statutes of 1913, p. 778; amended Statutes of 1915, p. 692; 1917. p. 582; 1919, p. 1207; Statutes of 1921, p. 1198.

regarding such questions as water supply; soil; probable amount of water that will be required; probable need of drainage; cost of works, rights, and other property; proper dates of maturity for bonds; and whether in its opinion it is advisable to proceed with the proposed bond issue. The commission is not given veto power over the voting of bonds, but if later the district issues bonds to carry out any plans 'approved' by the commission, no material change in such plans can be made without the consent of the commission. Furthermore, section 3 of the bond certification commission act provides that after the bonds of an irrigation district have been enumerated and described as entitled to certification, "it shall be unlawful for that district to issue bonds that will not be entitled to such certification."

While, as above indicated, the Bond Certification Commission can not prevent the calling of a bond election and the voting of bonds, the commission in effect is able to do so by an adverse report, because it would be an exceptional case in which a proposed issue that has not been 'approved' by the commission prior to the bond election, would be authorized by the electors at the election. Without the subsequent 'approval' of the commission, there could be no certification by the state controller, and the bonds would remain practically unsaleable.*

The activities of the Bond Certification Commission in connection with a proposed bond issue, and before the bond election is held, are covered by the bond sections of the California irrigation district act. Activities of the commission with reference to certification, which follows authorization of the bond issue by the electors of the district, are prescribed by the supplemental act approved April 13, 1913, as amended, generally referred to as the "bond certification commission act."

The investigation of proposed expenditures from the proceeds of proposed bond issues is an exceedingly important proceeding and is so recognized by the commission, the districts, and interested bond dealers. Up to July 1, 1928, the commission had reported favorably on the certification of 149 separate irrigation district issues, totaling approximately $140,000,000, of which approximately $96,000,000 was then outstanding. The engineering phases are passed on by the state engineer, the legal phases by the attorney general, and the financial phases by the superintendent of banks. Economic and agricultural questions, although passed on by the entire commission, are usually investigated in detail by one or more experts employed especially for

* In a few cases uncertified bonds of California irrigation districts have been sold or otherwise disposed of. Such cases are noted in the detailed statements regarding the different districts which follow.

that purpose by the commission. After investigation, the commission is required to report in writing "upon such matters as it may deem essential," and particularly upon the following:*

(*a*) The supply of water available for the project and the right of the district to so much water as may be needed.

(*b*) The nature of the soil as to its fertility and susceptibility to irrigation, the probable amount of water needed for its irrigation, and the probable need of drainage.

(*c*) The feasibility of the district's irrigation system and of the specific project for which the bonds under consideration are desired or have been used, whether such system and project be constructed, projected, or partially completed.

(*d*) The reasonable market value of the water, water rights, canals, reservoirs, reservoir sites, and irrigation works owned by such district or to be acquired or constructed by it with the proceeds of any of such bonds.

(*e*) The reasonable market value of the lands included within the boundaries of the district.

(*f*) Whether or not the aggregate amount of the bonds under consideration and any other outstanding bonds of said district, including bonds authorized but not sold, exceeds sixty per centum of the aggregate market value of the lands within said district and of the water, water rights, canal, reservoirs, reservoir sites, and irrigation works owned, or to be acquired or constructed with the proceeds of any of said bonds, by said district, as determined in accordance with paragraphs (*d*) and (*e*) in this section.

(*g*) The numbers, date or dates of issue, and denominations of the bonds, if any, which the commission shall find are available for the purposes provided for in section 7 of this act, and, if the investigation has covered contemplated bonds, the total amount of bonds which the district can issue without exceeding the limitation expressed in paragraph (*f*) of this section.

It is to be noted that the bond certification commission is not required to report on the economic feasibility of irrigation districts, although authority for so doing probably is given in the provision that the commission shall report on "such matters as it may deem essential." At the time the bond certification commission act was passed, the districts were unwilling to extend this authority specifically. The need for consideration of economic feasibility is now recognized by the Irrigation Districts Association, and as a matter of

* Section 3-a of the bond certification commission act provides as follows: "The provisions of section 2 of this act as to the points upon which said commission shall report are directory, merely, and the board may authorize such certification when in their opinion, subject to the provisions otherwise contained in this act, their findings justify such action."

fact, economic considerations have by no means been overlooked, even if not previously stressed as much as at present.

Certification by state controller.—Certification of bonds 'approved' by the commission as above indicated is a function of the state controller. When a bond is so certified it becomes "a legal investment for all trust funds and for the funds of all insurance companies, banks, both commercial and savings, trust companies, the state school funds, and any funds which may be invested in county, municipal, or school district bonds, and it may be deposited as security for the performance of any act whenever the bonds of any county, city, city and county, or school district may be so deposited, * * *."

State control of expenditures.—When the bond commission act was first passed, the commission was given no authority over the expenditures made from the proceeds of certified bond issues. After much discussion, the act was amended in 1921 * to provide that whenever the bonds of any irrigation district have been certified, no expenditures can lawfully be made from the proceeds of the bonds, nor any liability to be met from such proceeds incurred, until the commission has approved a schedule of the proposed expenditures. Furthermore, during the progress of any work to be paid for from the proceeds of bonds which the commission has certified, the state engineer, on behalf of the commission, is required by the act to make such inspections as are necessary to enable him to know that the plans are being carried out without material modification unless approved by the commission.

Character and importance of state control of irrigation district organization and financing.

State control of organization and financing, and to a certain extent of construction, has within a period of about fifteen years greatly improved the standing of California irrigation districts. Effective control was at first accepted reluctantly by the districts. Even now, with the advantages of state control clearly evident, so strong is the feeling in favor of local control, that some districts still oppose further extension of state authority. However, in its administrative supervision of irrigation districts the state is performing a service of great value to the districts, and there seems to be more likelihood of this supervision being strengthened than of its being weakened. The only question really at issue is how this state supervision can most effectively and most satisfactorily be extended.

The exercise of state control through an ex officio state commission has not at all times operated to the complete satisfaction of the members of the commission, or perhaps to the districts. Improvement doubtless could be made, and opinion seems to be crystallizing toward

* Statutes of 1921, p. 1198.

a more centralized administration. On the other hand, some of the farm organizations of the state at one time proposed that the present commission be enlarged to include the Dean of the College of Agriculture for the purpose of insuring increased consideration of questions of agricultural and agricultural economic feasibility at the time districts are organized, or when bond issues are authorized for certification by the state controller. Still another proposal was made at a recent meeting of the California Irrigation Districts Association to the effect that the association be made an independent official state body for the purpose of strengthening irrigation district bonds by means of a fund to be supplied by assessments on all of the active irrigation districts of the state and a tax on all future irrigation district bond issues; and for other purposes in connection with irrigation district affairs. This proposal was not, however, approved by the association. Recent defaults by certain California irrigation districts in the payment of bond interest or principal, or both, had awakened the association to the need for greater caution in future irrigation district financing, and many of the members of the association believed that there should also be some form of guarantee of bond interest. However, it appears that no action along this line will be taken by the legislature of 1929. A proposal for a state guarantee fund was considered at several recent legislative sessions,* but was not adopted.

There has been some misconception, especially among purchasers of irrigation district bonds, that state certification of bonds constitutes state approval. While it is true that the term 'approval' is used occasionally in the California irrigation district act in referring to the action of the Bond Certification Commission, the bond certification act does not provide for approval by the commission. On the other hand, the bond certification commission act only directs the commission to investigate and report on proposed irrigation district bond issues, and to state its conclusions on the specified matters listed above. If it finds that certain conditions set forth in the act are met and "that the irrigation system of the district, and the specified project for which the bonds under consideration are desired or have been used, whether such project be constructed, projected, or partially completed, are feasible * * *," such bonds shall be certified by the state controller.

The fact that an irrigation district project is feasible is in no sense proof that its obligations will all be met promptly as due. After physical, legal, and financial feasibility, the essence of soundness in an enterprise is good management, and over this, except in connection with the expenditure of the proceeds of certified bonds, the state

* Legislature of 1927, Senate Bill 586.

now has no control whatever, nor is there probability that such control will be given to or accepted by the state. Certainly there has not yet been any move in that direction, other than a proposal, which has not been adopted, that under certain conditions of default the state should assume control and management until the default shall have been met.

State approval of irrigation district bonds has been considered by some uninformed purchasers of such bonds as being equivalent to a state guarantee. Such a conclusion, however, is not justified either by the bond certification commission act, or by the nature of the action taken by the commission or the state controller. State guarantee would be tantamount to extension of state credit to irrigation districts. The giving or lending by the legislature of the credit of the state, except in certain specified instances which do not include irrigation districts, is definitely prohibited by the state constitution.*

Refunding of bonds.—The first bond refunding act was passed in 1897 and amended in 1901.†

Under this act the bonds of several of the original 'Wright act' districts were refunded. The next enactment was approved May 25, 1919,‡ and related only to the refunding of bonds "lawfully issued prior to January 1, 1913." Under this act a majority of the directors of a district could call an election on the proposition of refunding, without the circulating and signing of a petition therefor. In 1923§ provision for refunding was put into the irrigation district act in section 32-a thereof. Under this section the board of directors, by vote of a majority of its members, may, as in the case of the act of 1919, call an election on refunding. Refunding bonds are to be issued and sold substantially as other bonds are issued and sold under the California irrigation district act and the act creating the Bond Certification Commission; *provided,* that maturities of refunding bonds are subject to approval of the Bond Certification Commission. They may be sold or exchanged for outstanding bonds.

As will be seen from the statements relating to the various irrigation districts appearing later in this report, a number of districts have refunded or are in process of refunding previous issues, viz: Cordua, Glenn-Colusa, Williams, Compton-Delevan, Naglee Burk, and Palo Verde.

Excepting the refunding of early 'Wright act' districts at the time of their financial reorganization, refunding has thus far been resorted to only in cases of relatively early maturities.

* Article IV, section 31.
† Statutes of 1897, p. 394; amended Statutes of 1901, p. 514.
‡ Statutes of 1919, p. 1004.
§ Statutes of 1923, p. 628.

Development and distribution of hydro-electric power by irrigation districts.

Reference has been previously made to the importance of hydro-electric power in connection with some of the irrigation district projects constructed in recent years. This activity is provided for in an act entitled "An act to provide for the development of electrical power by irrigation districts," approved May 21, 1919.*

Under this law irrigation districts are authorized to provide for the construction, acquisition, operation, leasing, and control of works for generation, distribution, sale, and lease of electrical energy. By this law the California irrigation district act is made applicable also to power, and a district may sell power outside of its boundaries, and is not required to distribute power controlled by it in accordance with district assessments.

A second act relating to power, approved May 25, 1923,† grants to irrigation districts the right to "construct, operate, and maintain electric light and power lines along or upon any road, street, alley, avenue, or highway, or across any railway, canal, ditch or flume." Certain conditions are imposed with reference to use of streets within cities.

Redemption of property sold for delinquent district assessments.

As originally adopted, the irrigation district act of 1897 allowed redemption of land sold for district taxes within one year from date of purchase. This was changed in 1909‡ to allow redemption within five years from date of purchase, "or at any time thereafter before a deed has been made and delivered." Under pressure from investment bankers the period of redemption was reduced to three years in 1921§ and it so remains today, except that property sold for assessments may be redeemed at any time before a deed has been issued. Further amendments were made in 1925 and 1927‖ with reference to the rights of districts to property acquired by them at tax sale. Under the last amendment the district has the same rights as a private purchaser, including "the rents, issues, and profits thereof," and the property can not be redeemed after the district takes a deed to it. These recent changes were intended to ease the financial situation in districts carrying a large amount of property acquired by tax deed, these amendments enabling districts to dispose of such property, and if possible to get it into the hands of owners who will pay district assessments.

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* Statutes of 1919, p. 778; amended 1921, pp. 829 and 1083; 1923, p. 629.
† Statutes of 1923, p. 449.
‡ Statutes of 1909, p. 429.
§ Statutes of 1921, p. 1109.
‖ Statutes of 1925, p. 429; Statutes of 1927, chapter 101.

Enforcement of the levying and collection of assessments.

One of the situations arising under the Wright act of 1887 that caused much unfavorable comment, and involved evasion of obligations by some of the old irrigation districts, grew out of the refusal of the officers of those districts to levy assessments to pay outstanding bond interest and principal and other overdue obligations. In fact, that was not an uncommon occurrence when some of the old districts came under the control of those who constituted the 'opposition.' The revised act adopted in 1897 made it the duty of the county supervisors to levy required assessments when not levied by the directors of the district, also substituting the county assessment roll for the roll the directors should have made up, and the county tax collector and county treasurer, if the district collector or treasurer should refuse to act. No instance has been found in which this procedure has been followed in connection with any district organized under the California irrigation district act, and no instance within at least 20 years in connection with one of the old Wright act districts.

In a revision of various sections of the law in 1913, sponsored by the Irrigation Districts Association, section 39 of the irrigation district act was amended * to make it the duty of the district attorney of each county in which the office of any irrigation district is located to ascertain each year whether the duties relating to the levying and collection of assessments have been performed by the directors of the district or the county officers, as the case might be, and to take such action in court as may be necessary to compel performance of their duties.

To increase further the force of law behind the levying and collection of assessments, it was made the duty of the attorney general of the state to act in case of failure of the district attorney and other officers named to do so. However, to avoid opening up any case involving an old, defunct Wright district, the amendment specified that the attorney general should act only for the enforcement of the levying and collection of any assessment "hereafter required to be levied and collected for the payment of any debt hereafter incurred." In addition, other minor amendments in connection with the enforcement of assessments and collections have from time to time been made.

While these amendments regarding the enforcement of the levying and collection of assessments are undoubtedly of potential value in strengthening the law, no case is of record in which either the district attorney or the attorney general has been called on to act.

* Statutes of 1913, p. 59.

Adjustment of installment payments of assessments.

An act approved March 19, 1909,* permitted boards of directors to provide for the payment of district assessments in two installments, instead of only one as then provided in the irrigation district act. In 1927 this act was repealed and the matter of payment of assessments in installments was inserted in the irrigation district act as section 41-c thereof. This 1927 amendment also authorizes the directors to specify the percentage of the assessment that is to be included in each installment. This provision enables districts so to adjust the payments of annual assessments as to meet their particular needs. Several districts have taken advantage of the authority given by the amendment.

Consolidation of irrigation districts.

In several cases consolidation of irrigation districts has been found desirable. This was authorized by an act approved May 31, 1921, and amended in 1925.†

Consolidation of two or more irrigation districts is accomplished by the following procedure: (a) adoption by the directors of the districts concerned of resolutions for consolidation; (b) investigation and report by the state engineer, the state engineer having authority to make such investigation as he deems necessary and to recommend the elimination from the original districts of any lands whose elimination he thinks desirable, and the portion, if any, of the assessments previously paid which equitably should be returned to their owners; to set out the boundaries of the consolidated district recommended and the five divisions into which it is to be divided; and to recommend such apportionment to the lands of the respective districts of any outstanding indebtedness of such districts as he deems equitable; (c) election on consolidation in each of the consolidating districts, a majority affirmative vote in each being required to effect consolidation, officers of the consolidated district being elected in the same election; (d) if the election carries, apportionment by the directors of the consolidated district of the outstanding indebtedness of the districts that have been consolidated; and finally, (e) an order by the directors of the consolidated district declaring consolidation effective and setting out the date when effective, and the boundaries of the consolidated district.

A consolidation may be initiated by the boards of directors of the districts proposed to be consolidated, or by petition signed as a petition for organization of an irrigation district must be signed. On receipt of such a petition for consolidation, action favorable to consolidation is mandatory on the directors. If the state engineer deems consolidation

* Statutes of 1909, p. 415.
†Statutes of 1921, p. 1018; amended by Statutes of 1925, p. 802.

not desirable or should fail to report within ninety days, the directors of the districts proposing consolidation may still proceed with the calling of an election on consolidation.

Under the terms of this act there have been two important consolidations, viz: by Glenn-Colusa and Williams districts, under the name of the former, and by Brentwood, Knightsen, and Lone Tree districts, under the name of East Contra Costa Irrigation District. Other consolidations are being given some consideration.

Drainage by irrigation districts.

The California irrigation district act contains no provision for drainage by irrigation districts. However, such districts are authorized to provide drainage by an act approved March 18, 1907.* At the time this act was passed an effort was being made to draft a satisfactory drainage district law applicable particularly to waterlogged irrigated lands. Modesto and Turlock irrigation districts were then foreseeing the need for drainage, and it was obvious that the irrigation district law could be made to apply to drainage as well as to irrigation, and that doing this would obviate the necessity for the formation of drainage districts with irrigation districts.

The drainage act as passed in 1907 has not been amended. It extends to irrigation districts the right to use all powers granted for irrigation purposes for the additional purpose of drainage. The act, in fact, makes it the duty of the boards of directors of irrigation districts to provide for drainage. Under the authority and direction of this law, every irrigation district in the state requiring drainage includes it in the district activities. In some irrigation districts, as appears in the statements regarding the several districts which follow, drainage is one of the very important functions. In several cases drainage activities by irrigation districts have practically eliminated very serious conditions of high ground water of long standing.

Constitutional amendments.

The constitution of California has been amended on numerous occasions in the interest of irrigation districts. Perhaps the most important of these amendments is that to article XI, section 13½, adopted November 3, 1914, which added the provision "that the legislature shall have power to provide for the supervision, regulation, and conduct, in such manner as it may determine, of the affairs of irrigation districts, reclamation districts, or drainage districts, organized or existing under any law of this state."

* Statutes of 1907, p. 569.

Another important amendment was the addition of section $1\frac{3}{4}$ to article XIII, adopted November 4, 1902, including irrigation districts within the state among those districts the bonds of which shall be exempt from taxation. Two other important amendments of general interest are the following: a provision in article I, section 14, that irrigation districts shall be included among the agencies which, in actions in eminent domain, "may take immediate possession and use of any right of way required for a public use * * * upon first commencing eminent domain proceedings * * *" (adopted November 5, 1918); an addition to article IV, section 31, that irrigation districts "for the purpose of acquiring water and water rights and other property necessary for their uses and purposes, may acquire and hold the stock of corporations, domestic, or foreign, owning waters, water rights, canals, waterworks, franchises, or concessions subject to the same obligations and liabilities as are imposed by law upon all other stockholders in such corporation * * *."

CHAPTER V

ACTIVE CALIFORNIA IRRIGATION DISTRICTS*

In the preparation of the following historical and descriptive statements regarding the active irrigation districts in California, the purposes in mind have been:

(1) To present such of the salient facts in their histories as are needed to furnish a perspective for understanding their present situations and problems. In the case of a few of the districts which have been pioneers in the district movement, which embrace very important areas, or which have evolved from important developments of other form or forms, these historical statements have been somewhat extended in order that together they may set forth a rather complete picture of the problems that have been encountered and met in the irrigation district movement in California.

(2) To describe generally the soil and agricultural conditions in each district, and the present extent of development.

(3) To set forth the nature and extent of the irrigation water supply in enough detail to indicate generally its sufficiency and reliability.

(4) To show the extent irrigation water is being used and generally how and under what conditions it is distributed and delivered.

(5) To describe generally the principal irrigation works and the structures of magnitude.

(6) To set forth the amount of district indebtedness and how it is being met.

(7) And finally to show the amounts of the annual irrigation charges lands in the districts pay, and the procedure followed in levying and collecting these charges.

The chief sources of the information presented in the following pages have been (1) data gathered from the districts during 1928; (2) official and nonofficial records and data on file in the office of the state engineer and of the California Bond Certification Commission; and (3) the information accumulated by the Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture, and the Division of Irrigation Investigations and Practice, College of Agriculture, University of California, during many years past.

In the case of most of the Sacramento Valley districts, Tule and Baxter Creek districts, South San Joaquin District, and Merced Dis-

* Generally speaking, irrigation districts are classed as 'active' in this report if they are established operating enterprises, or if they have adopted definite plans and are engaged in the stages preliminary to constructing or acquiring an irrigation system, or a storage supply for an existing system.

trict, very thorough economic studies made for the Division of Agricultural Economics of the College of Agriculture and the Federal Land Bank of Berkeley, by David Weeks and Charles H. West, have been available and of much assistance. With very few exceptions all of the districts in the state have been visited by the writer and all of them have been visited during 1928 by one or more of the assistants engaged in the inquiry, viz: Vernon Givan, John H. Peaslee, Martin R. Huberty, and Jerald E. Christiansen. Reports prepared by these assistants have been submitted to the irrigation districts and either revised or accepted by them as written. Copies of the reports have then been filed in the office of the state engineer as a public record. By the thoroughness and accuracy of their field work and their good judgment in contacts with the officials of the irrigation districts, the assistants above named have been able to assemble essential and dependable information relating to every active irrigation district in the state.

For information presented in the statements which is not included in the field reports obtained during 1928 the writer has drawn mainly on his own contacts with most of the districts, in conjunction with or independently of former State Engineer Wilbur F. McClure and his assistants in administrative investigations of irrigation districts during the period 1912 to 1926.

That there have been mistakes in the organization and management of irrigation districts in California can not be denied, just as it can not be denied that the accomplishments of many of them reflect great credit on their engineers and officers. It is not the part of this report, however, either to emphasize the mistakes or unduly to commend that which has been commendable. The purpose has rather been, in the main, merely to state the salient facts without more than explanatory comment. Matter covered in previous publications is not reproduced in any extended form but is referred to in the text or in footnotes.

An attempt has been made to obtain the bonded indebtedness in each irrigation district other than irrigation district bonds; also to obtain the portion of the county assessment that covers the land inside of each irrigation district. Because there is no exact method of arriving at these figures, the results are only approximations, although they are believed to be sufficiently near the truth to justify inclusion. However, bonds issued by some of the smaller special assessment districts lying wholly or partly within irrigation districts are not included.

In addition to the above, an attempt has been made to estimate the county assessed valuations on property within the irrigation districts. It should be borne in mind that these do not purport to represent true values. According to the last biennial report of the State Board of Equalization, county assessed valuations represent an average of 42 per cent of valuations as appraised by the Board of Equalization, the percentages in the various counties ranging from 24.24 to 63.16.

In the statements which follow regarding the individual districts, the districts are arranged in geographical order, generally from north to south. This order has been somewhat varied, however, to permit the grouping of districts obtaining their water supplies from the same stream or situated within the same general region.

BUTTE VALLEY

Location: about 7.5 miles south of California-Oregon line, in Siskiyou County. (Pl. IV.)
Date of organization election: December 4, 1920.
Gross area: 28,686 acres; **area assessed 1927:** 20,595 acres.
Principal town: Macdoel.
Post office: Macdoel.
Railroad transportation: Cascade line of Southern Pacific railroad.

History.—Settlement in Butte Valley began about 1880 when most of the land was acquired by cattle men. A little over 20 years ago, after construction of the railroad from Weed to Klamath Falls, Oregon, subdivision of the valley into smaller holdings was begun. A large number of settlers acquired relatively small holdings, but difficulties were encountered and most of these settlers left within a few years. Efforts have been made from time to time since then to work out a plan of development for the valley, the organization of Butte Valley Irrigation District being the last definite step in that direction.

Soils, topography and climate.—A preliminary soil survey of Butte Valley was made in 1907.* Light or sandy soils occur in the southern part of the valley, extending 2 or 3 miles north of Macdoel and along the eastern border, while heavier or loamy soils are found in the areas near Butte Lake and over the valley floor north of Macdoel. The district boundaries include 7700 acres in Butte Lake. The surface of the valley floor is flat. Ground water is found 6 to 10 feet below the surface over most of the district. About 5000 acres has been provided with open drains which have not yet been put to test because of the dry seasons through which the district has been passing.

The average elevation is about 4260 feet. A 9-year rainfall record shows mean precipitation of about 15 inches. The growing season, however, is short and uncertain. Weather Bureau records extending from January, 1907, to June, 1915, showed mean summer temperatures as follows: April, 41.9°; May, 47.8°; June, 53.6°; July, 62.9°; August, 61.7°; September, 54.3°. During these months the mean minimum temperatures ranged, during the 9-year period, from 26.7° in April to 43.2° in July and down to 34.4° in September. The lowest recorded temperatures during these months were 9° in April, 17° in May, 16° in June, 22° in July, 21° in August, and 15° in September.

Development.—Reference has already been made to development. An attempt to carry out a colonization program along with the construction of the irrigation system did not prove very successful and the present population of the district is only about 200, of whom about half live within the unincorporated town of Macdoel. The county assessment roll for 1922 showed a value of $116,405 for 27,665 acres. There has been no segregation of county assessment since then, but it is

*U. S. Dept. of Agr., Bureau of Soils, The Soils of Butte Valley, California.

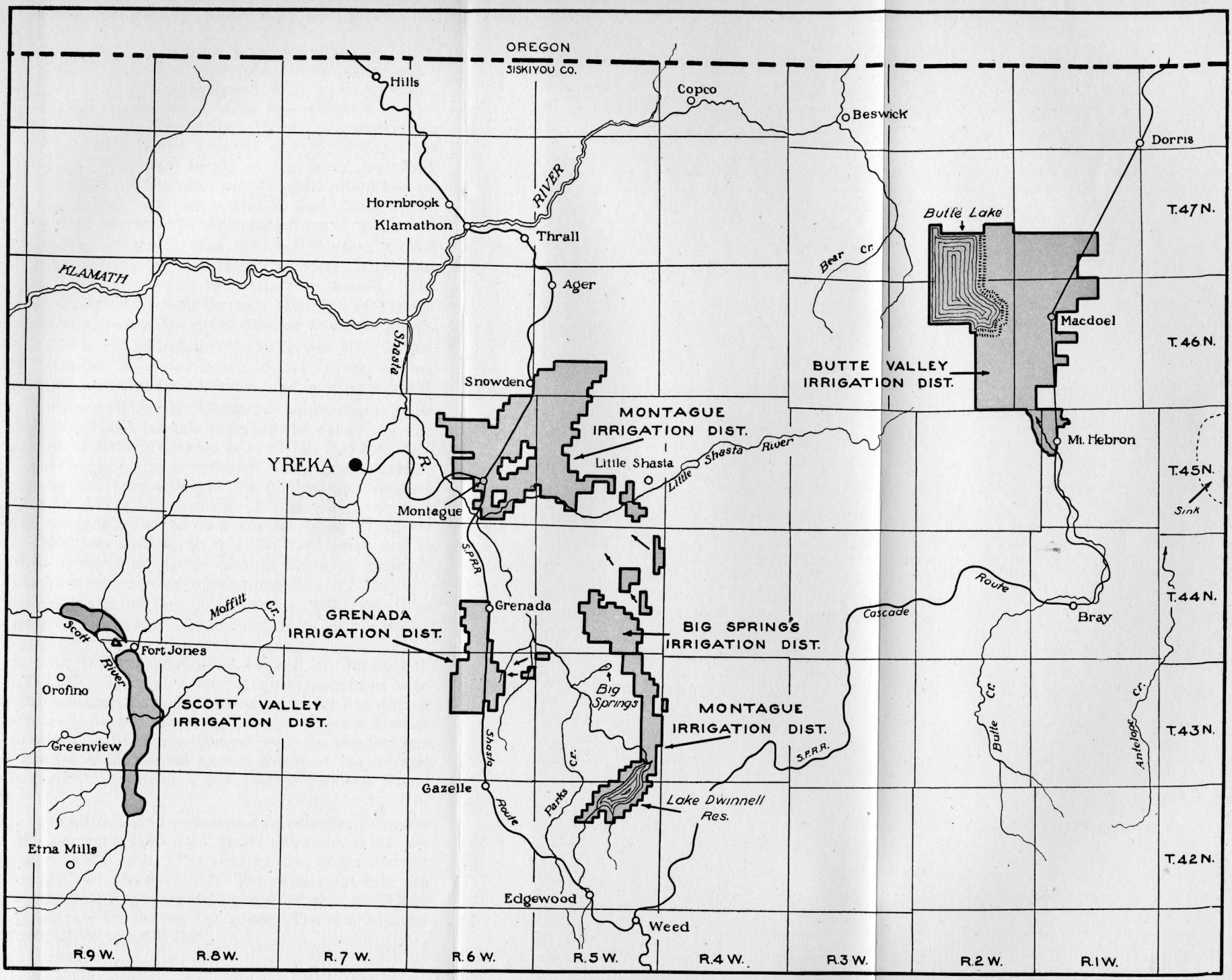
reported that there has been very little change. There is one holding of 3130 acres and another of 1820 acres within the irrigable area of the district. The total number of ownerships, exclusive of the town of Macdoel, is about 180, averaging approximately 90 acres each.

Water supply.—The engineer of the district estimates that 81,400 acre-feet of water is available in the average years, although there is a considerable variation. The sources of supply are Butte and Antelope creeks, which drain from the north slopes of Mt. Shasta into sink holes in the valley; Bear Creek, heading in the Siskiyou range west of the district and naturally tributary to Klamath River; Prather Creek, heading in the mountains west of Mt. Hebron and flowing into Butte Lake; and Morrison and Icy creeks, which are small tributaries of Butte Lake. Water can be supplied to the district by gravity from Butte, Antelope, and Prather creeks, but the summer flow is not sufficient, so that storage must be resorted to in Butte Lake. Bear Creek is diverted directly for storage in the lake. The plan of utilizing the waters is to use gravity flow whenever available and thereafter pump from Butte Lake.

The district has received the following permits from the State Division of Water Rights: 1114, priority date of February 28, 1921, allowing 100 cu. ft. per sec. from Butte Creek during the period May 1 to October 1, and 10,000 acre-feet storage in Butte Lake; also 150 cu. ft. per sec. direct diversion from Antelope Creek during the same period, and 10,000 acre-feet storage in Butte Lake; 1115, priority date of May 10, 1921, allowing 100 cu. ft. per sec. direct diversion from Bear (or Shovel) Creek between May 1 and October 1, and 5000 acre-feet storage in Butte Lake; and 1116, priority date of August 31, 1921, for 10,000 acre-feet storage in Butte Lake. The supply available is estimated to be sufficient in normal years, but there was a shortage in 1925 and 1926. Butte Lake is estimated to have a storage capacity of 62,000 acre-feet. No data are available as to the amounts that have been diverted. Some question has arisen as to the quality of Butte Lake. The report of the soil survey previously referred to, which was made in 1907, stated that the lake contained considerable quantities of black alkali. Locally, however, the lake waters are not considered dangerous to use.

Works.—The construction work of the district was done under a construction program calling for an expenditure of $593,623, of which $287,875 was for actual construction work, which was not to include the Bear Creek diversion or second unit of pumps. The system which has been built, however, consists of the following: weirs, canals, and regulation works for the diversion of Antelope, Butte and Bear creeks; 21 miles of main canals, 22 miles of small laterals, and 6 miles of drains; a pumping plant with two 30-inch centrifugal pumps operated by 250 h.p. motors, one lifting water 38 feet and the other 24 feet; a 10-inch booster pump operated by a 75 h.p. electric motor.

Antelope Creek is diverted about 15 miles south of the district through a short canal and natural channel into Butte Creek, the diversion weir consisting of a concrete turnout and a rock and earth wing dam about 60 feet long and 3 feet high. Butte Creek diversion, which is similar, is made on the Boyes ranch at the south end of the district.



Location and boundary map of irrigation districts in Butte, Shasta, and Scott Valleys.

Water is taken through about 7 miles of canal into Prather Creek. The Bear Creek diversion consists of a wing dam 150 feet long and 3 feet high, headworks and gates being equipped with fish screen and three automatic-trip emergency spillways. The first 400 feet of conduit is a wooden flume, which is followed by 0.75 mile of canal which discharges through 1600 feet of 34-inch inverted steel siphon into the lower section of the canal. The total length of the canal, including flume and siphon, is 3.6 miles. Structures on the distribution system include 120 turnouts, 35 checks, 30 culverts, and 30 farm bridges, the culverts being of corrugated iron and the other structures of wood.

Water pumped from Butte Lake is first diverted through a feed canal about 4 miles long, varying in cut from 0 to 25 feet, at the end of which the pumping plant previously referred to is located. The pumps discharge into the high-line canal through 1100 feet of 42-inch redwood stave pipe and into the low-line canal directly from the pump.

The total investment in works to January 1, 1928, was $552,703.37. Property purchased included the Boyes ranch of 2148 acres, costing $45,000, and 4420 acres of easement for reservoir land, costing $19,890.

Use and delivery of water.—Water is delivered to approximate units of 160 acres, the main canal and laterals covering the entire district. No record of the amount of water delivered is available, but it is estimated that 1.5 to 2 acre-feet per acre is sufficient under proper irrigation methods. The rules and regulations of the district provide that in no case shall water be delivered in excess of 2 acre-feet per acre irrigated. In general, water is delivered on a rotation basis. The area reported irrigated in 1926 was 1360 acres, in 1927, 2260 acres, and in 1928, 4660 acres, 3600 acres of the latter amount being in grain or grain hay. Some measurement weirs were being installed in 1928.

Bonds.—The district has put out one bond issue of $594,000. The entire issue was outstanding January 1, 1928. Owing to lack of settlement the district has not been able to meet its bond interest payments in full. Default began with 1927, the defaulted interest on January 1, 1928, amounting to $53,610. Through a temporary arrangement with a bondholders' protective committee, bond interest payments due during a period of five years are to be postponed in order to give the district an opportunity to develop. A final arrangement with the bondholders is pending. Other bonded indebtedness against lands of the district amounts to only about $130, this being a pro rata of Siskiyou Union High School bonds.

Assessments.—All agricultural land is assessed for district purposes at the flat rate of $40 per acre, land held under easement at $1 per acre, and lots in Macdoel at $50 each. The total amount of the district assessed valuation for 1927–28 was $771,375. The assessment rate per $100 valuation during the past five years has ranged between $4.70 and $6.50, the latter being the rate for the last two years. The total amount of the district levy for 1927–28 was $50,139.

MONTAGUE WATER CONSERVATION DISTRICT*

Location: Shasta Valley, east and southeast of Yreka, in Siskiyou County. (Pl. IV.)
Date of organization election: May 5, 1925.
Gross area: 26,117 acres; **area assessed 1927:** 22,424 acres.
Principal town: Montague.
Post office: Montague.
Railroad transportation: Shasta route of the Southern Pacific railroad.

History.—Shasta Valley was settled in the early days of California history, the first water-right filing dating from 1850. Up to about 15 years ago irrigation was confined to areas that could be reached by gravity diversion of the unregulated flow of Shasta River and tributaries, with some pumping from Big and Little Springs. A seasonal study of the use of water in the valley in 1912† showed 46 diversions from Shasta River, exclusive of Little Shasta River, irrigating a total of about 6500 acres, 7 from Big and Little Springs irrigating approximately 1000 acres, and 15 from Little Shasta River and adjacent springs irrigating 4498 acres.

A preliminary survey for a Shasta Valley project to be watered from Klamath River was made by the U. S. Reclamation Service in 1905, but the project was not undertaken. In 1912 the Shasta River Water Association was formed for the purpose of constructing a pumping project for lands near Montague, west of Shasta River. During the following three years the Big Springs and Lucerne water companies were formed, the stock of these companies being absorbed by another company known as Mount Shasta Land and Water Company. Pumping systems were built by both Big Springs and Lucerne water companies, but neither project was very successful and financial reverses followed. In 1919 an attempt was made by the financial interests back of these projects to organize "Shasta Irrigation District" to take over their works and to make improvements and extensions, but the project was reported on unfavorably by the state engineer and was dropped. In 1921 Grenada Irrigation District was organized to take over the Lucerne water system and for the time being the Big Springs company remained as a mutual organization.

After the proposed Shasta Irrigation District was dropped others interested in irrigation development in Shasta Valley decided to make a comprehensive study of irrigation possibilities in the valley and again to consider Klamath River as a source of supply. Accordingly, Klamath-Shasta Valley Irrigation District was organized for that purpose October 4, 1921, by a vote of 878 to 57. The gross area included was 287,000 acres, of which 115,000 acres was estimated to be irrigable. The U. S. Reclamation Service, the California State Department of Engineering, and Klamath-Shasta Valley Irrigation District contributed $55,000 for a new investigation by the Reclamation Service. A

* Section 109*a* of the California irrigation district act permits the name of any irrigation district to be changed by substituting for 'irrigation' the words 'water conservation' upon filing with the county board of supervisors of a resolution ordering such change which has been adopted by unanimous vote of the directors of the district. Montague district was organized as an 'irrigation district' and the resolution to change the name to 'water conservation district' was adopted by the directors October 5, 1926. Adoption of this resolution followed a request for such action submitted by the investment banking firm which had purchased the bonds of the district.

† U. S. Dept. of Agr., Office of Experiment Stations Bul. 254, 46-53.

complete topographical survey of Shasta Valley was made, and proposed canal lines were surveyed diverting from Klamath River. Costs were found to be excessive and no action was taken. In the meantime a private project entirely within Shasta Valley had been investigated, calling for storage of 60,000 acre-feet at the Duke reservoir site on Parks Creek.

After the adverse report of the Reclamation Service on the Klamath-Shasta Valley Irrigation District project the district employed an engineer again to investigate storage possibilities on Shasta River. This resulted in recommendation for storage of 60,000 acre-feet on the middle fork of Shasta River, to irrigate a net area of 20,000 to 22,000 acres. Thereupon activities of Klamath-Shasta Valley Irrigation District ceased, and the district was dissolved by the superior court of Siskiyou County, January 23, 1924. After this, an attempt was made to organize a district to develop storage on Shasta River according to the last plan that had been proposed. The county supervisors permitted a large area to be withdrawn at the time of the hearing of the organization petition and, so, on request of the petitioners, the petition was denied. A second petition received approval by the state engineer and by the supervisors and a district was thus finally organized, by a vote of 198 to 2.

Soils and topography.—The soil survey of Shasta Valley classifies about one-third of the district as Montague clay loam adobe, a little more than one-fourth as agate gravelly and sandy loams, about one-seventh as 'scabland,' the remainder ranging between sandy and clay loams.* The soils are generally underlain with hardpan at depths of 6 inches to 4 feet. The hardpan layer varies in thickness from 6 to 12 inches, has a coarse, granular composition, and is permeable to water. The topography is that of a valley fill over a lava flow. Lava buttes and outcrops are frequent throughout the valley, but most of these have been excluded from the district. The mean annual rainfall at Montague is about 12 inches, more than 80 per cent of which occurs within the nonirrigation season. The average altitude is about 2500 feet. Natural drainage conditions are considered good and no artificial drainage has been provided, although an allowance of $15,000 for this was made in the cost estimates. Arrangements have been made for expending about $2,000 of this during the winter of 1928–29, this covering all of the work now thought to be necessary. Very little alkali concentration has appeared.

Development.—The assessment roll for 1927–28 showed 76 separate holdings, exclusive of the Dwinnell reservoir site, averaging 310 acres. About 7500 acres is in 4 holdings, ranging from 1280 acres to 3050 acres. The population of the district is about 700, of which 500 are in the town of Montague. Most of the land of the district has been dry-farmed but never irrigated. The estimated assessed value of land in the district for city and county purposes in 1927–28 was $494,703, of which $108,715 was for city lots in Montague. Before the Bond Certification Commission approved the district bonds for certification, they obtained an agreement from the landowners to sell land in the district at not to exceed $75 per acre during a three-year period, this being intended to reduce speculation and promote settlement.

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Shasta Valley Area, California.

Water supply.—The water supply of the district is to be obtained by storage on Shasta River north of Edgewood and southeast of Gazelle. The district has permit 2452, with priority of July 23, 1923, from the State Division of Water Rights, which calls for 55,000 acre-feet from Shasta River, between October 1 and June 15 of each year; permit 2453, with priority of July 30, 1923, for 15,000 acre-feet from Parks Creek, between September 1 and July 1; and permits 2581 and 2582 for 2.3 cu. ft. per sec. from Little Shasta River for municipal use and 50 cu. ft. per sec. from Little Shasta River for irrigation, the latter being limited to the period April 1 to June 15. Under permit 2453 the maximum rate of diversion allowed from Parks Creek is 150 cu. ft. per sec. Diversion under this last-named permit has been prohibited by an injunction in the case of *W. D. Duke* vs. *Montague Water Conservation District.*

Water supply studies by the engineer of the district led him to estimate an average annual supply of 60,000 acre-feet, based on the periods 1911–13 and 1916–24. Water to be taken from Little Shasta River is in addition to the water to be stored, but this will only be available in the early season. The injunction against diversion from Parks Creek will reduce by about one-third the supply that had been counted on, but it is stated that this will not affect the district adversely for a period of 8 or 10 years.

Works.—The district reservoir, known as Dwinnell Reservoir, has just been completed. It has a storage capacity of 72,000 acre-feet above the outlet, which permits some carryover. This reservoir has been formed by the construction of a hydraulic fill dam 100 feet high and 1250 feet long, containing 700,000 cu. yds. of material. The main canal, which is about 21 miles long, including two flumes with a total length of 1950 feet, leads from the reservoir to the main body of irrigable land. From this main canal about 55 miles of unlined lateral canals will be constructed. The main canal terminates in a pumping plant which is operated by a hydraulic turbine under a 39-foot head. This pump raises a maximum of 28 cu. ft. per. sec. through a 74-foot lift to a lateral which delivers water to about 2150 acres.

Cost estimates for the district system as revised by the engineer of the district April 16, 1926, called for a total expenditure of $1,284,270, of which $641,350 was for Dwinnell Reservoir, $173,800 for the main canal, $126,140 for the lateral system, the pumping plant, and a small reservoir for the town of Montague, and the balance for interest and overhead during construction. The amount expended to October 23, 1928, was $1,049,667, leaving a balance on hand of $36,230, which the president of the district states will be enough for completing the project.

Use and delivery of water.—The district expects to deliver water to each holding. In designing the system the estimated duty of water was 1.75 acre-feet per acre per year delivered to the land. Alfalfa and grain have been the chief crops grown in Shasta Valley with dairying the basic industry. Alfalfa gives excellent yields on neighboring irrigated lands.

Bonds.—The district bond indebtedness is $1,395,000. The total amount available to the construction fund from the bond issue was $1,103,780.66. Big Springs School bonds and Siskiyou Union High School bonds prorated to lands in the district amount to only about $800.

Assessments.—The district assessment for 1928 carried 9325 acres at $125 per acre, 3501 acres at $100 per acre, 1954 acres at $75 per acre, 1210 acres at $15 per acre, 770 acres at $3 to $10 per acre, 4514 acres at the nominal rate of $1 per acre, and the remainder of the 22,216 acres of irrigable land at rates varying from $25 to $70 per acre. The basis of the district valuations is the estimated actual value when irrigated. Pasture land is valued at $10 to $15 per acre. The total district assessed valuation for 1927–28 was $2,191,183. Since bond interest is being paid out of the construction fund up to January 1, 1929, inclusive, no levy for that purpose was made until 1927–28. The district assessment rate per $100 valuation was only $0.15 in 1925–26 and $0.20 in 1926–27, but because of bond interest was increased to $0.90 in 1927–28. The total district assessment in 1927–28 was $19,717.

GRENADA

Location: western slope of Shasta Valley, about 10 miles southeast of Yreka, in Siskiyou County. (Pl. IV.)
Date of organization election: February 8, 1921.
Gross area: 4948 acres; **area assessed 1927:** 4948 acres.
Principal town: Grenada.
Post office: Grenada.
Railroad transportation: Shasta route of Southern Pacific railroad.

*History.**—This enterprise was started about 1913 or 1914 as a private land project. The promoters organized Lucerne Water Company and gave one share of stock in this company with each acre of land sold. The promoters built an irrigation system to irrigate about 4000 acres, pumping from Shasta River at a point about 2 miles east of the eastern boundary of the project. The system was constructed without engineering study, and the construction work was far below satisfactory standards. Pumping costs were high, and the farmers under the project were not prosperous. When it became clear that the project was a business failure, and that the money advanced to the promoters was in jeopardy, those financially involved sought to bring about the formation of an irrigation district, with a view to transferring the load to the land, through the issuance of district bonds. This they succeeded in doing, the electors approving the formation of the district by a vote of 74 to 1, and later approving the issuance of $240,000 in bonds by a vote of 63 to 0. An appraisal of the Lucerne Water Company system was made and estimates were prepared for betterments. The total preliminary cost amounted to $238,757, or an average of approximately $60 per acre. Of the total estimate, $130,000 was for the purchase of the Lucerne Water Company system. On the basis of these estimates the system was taken over December 13, 1921. The new construction work outlined was carried out in 1922 and 1923.

As will appear later, the transferring to an irrigation district of the obligations of the promoters of this project and their financial backers has not solved its difficulties.

Soils and topography.—The principal soil classifications in the district are Elder gravelly sandy loam, extending about 2.5 miles south of Grenada, and Gazelle clay loam, Elder loam and 'scabland' in the

* See also report on Montague Water Conservation District above.

southern portion of the district.* Alkali is indicated in spots in a portion of the central part of the district. The district officials estimate that 450 acres is sufficiently alkaline to affect adversely crop production. The topography ranges from a fairly steep slope on the west side to a more general slope nearer the railroad. Some lava buttes occur in the southern end. The district reports that no land needs drainage, but that the ground water table is fairly close to the surface in the lower areas.

Development.—There are about 44 farm holdings in the district, averaging approximately 80 acres each. The larger holdings include one of 700 acres, one of 295 acres, and one of 234 acres. No crop census has been taken, but practically the only crop receiving water is alfalfa. The town of Grenada has a population of about 100, and 156 are reported elsewhere in the district. Besides the Shasta route of the Southern Pacific Railroad, the district is traversed by the Pacific Highway.

Water supply.—All of the water of the district is obtained by pumping from Shasta River. Water in this stream taken by Grenada District comes principally from Big Springs Creek during the summer months. The district holds Division of Water Rights permits 501, with priority of August 28, 1916, for 40 cu. ft. per sec., available April 1 to October 1, and 2771, with priority of December 10, 1919, for 10 cu. ft. per sec., available April 1 to June 15. Prior rights to this source are said to amount to 128.39 cu. ft. per sec., besides a prior power right of 213 cu. ft. per sec., which has not been exercised during the irrigation season. Past experience has shown a deficiency in water for the district. About 50 cu. ft. per sec. is available until about June 1, but after that the minimum appears to be from 15 to 20 cu. ft. per sec. This has given a fair supply to the lands irrigated, but would not be sufficient for the full area in the district. Data regarding the quantities used annually are not available.

Works.—Water is diverted to the pumping plant by a combination loose rock and sheet pile dam which raises the water 3.5 feet. A main pumping plant and two booster plants lift the water to the distribution system. The main, or first-lift, plant consists of two 18-inch horizontal centrifugal pumps with respective capacities of 28 and 22 cu. ft. per sec. They both raise against a head of 72 feet and are operated by one 350 and one 250 h.p. electric motor.

These pumps discharge through 720 feet of 44-inch redwood stave pipe into the main canal, which is about 5.3 miles long before it reaches the second-lift pump. Most of the water is here pumped against a head of 56 feet to laterals reaching north and south through nearly the entire length of the district. One 15-inch and one 18-inch pump, with a combined capacity of 33 cu. ft. per sec., and operated by 150 h.p. motors, discharge through 670 feet of 36-inch redwood stave pipe into a concrete discharge bay from which the water may be diverted through the upper lateral north or the lower lateral south.

Water not pumped through the second lift goes through the lower lateral north, which is a ditch 3.5 miles long, with a capacity of about 13 cu. ft. per sec. The upper lateral north, 3.7 miles long, has a capacity of 10 cu. ft. per sec.

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Shasta Valley Area, California.

The third-lift pump boosts water from the lower lateral south to the upper lateral south through 950 feet of riveted steel pipe. A 14-inch horizontal centrifugal pump, with a capacity of 13 cu. ft. per sec., is used here. The head pumped against is 52 feet, a single 150 h.p. electric motor being used. The maximum lift in the district is 180 feet. The upper lateral south is about 4 miles long and has a capacity of 12 cu. ft. per sec. The total investment in works to January 1, 1928, has been $233,442.59. This includes the $130,000 in bonds given for the old system of Lucerne Water Company.

Use and delivery of water.—The district pumped water in 1928 for 1338 acres at an average rate of 4.3 acre-feet per acre. The system was reconstructed by the district, however, on an assumed water duty of 2 acre-feet per acre. The district does not deliver water to lands on which assessments are delinquent.

Bonds.—One bond issue of $240,000 has been disposed of. Bonds to the amount of $130,000 were exchanged at par for the Lucerne Water Company system. Bond principal, amounting to $32,000, due July 1, 1926, and July 1, 1927, was defaulted, also interest due January 1, 1926, to January 1, 1928, amounting to $32,370, of which $23,640 was still unpaid on December 31, 1927. School bonds prorated against the lands in the district total only about $250.

Assessment and water tolls.—The normal district assessment of irrigated alfalfa land is $200 per acre and of unimproved irrigable land, $60 to $100 per acre. One thousand acres of nonirrigated hill land is assessed at $5 and lots in Grenada at from $75 to $150 each. The total district assessed valuation for 1927–28 was $597,098. The assessment rate, since the district was organized, has varied from $6 to $7.50 per $100 of valuation, the higher figure being for 1927–28. The total levy for 1927–28 was $44,782. No water tolls are charged, but 2300 acres, which is the area assessed for district purposes at $200 per acre, is assessed $15 per acre per annum, and a considerable area of unimproved irrigable land, which is assessed at $60 to $100 per acre, is being charged at $4.50 to $6 per acre per annum. A large part of the cost of operation, of course, is the power for pumping.

Present outlook.—The condition of this district is not good. High irrigation costs and the low yields, as compared with production in areas having a longer growing season, have made success practically impossible. When the district was visited in July, 1928, local sentiment seemed to be against payment of the bonds, although it is the policy of the district to make payments on bond principal and interest as fast as money is received from assessments. The district has taken tax deeds to 1707 acres and expects this to be increased in 1928. The total face value of tax sale certificates on December 31, 1927, amounted to $40,766. Outstanding general fund warrants on that date totaled $24,161. A financial readjustment is inevitable.

BIG SPRINGS

Location: in Shasta Valley about 10 miles southeast of Montague, in Shasta County. (Pl. IV.)
Date of organization election: June 3, 1927.
Gross area: 3570 acres; no assessments yet made.
Principal town: none.
Post office: Montague.
Railroad transportation: Shasta route of Southern Pacific railroad, 6 miles west at Grenada.

*History.**—This district was formed to take over and reconstruct the unsatisfactory system of Big Springs Water Company. The latter company was organized in 1913 and issued 5000 shares of stock, part of which went with land sold by the promoter. The promoter of the project built a pumping system from Big Springs, which is situated about one mile south of the southern boundary of the project. The land owned by the promoter was quickly sold and rapidly settled. It was later found, however, that the irrigation system was poorly designed and inadequate, and that reconstruction was necessary. After formation of the district in 1927 an engineering study indicated that the old pumps were operating under very low efficiency and that some of the structures were in bad condition. The report of the engineer recommended a bond issue of $69,000 and this was authorized by unanimous vote of the electors, February 2, 1928. When visited in July, 1928, approval of the bonds by the Bond Certification Commission was withheld pending purchase by the district of all outstanding stock of Big Springs Water Company.

Soils and topography.—The soil survey of the Shasta Valley area classifies the soils of the district mainly as Vina sandy loam and fine sandy loam.† There is also, however, some 'scabland' around the edges. When originally opened for settlement the land was mainly covered with juniper and rocks, but after clearing it was found to be fertile and satisfactory for agricultural crops, yielding three cuttings of alfalfa per annum. 'Scabland' is usually shallow, but where sufficiently deep and cleared has given good production. The topography is rolling, with frequent small buttes and outcrops of lava, and with sedimentary fills in the lower levels. Only 20 or 30 acres is considered to be in need of drainage. The district includes only the irrigated lands formerly under Big Springs Water Company. The average elevation is 2650 feet.

Development.—The district is a settled community of 44 farm holdings averaging about 60 acres each. There are, however, two holdings of 160 acres each and one of 155 acres. All settlers are reported to be making good incomes, except those located under ditches with structures in such bad condition that they are unable to deliver an adequate irrigation supply. Alfalfa raising for dairying is the principal industry but some potatoes, garden truck, and small fruits are also grown. The population of the district is about 120. The estimated assessed valuation for county purposes within the district for 1927–28 was $96,000. An appraisal for the Bond Certification Commission, dated January 17, 1928, fixed the approximate value of the land in the district on that date at $205,995, not including farm buildings, which were appraised at $29,900.

* See also report on Montague Water Conservation District above.
† U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Shasta Valley Area, California.

Water supply.—The district claims priority of March 22, 1913, for 30 cu. ft. per sec. from Big Springs, which, according to the records of the Division of Water Rights, is about the average seasonal use of the system. The entire supply is pumped. The total supply of water annually available to the district is estimated by the district at 10,000 acre-feet.

Works.—The present works of Big Springs Water Company, which it is proposed to take over and reconstruct and extend with the funds derived from the bond issue, consist of the following main features: a 30-inch centrifugal pump operated by a 450 hp. motor and with a rated capacity of 22,500 g.p.m. located at Big Springs; 1468 feet of 44-inch wood stave pipe, through which the main pumping plant delivers water under a static head of 55.46; 650 feet of wooden flume and an earth and rock ditch which carry the water from the main pumping plant to the southwestern portions of the district; a second-lift pumping plant consisting of an 18-inch certrifugal pump operated by a 150 h.p. electric motor, which discharges through a 30-inch wood stave pipe line about 600 feet long into the second-lift ditch under a static head of 31.5 feet; a 4500-foot wooden flume; and about 4 miles of earth ditch leading from the second-lift pumping plant to the land east and north of that covered by the first-lift ditch.

The plans of Big Springs District call for reconstructing the pumping plant at a cost of $14,000, the addition of 650 feet of metal flume, repair to present pipe lines and canals, including the substitution of 1005 feet of metal flume and 1850 cu. yds. of ditch reconstruction, construction of the remainder of the second-lift ditch, 4000 feet of new metal flume near the lower end of the project, drainage costing $2,000, and necessary repairs and structures. The construction program in 1928 called for completion of this work for the irrigation season of 1929. The total estimated cost of the new work, including the purchase of Big Springs Water Company stock, is $69,000.

Bonds.—As previously indicated, the bonds voted totaled $69,000. Since they have not yet been issued the district has no bonded indebtedness. Other bonds estimated to amount to $1,600 are out against lands within the district, these having been issued by Big Springs School District and Siskiyou Union High School District.

Assessments and water tolls.—All good land in the district is assessed for district purposes at $200 per acre, and nonirrigable, rocky land at $1 per acre, the total district valuation being estimated at $453,120 for 1928–29. An assessment of $0.70 per $100 valuation has been fixed to cover bond interest due in 1928–29, the total levy being $3,171. It is proposed to cover operating expenses by water tolls.

SCOTT VALLEY

Location: on east side of Scott Valley, south of Fort Jones, in Siskiyou County. (Pl. IV.)
Date of organization election: July 7, 1917.
Gross area: 5124 acres; **area assessed 1927:** 5124 acres.
Nearest town: Fort Jones.
Post office: Fort Jones.
Railroad transportation: Shasta route of Southern Pacific railroad, 20 to 30 miles distant in Shasta Valley.

History.—Scott Valley is an isolated area which has been settled and prosperous for some years. Prior to the formation of Scott Valley Irrigation District, the principal irrigation system was the cooperative one known as the Farmers' Ditch Company, but there were also numer-

ous private ditches. The valley has a mean elevation of about 2750 feet, which is a little higher than Shasta Valley on the east, and lies between mountains which range from 4000 to 8000 feet in elevation, which are heavily timbered down to the valley floor. The mean annual rainfall, which mostly falls during the winter months, is about 25 inches. In 1912, 16,300 acres was irrigated in the valley, water coming chiefly from creeks entering from the south and west rather than from Scott River. The district was organized for obtaining water from Scott River and covers only about 10 per cent of the entire valley area.

Soils and topography.—Soil varies from gravelly to clay loam. The surface is flat, sloping toward Scott River, on the west, with a few low ridges protruding on the east.

Development.—In 1926–27 the district assessment roll showed 27 separate farm holdings averaging 190 acres gross. There was one holding of 644 acres, another of 596 acres, and a third of 400 acres. The area irrigated is stabilized at about 4000 acres, of which 2500 is in alfalfa and 1500 in grain or grain hay. The population of the district is about 100, the population of Fort Jones, the nearest town, 350. The estimated assessed valuation of the land in the district in 1927–28 for county purposes was $240,000.

Water supply.—The district holds license 441 from the Division of Water Rights, calling for 62.5 cu. ft. per sec. from Scott River, with a priority date of November 2, 1916. No storage has been provided, and while sufficient water is usually available up to July 1 or July 15, the flow drops rapidly thereafter and within a short time no water is available. Application 2461 for 5000 acre-feet of storage was made to the Division of Water Rights on July 30, 1921, but was cancelled October 31, 1921, at the request of the district. No plans have been made for storage, although a reservoir site is said to be available above the present diversion. There are no records of the amounts of water thus far diverted.

Works.—The irrigation works consist chiefly of a concrete diversion dam on Scott River and 20 miles of main canal with a short tunnel, flume, and siphon line. The main canal diverts about 6 miles above the upper end of the district and follows along the east side of the valley about 15.5 miles to a point near Fort Jones, where it crosses Moffitt Creek in a 36-inch inverted siphon 2650 feet long. The concrete diversion dam has 8 openings, 9.5 feet by 3 feet, fitted with removable wooden flashboards. The tunnel below the dam is about 250 feet long and runs through solid rock. A short metal flume of Lennon type is located a short distance south of Fort Jones. There is only one small lateral ditch on the system, most of the turnouts being made from the main canal.

The original construction estimate called for an expenditure of $82,987, but this was increased by the assistant state engineer to $124,466, and a bond issue of $125,000 was voted on December 13, 1919. This was not sufficient to complete the construction work, most of which was done by force account. In August, 1921, a special assessment of $3 per acre was levied to complete the work, and a second assessment of equal amount was levied in 1922, after first borrowing money at the rate of $3 per acre from the local bank on individual notes signed by each landowner. The total cost of construction to December 31, 1927,

has been $146,141. The principal items in the construction were the dam and headgate, rock work and earth work, the tunnel, and the steel siphon.

Use and delivery of water.—Water is delivered to each holding, the superintendent of the district being the only paid official. He is hired full time during the irrigation season. The rules and regulations of the district specify that the quantity of water to be delivered shall in no case exceed 9 inches in depth for land irrigated in any 30-day period. Water is delivered by the ditch superintendent in rotation, commencing at the lower end of the system.

Bonds.—The total bonds voted amount to $125,000. Bonds in the amount of $30,000 have been retired to January 1, 1928, leaving $95,000 outstanding. Other bonds against lands in the district amount to about $325, and have been issued by Etna and Mound School districts and Siskiyou Union High School District.

Assessments.—All lands within the district boundaries are assessed for district purposes at $50 per acre, the total district assessed valuations for 1927–28 being $256,235. The assessment rate, since the district was organized in 1921, has varied from $5.50 to $9 per $100 of valuation, the rate for 1927–28 being $9. The total amount of the levy for 1927–28 was $23,061. The district has never sold any tax deeds, occasional small delinquencies having been paid up before tax sale.

HOT SPRING VALLEY

Location: along Pit River between Alturas and Canby, in Modoc County. (Pl. V.)
Date of organization election: September 27, 1919.
Gross area: 9497 acres; **area assessed 1927:** 9497 acres.
Principal town: none.
Post office: Alturas.
Railroad transportation: Nevada-California-Oregon railway at Alturas.

History.—This district was formed to supplement the irrigation supply to lands along Pit River below Alturas by storage at the Big Sage Reservoir site in the Rattlesnake Creek drainage basin about 8 miles northwest of Alturas. Owing to the flashy nature of Pit River, the water supply available to these lands was very unsatisfactory, the summer flow generally failing entirely.* Furthermore, the supply had greatly decreased, owing to increased use above and reclamation of a swamp area along South Fork of Pit River south of Alturas. Storage was therefore the only way of furnishing an adequate amount of irrigation water. The lands irrigated were largely meadow lands. Organization of the district was carried by unanimous vote of 21 electors. The first engineering report estimated the cost of storage at $100,000. Bonds to this amount were voted and the work started on this basis. Changes and improvements in the design of the storage dam and other changes in connection with the diversion canal increased the cost of these features by about $20,500 above the contract price of $88,736. For this and other purposes in connection with works of the district it was necessary in 1921 to sell a second bond issue of $60,000. The construction

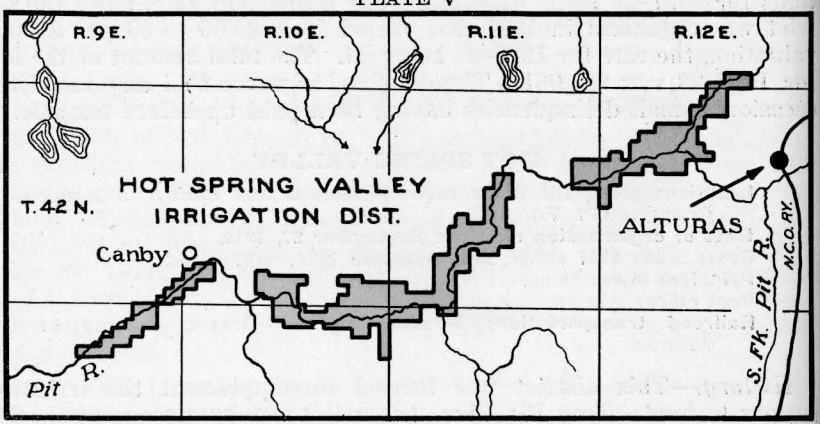
* U. S. Dept. of Interior, Reclamation Service, Report on Pit River Basin, April, 1915, 76.

was accepted by the board of directors on January 12, 1922, but the district found it necessary to complete the diversion canal, which had been left unfinished by the contractor. Most of the area covered by the reservoir was government land, but the district purchased 800 acres from private owners at a cost of about $24,000.

Soils and topography.—Lands in the district are largely alluvial deposits along the Pit River bottom, although about 35 per cent of the total area of the district is made up of bench lands lying on both sides of the stream. There is good natural drainage to the river channel, and ground water in the lower land averages about 10 feet below the surface. The average elevation in the district is about 4400 feet. The district is now supplying water to only the bottom lands along the Pit.

Development.—There are 35 ranch holdings in the district, averaging 270 acres, with one large holding of 1357 acres and others of 921, 720, and 677 acres. The estimated population of the district is 150. Real estate in the district is assessed for county purposes at about $138,000, not including improvements of about $105,000.

PLATE V



Location and boundary map of Hot Spring Valley Irrigation District, Modoc County.

Water supply.—The district holds permit 1768 for the storage of 50,000 acre-feet in Big Sage Reservoir, this permit having a priority of April 12, 1923, with an extension to December 1, 1930, to complete beneficial use. The amount of water available over a long period by storage in Big Sage Reservoir is not known. The reservoir has a total capacity of 77,000 acre-feet, and the drainage area back of the reservoir is about 107 sq. mi. During 1922 the reservoir accumulated 22,500 acre-feet, but during 1924 it was emptied. In 1925 the storage was 12,500 acre-feet, of which 7000 acre-feet was carried over. In 1926 the total storage was 10,000 acre-feet, all of which was used. In 1927 storage amounted to 20,000 acre-feet, of which 10,500 acre-feet was left for carry-over to 1928. During the early season the water used is entirely from Pit River.

Works.—The district has built no works other than Big Sage Reservoir, a diversion weir in Rattlesnake Creek, and 3.5 miles of canal to carry the water to the channel of Pit River from which it is diverted by the individual users. Big Sage Dam is of earth and rock-fill construction with a concrete core wall and heavy stone riprap on both up-stream and down-stream faces. The height above streambed is 46

feet, the crest length 680 feet, top thickness 20 feet, and up-stream and down-stream slopes 3 to 1 and 2 to 1 respectively. The outlet is a 36-inch steel pipe encased in concrete and discharge is controlled by means of a concrete gate-tower at the up-stream toe of the dam.

The outstanding features of Big Sage Reservoir are its great capacity, low unit cost—only a little over $1 per acre-foot—and the existence of a natural spillway one mile from the dam site. Specifications for the diversion canal called for a bottom width of 11.6 feet and a grade of 2 feet per mile. There are 5 private pumping plants which raise water some 14 feet to 500 acres of bench lands, but most of the diversions are made by means of small dams constructed in the channel. The total investment in district works to December 31, 1928, was $141,271.

It has been the plan of the district to construct a highline canal to serve the elevated lands within the district and certain other areas between Alturas and Canby whose owners would like to receive water. The estimated cost of such a highline canal is $50,000, but the district does not contemplate building this canal until the water supply available from Big Sage Reservoir has been tested during a longer period.

Use and delivery of water.—Bottom lands along Pit River within the district are irrigated by flooding caused by the closing of simple timber dams, owned and operated by the various ranchers. The district turns water into Pit River from Big Sage Reservoir under a definite schedule set forth in the rules and regulations adopted by the board of directors July 26, 1924. Water is released from the reservoir in such quantities up to the capacity of the diversion canal as may be necessary to supplement the flow in Pit River to give a full head of water for use on lands in the district. The rules require that the release be so controlled that no water other than drainage water shall be allowed to pass down the river channel below the district boundaries while the water is being released from the reservoir.

Diversion of water by the irrigators is under the direction of a water superintendent employed by the district. The rules and regulations set forth the maximum time the privately owned dams are to remain closed, the periods ranging from 1 to 2.5 days. The water superintendent is allowed to deviate from the distribution schedule set forth in the rules and regulations only on permission of irrigators who would be delayed in their irrigations because of such deviation. All dams and pumping plants and other works constructed for diverting water from the river must be maintained by the owners.

The amount of water used on the lands of the district is not known, other than that from 8000 to 10,000 acre-feet of stored water are used annually in the late season on about 6400 acres of bottom land, of which 60 per cent is meadow.

Bonds.—As previously indicated, bonds issued by the district total $160,000. The first issue amounts to $100,000 and the second issue amounts to $60,000. Bonds amounting to $38,000 have been retired to January 1, 1928, leaving $122,000 outstanding. These bonds all carry 6 per cent interest. Other bonds against lands in the district are estimated to total $10,600. These have been issued by Alturas Elementary School District, Modoc Union High School District, and Modoc County.

Assessments.—Meadow and alfalfa lands are assessed for district purposes at $30 per acre, grain land at $15 per acre, and grazing land at $10 per acre. The total district assessed valuation for 1927–28 was $188,759. During the past five years the district assessment for each $100 valuation has ranged between $7.80 and $10, the latter figure having applied to the last two years. A special assessment of $0.70 per acre was levied in 1924–25 for improvements to the canal. The total amount of the district levy for 1927–28 was $18,875. Owing to the fact that district assessments are collected in installments, it has been found necessary to issue warrants to meet bond retirements on the first of each year. To remedy this situation it has been recently decided to collect 60 per cent of the total assessment in the first installment, which comes in before the first of the year, and 40 per cent in the second.

TULE AND BAXTER CREEK DISTRICTS

Location: north of Honey Lake and along Susan River and Baxter and Willow creeks, in Lassen County. (Pl. VI.)
Dates of organization elections: Baxter Creek, February 8, 1917; Tule, June 14, 1920.
Gross areas: Baxter Creek, 9336 acres; Tule, 15,015 acres; **areas assessed 1927:** Baxter Creek, 9336 acres; Tule, 15,015 acres.
Principal town: Litchfield.
Post office: Litchfield.
Railroad transportation: Southern Pacific railroad.

*History.**—The people of Honey Lake Valley have encountered many trying experiences in their endeavor to utilize the irrigation resources of that section of California. The most recent of these have come in connection with Tule and Baxter Creek irrigation districts.

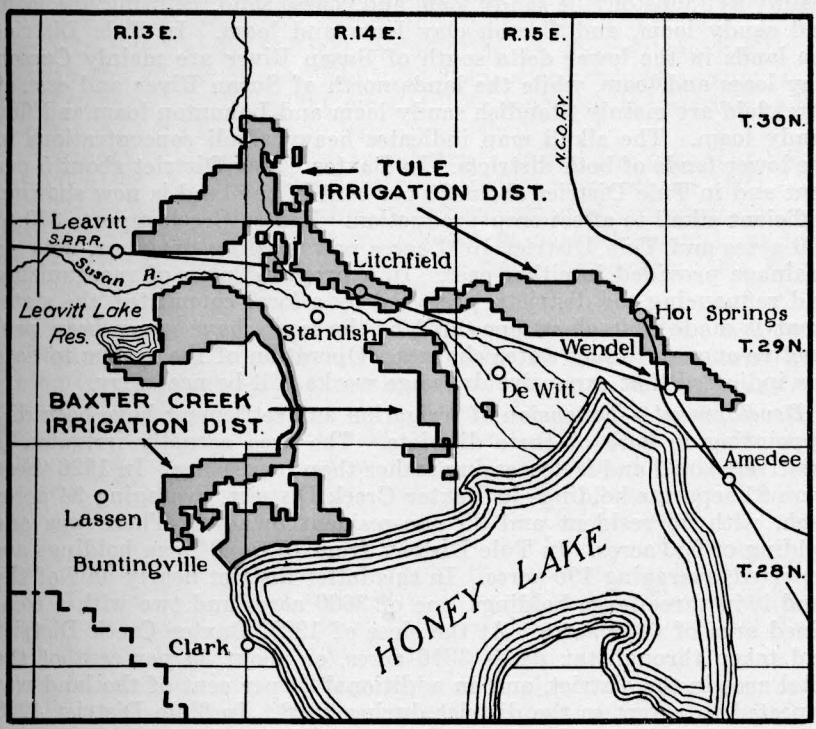
The principal stream entering Honey Lake Valley is Susan River. For some years this stream and several smaller streams have been fully utilized according to the standards of the neighborhood. The water furnished by them, however, is far less than enough to meet the irrigation needs of the valley and the people of the valley have long felt that the supply could be materially augmented by tapping Eagle Lake, a closed basin lying about 15 miles northwest of Susanville. The first efforts to tap Eagle Lake, made many years ago, proved unsuccessful, but the hope of obtaining water from this source was never abandoned. About ten years ago the matter was again taken up by the engineer-promoter of the so-called 'Bly' irrigation project, and in connection with this proposed project a new study of the possible yield from this source was made by the State Water Commission. This indicated that by materially reducing the evaporating surface of Eagle Lake—a procedure that had been under consideration for many years—sufficient water could be obtained along with that from other sources to irrigate about 25,000 acres of land. The promoter of the 'Bly' project made surveys and laid out a project designed to draw down the surface level of Eagle Lake by tunnel and to irrigate about 12,000 acres along Susan River, east and northwest of Litchfield, including the lower tule lands along Susan River. He then promoted the organization of Tule Irrigation District, with a view to transferring to it his proposed completed project at a flat cost of $50 per acre, to be paid for in district bonds at not less than 95. Local sentiment was very much in favor of the

*See also U. S. Dept. of Agr., Office of Experiment Stations Bul. 100, 71–103.

project and it was approved by the state engineer with the distinct understanding that there should be definite and satisfactory specifications as to the extent of the distribution system and as to the capacity of the main and lateral canals and delivery structures, and that the district would employ a high-grade irrigation engineer who would take the lead in the preparation of specifications governing physical structures, and be on hand for inspection throughout the construction period. On this basis the district was organized by a vote of 66 to 6 and construction on the 'Bly' project was started.

Prior to the promotion of the 'Bly' project and the organization of Tule Irrigation District, Baxter Creek Irrigation District had been organized to extend the area of land irrigated by Baxter Creek. Some land near the town of Janesville had been irrigated from this stream, but the water supply was short and it was proposed to increase the summer supply by building an earth-filled dam on Baxter Creek.

PLATE VI



Location and boundary map of Tule and Baxter Creek irrigation districts, Lassen County.

This district voted bonds in the amount of $310,000 and the board of directors went through the form of selling them, the sale to be contingent upon approval by the Irrigation District Bond Commission. Studies of the water supply under direction of the State Water Commission, however, indicated it to be inadequate and it became clear that the district could not proceed as originally contemplated. Bonds to the amount of $35,000 had been disposed of for promotion purposes, but the question of their legality was carried to the courts.

In the meantime, Tule Irrigation District, with about 15,000 acres, had been organized, and the 'Bly' project was under construction with

the expectation that it would furnish water to some 10,000 acres additional. Baxter Creek Irrigation District thereupon changed its plans and entered into an agreement with Tule Irrigation District, by which the system under construction would be jointly owned by the two districts, with the exception of certain features which were to be owned separately by them. Ownership in the system was to be in the proportion of 153 for Tule District to 97 for Baxter Creek District.

Although the irrigation system for the two districts was ready to begin delivering water during the season of 1924 and did so, the tunnel tapping Eagle Lake was not then and has not yet been completed. This has resulted in water shortage which, together with alkali troubles and lack of settlers, has caused serious financial difficulties.

Soils and topography.—Honey Lake Valley lies at an elevation of 4000 to 4250 feet. Soils of these two districts comprise a large number of different series.* Those of Baxter Creek District are classified mainly as Johnstonville sandy loam and coarse sand, Buntingville loam and sandy loam, and Carson clay loam and loam. In Tule District the lands in the lower delta south of Susan River are mainly Carson clay loam and loam, while the lands north of Susan River and east of Litchfield are mainly Standish sandy loam and Lahonton loam and fine sandy loam. The alkali map indicates heavy alkali concentrations in the lower lands of both districts. In Baxter Creek District about 5 per cent and in Tule District about 20 per cent of the land is now showing sufficient alkali to affect crop production. Baxter Creek reports 300 to 400 acres and Tule District 1000 acres now needing drainage, with no drainage provided in either case. In a proposed plan of reorganizing and refinancing the districts, prepared by a local committee, the statement is made that about one-third of the lands have never been productive enough to pay water charges. Operation of the system to date has indicated that expensive drainage works will be necessary.

Development.—Extension of irrigation and settlement have been disappointing in both of these districts. The area actually irrigated is relatively small and is decreasing rather than increasing. In 1926 there were 91 separate holdings in Baxter Creek District, averaging 94 acres each, with 56 resident and 35 non-resident owners. There was one holding of 550 acres. In Tule District from 75 to 80 farm holdings are reported, averaging 190 acres. In this latter district nearly half of the land is in three large holdings, one of 3600 acres and two with a combined area of 6430 acres. At the close of 1927, Baxter Creek District had taken through tax deeds 3316 acres, or about 35 per cent of the total area in the district, and an additional 24 per cent of the land was expected to revert to the district during 1928. In Tule District 4235 acres, or 28 per cent, has been taken through tax deeds, and 24.8 per cent was expected to become delinquent during 1928. The population of the two districts was estimated at less than 350 at the end of 1927.

Lands of Baxter Creek District are assessed for county purposes at about $90,000 and those of Tule District at about $110,000. County valuations, which are assumed to be about 60 per cent of true value, range from $3 to $6 per acre for arable sagebrush land, from $3 to $7.50 per acre for grazing land, and from $7.50 to $15 for dry-farmed

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Honey Lake Area, California.

grain land. Dry alfalfa land is assessed at $9 to $36 per acre, irrigated grain and alfalfa land at $36 to $75 per acre, and meadow land $9 to $36 per acre.

Water supply.—As previously indicated, these districts obtain their water from Eagle Lake. Having no known outlet other than by seepage at the head of Willow Creek, the surface of this lake has fluctuated chiefly under the influence of inflow and evaporation, the loss by evaporation over a period of years obviously balancing inflow. It was proposed to lower the surface of the lake some 40 feet, thus reducing its evaporating area. Studies by the State Water Commission at first indicated that this procedure would make available some 60,000 acre-feet of water annually. Later studies, however, brought the conclusion that this annual supply would be about 55,000 acre-feet, this to result from lowering the lake 45 instead of 40 feet. Lowering of the lake surface was to be accomplished by tunneling at or near the location of the tunnel started some years previously. The district accepted the project from the promoter before this tunnel was completed. It has since expended about $50,000, in addition to the contract price, in unsuccessful efforts to complete it, and an undetermined amount, estimated to be at least $150,000, must still be expended if lowering of the lake to the desired level is to be accomplished.

Diversions of water for the two districts during the past four years are estimated to have ranged between 10,000 acre-feet, in 1924, and 40,000 acre-feet, in 1927. Due to agreements with appropriators on Willow Creek and to transmission losses in natural channels and in canals, not more than 30 per cent of the water withdrawn from Eagle Lake reaches the districts.

Works.—The irrigation system taken over by the district is only a skeleton system. The main diversion is by Willow Creek Canal and Gibson lateral skirting the north side of the district to its eastern extremity. About two miles above Litchfield water is carried across the valley of Susan River by a 54-inch banded-fir siphon 3 miles long, from the southern outlet of which it is distributed southerly and westerly. Wrede lateral diverts from Susan River southwest of Litchfield and carries water to the lands in Tule District south of Susan River. In addition to 1.5 miles of tunnel 6 feet by 8 feet in cross-section and 1 mile of flume, both held jointly by the two districts, Baxter Creek District owns 12 miles of unlined main canal and 6 miles of unlined laterals, not counting the Susan River siphon referred to, and Tule District owns 18.5 miles of unlined main canal.

The estimate of the consulting engineer employed by the promoter of the 'Bly' project fixed the complete cost of construction at $1,250,000, of which $650,000 was for the Eagle Lake tunnel, $75,000 for the main canal, $175,000 for the Willow Creek canal, $214,000 for the distributing system of Tule District, and $135,000 for the distributing system of Baxter Creek District. The total investment in works to December 31, 1927, by Baxter Creek District was $538,955 and by Tule District $832,378, or a total of $1,371,333.

Use and delivery of water.—As previously indicated, the irrigation system is merely a skeleton to which the farmers must build their laterals. Water is measured with a current meter in the main canal, but deliveries to users are not measured, and no estimate of the quantity

delivered is practical. It has been estimated, however, that 50 per cent of the water applied is dissipated through over-use and poor methods of application. The assumed net duty of water is 1.5 acre-feet per acre per year. The two districts jointly employ the engineer, as they do also the attorney, the secretary, the assessor, and the treasurer.

In the present disorganized condition of the two districts no effective water distribution is possible. In 1925, when conditions were somewhat better than at present, 4290 acres was reported irrigated in Baxter Creek District, of which 1495 acres was in alfalfa, 1245 acres in grain or grain hay, and 1155 acres in pasture or meadow. In 1927 water tolls were paid on 2000 acres. The area reported irrigated in 1925 in Tule District was 2565 acres, of which 1700 acres was in alfalfa. No record is available for 1926. In 1927 a toll was collected on 1500 acres.

Bonds.—The bonded indebtedness of Baxter Creek District is $511,000. Bonds amounting to $5,000, due January 1, 1926, $8,000, due January 1, 1927, and $12,000, due January 1, 1928, were defaulted. Likewise, interest has been defaulted amounting to $120 due July 1, 1925, $10,170 due January 1, 1926, $15,330 due January 1, 1927, $15,180 due July 1, 1927, and $15,180 due January 1, 1928.

The bond situation in Tule District is similar. The total bonds issued was $806,000. Bonds amounting to $8,000 due January 1, 1926, $13,000 due January 1, 1927, and $12,000 due January 1, 1928, have been defaulted; also, interest amounting to $1,668 due July 1, 1925; $2,418 due January 1, 1926; $23,940 due July 1, 1926; $23,940 due January 1, 1927; $23,550 due July 1, 1927; $23,550 due January 1, 1928.

Assessments and water tolls.—Both districts derive their income, or attempt to do so, through both district assessments and water tolls. In Baxter Creek District all land below the canal system is assessed for district purposes at a flat rate of $50 per acre and that above the system at $1 per acre. The total amount of the levy for 1927–28 was $8,421. The assessment rate per $100 of valuation during the past five years has been as follows: 1923–24, $7; 1924–25, $12; 1925–26, $12; 1926–27, $6; 1927–28, $2. Assessments for district purposes in Tule District are on the same basis as in Baxter Creek District, the total levy for 1927–28 having been $13,163. The total assessment rate per $100 of assessed valuation has also been the same in the two districts, except that it was $10 in Tule District in 1925–26. In 1927 both districts imposed water tolls at the rate of $2 per acre, yielding a total income of $6,000 to $7,000. Water is sold to some lands outside of the districts, the total income of the two districts from this source in 1925–26 having been about $1,000 and in 1926–27 about $200.

Present status.—Committees have been at work for some time upon reorganization of Baxter and Tule districts, but no final plan acceptable to all parties has been worked out. It is recognized that the bondholders are faced with a large loss. In June, 1928, the irrigation engineer of the Division of Engineering and Irrigation, State Department

of Public Works, listed the assets and liabilities of the combined districts as follows:

Assets		
Depreciated value of irrigation works	$600,000	
Delinquent taxes, largely not collectible	283,700	
		$883,700
Liabilities		
Bonds	$1,317,000	
Defaulted interest	236,740	
Outstanding warrants	80,000	
		$1,633,740
Lands (estimated values)		
5,000 acres, improved, at $135	$675,000	
5,000 acres, unimproved, at $45	225,000	
4,000 acres, unimproved, at $25	100,000	
10,000 acres nonagricultural, at $5	50,000	
		$1,050,000

A real effort is being made by some of the progressive men in the district and by others interested in the welfare of the community to rehabilitate both districts. It has been proposed that the districts should first be dissolved and then reorganized on a sound financial basis, the reorganized districts to embrace only such lands as can safely be counted upon to meet capital and maintenance costs. With this in view, an attorney has been employed to take steps to dissolve both districts. The area within the two districts that can be successfully farmed to irrigated crops of alfalfa, grain and vegetables, in case drainage is provided, has been estimated at 12,000 to 14,000 acres. Whether or not reorganization along the lines proposed can be accomplished is still problematical. Any practical plan of reorganization, in the opinion of the irrigation engineer of the Division of Engineering and Irrigation, must provide for supplying sufficient funds to complete the lake outlet and provide needed drainage, the amount required being estimated at about $250,000.

ANDERSON-COTTONWOOD

Location: northern end of Sacramento Valley below Redding, in Tehama and Shasta counties. (Pl. VIII.)
Date of organization election: July 14, 1914.
Gross area: 32,113 acres; **area assessed 1927:** 32,000 acres.
Principal towns: Anderson and Cottonwood.
Post office: Anderson.
Railroad transportation: main line Southern Pacific railroad.

*History.**—This was the first irrigation district to be organized in Sacramento Valley other than those formed under the original Wright act between 1887 and 1891, only one of which was still active when Anderson-Cottonwood District was formed. The formation of Anderson-Cottonwood District was, therefore, somewhat of a venture to the landowners concerned, and although organization was carried by a vote of 482 to 17, there was the usual opposition from some of the larger landowners. In the early days of the district several hundred acres was excluded, the original area as voted having been 32,500 acres.

A difficult element in connection with the organization of a district was the great differences in the soil. The first and second bottom lands along Sacramento River were in established orchards, largely prunes, but the rolling upper lands, although in part previously from time to time dry-farmed in grain, had reverted mainly to pasture. Those owning the developed lands along the first and second bottoms felt that irrigation would add relatively less to the value of their lands than to rolling lands which had very little value without water. However, a general agreement was reached that all lands should be assessed about equally.

* See also State Dept. of Eng., Bul. 2, 62–65.

The early construction history of the district was not fortunate. Cost estimates were found to be much too low and a considerable part of the early work proved to be unsuitable. After construction was started, it was seen that a second bond issue, exceeding the first issue, would be necessary. This was straightway voted by a large majority and the construction was carried forward along revised lines. Some three years later a third but smaller issue was found to be required, and this also was provided, although it has not all been expended. Lack of experience in building an irrigation project of the magnitude of that undertaken led to mistakes and some mismanagement. The landowners were conservative in adjusting themselves to the new conditions and subdivision and settlement were slow. However, conditions have improved. About half of the land has been brought under irrigation, but satisfactory use has not yet been found for much of the rolling area lying above the more fertile first and second bottoms.

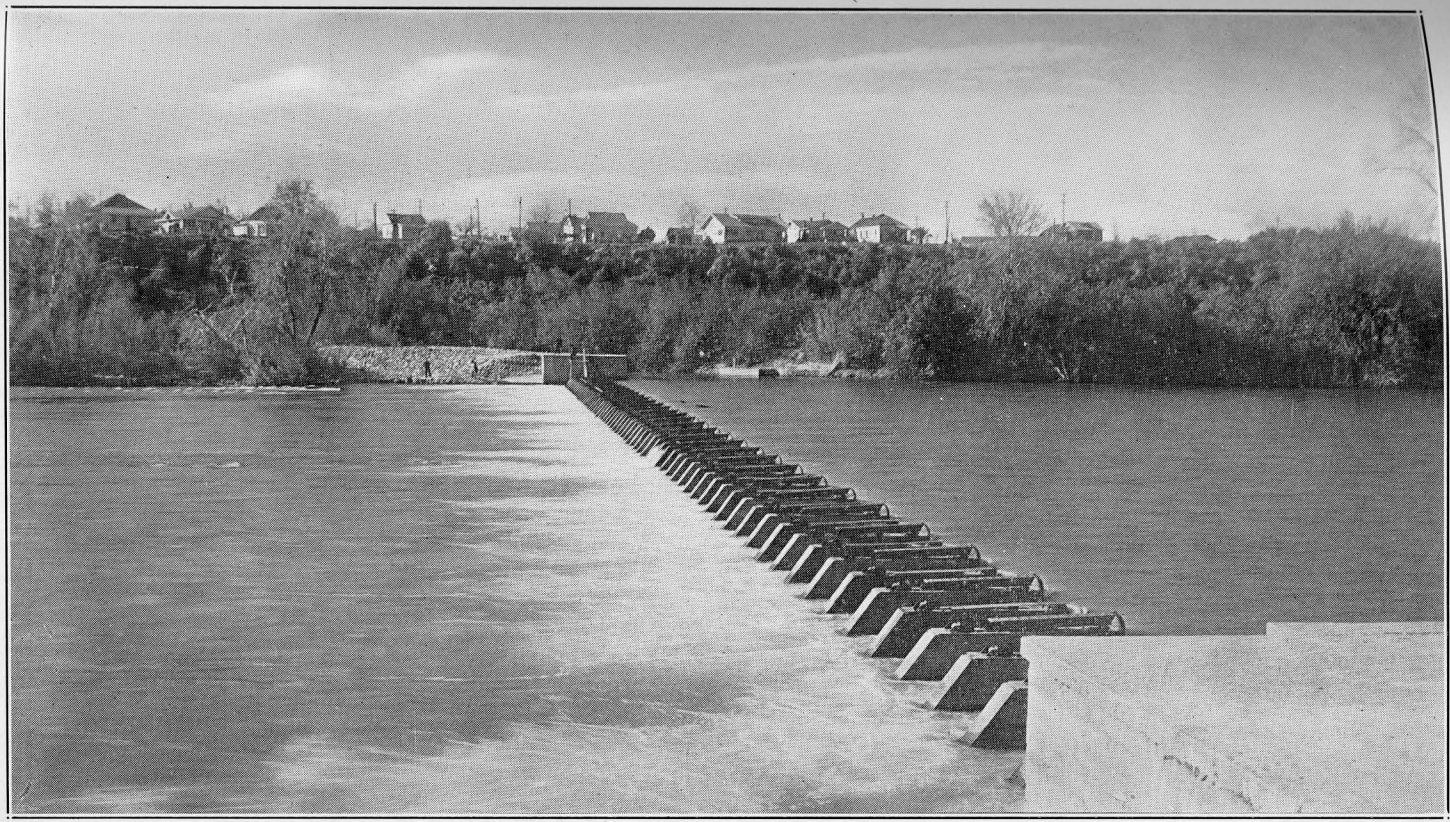
Soils and topography.—Generally speaking, the land consists of first and second bottom river lands, first bench, and rolling plains. The lower lands are classed by the Bureau of Soils as Sacramento silt loam, Sacramento fine sandy loam, Sacramento loam, and Anderson fine sandy loam.* The next higher lands are mostly Anderson gravelly loam, and the higher or plains areas chiefly Redding loam and Redding gravelly loam. The Redding and Anderson series are classed as hard-pan soils, although the hard-pan is relatively soft in the Anderson series. Elevations range from 350 to 500 feet. Several streams entering from the west have cut deep ravines toward the upper end. The lands included within the district extend to the east side of Sacramento River as far as the Churn Creek bottoms. The southern end of the district extends below Cottonwood Creek, which enters Sacramento River at the southeast corner of the district.

Excess water is generally removed by natural drains, some $40,000 having been expended in opening these up. Some local areas have been seeped, but generally speaking, the drainage problem is not serious. About 1000 acres is above the canal system.

Development.—There are two large holdings in the district, one of 2762 acres and one of 1537 acres. The total number of farm holdings is 350, the average containing 80 acres. The population of Anderson is about 1000 and of Cottonwood about 600, and the estimated population not included in these towns is 800. The principal undeveloped lands are the upper rolling areas. The assessed value of land in the district for city and county purposes was about $735,000 in 1927, exclusive of improvements which were assessed at about $377,000.

Water supply.—The district has a filing for 400 cu. ft. per sec. from Sacramento River dated November 21, 1914. Certificate No. 3, covering use under this filing has been issued by the Division of Water Rights on application of the district dated February 8, 1918. This permit allows a diversion of 400 cu. ft. per sec. The peak use up to the present time has not exceeded 375 cu. ft. per sec., which was reached in 1927. The irrigation system extends to the entire area within the district and there has been no shortage in the quantity of water available. The total annual diversions during the years 1925, 1926 and 1927, less the estimated amount returned to the river, have been 69,602, 87,870 and 74,600 acre-feet, respectively.

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Redding Area, California.



Collapsible weir across Sacramento River at Redding for diverting water into canal of Anderson-Cottonwood Irrigation District.

Works.—The principal features of the irrigation system are a concrete dam across Sacramento River at Redding, a concrete-lined tunnel 2480 feet long and 10 feet in diameter under part of the city of Redding, a branch line leading to the Churn Creek area east of Sacramento River, which it crosses in a flume supported by a steel trestle, and a main canal running from the end of the tunnel at Redding to the southern end of the district, crossing Cottonwood Creek in a concrete siphon. Very little of the canal system is lined, the total length of the main canals being 31 miles. Concrete siphons under Clear and Cottonwood creeks aggregate about one mile in length and have diameters ranging from 48 to 72 inches. There are about 63 miles of unlined laterals and about 5 miles of lateral pipe lines, ranging from 12 inches to 24 inches in diameter. Two 12-inch centrifugal pumping plants raise water 20 feet to 600 acres under a high-line canal. The total invested in works to December 31, 1927, was $1,355,000, of which all but $100,000, raised by district assessments, has come from bond issues.

Use and delivery of water.—Water is delivered to each farm, but with no particular unit specified. The Sacramento-San Joaquin water supervisor, operating under the Division of Water Rights, has a rating station at the district inlet, but no measurements are made of deliveries, so that no records of the amounts used are available. The estimated duty of water for alfalfa is 3 acre-feet per acre and for orchards 2 acre-feet per acre. No engineer is now employed by the district, operations being in charge of the secretary, who is also manager.

Bonds.—The total bonds issued to date amount to $1,255,000. Bonds to the amount of $48,000 have been retired, leaving $1,207,000 outstanding. Up to December 31, 1927, the district had acquired 1500 acres through tax deeds.

Assessments and water tolls.—All of the income is derived from district assessments. Bottom land is assessed for district purposes at $75 per acre, good upland at $50 per acre, and river-wash land and land above the high line nominally at $1 per acre. The total amount of the levy for 1927–28 was $118,847. The assessment rate per $100 of valuation in each of the last four years has been $8.50.

EL CAMINO

Location: west of Gerber and Tehama, in Tehama County. (Pl. VIII.)
Date of organization election: March 26, 1921.
Gross area: 7548 acres; **area assessed 1927:** 7548 acres.
Principal town: none; **nearest towns:** Gerber and Tehama.
Post office: Gerber.
Railroad transportation: main line Southern Pacific railroad.

History.—The area within this district was started as a land development project in 1920 by a land company and its subsidiary, El Camino Water Company. The land was subdivided into small holdings, largely between 10 and 15 acres each. Some wells were put down and pipe lines installed, and a number of settlers moved onto the project. With a view to better financing, the promoters brought about the organization of El Camino Irrigation District by a vote of 7 to 2. For two years after organization the district leased the irrigation system from El Camino Water Company, but two years later El Camino Canal Company, a mutual organization, was formed, and it took over and

operated the system until 1926. In that year the district voted bonds in the amount of $430,000 and with funds derived from these, the irrigation system was purchased for $187,000 and brought to completion in the early summer of 1928 at an additional cost of about $215,000. The district is one of the few in the state governed by a board of three directors.

Soils and topography.—The topography of the tract is somewhat irregular, the general slope being toward the east. The soils of the Redding and Tehama series predominate, except along Elder Creek, where the Elder series are found.* The Redding series have a distinct hard-pan and those of Tehama series are underlaid with a heavy subsoil. Soils of the Elder series are of rather high quality. The district is well drained naturally, although probably some 2000 acres will need inexpensive drainage ditches. Over-irrigation of some of the hard-pan land has resulted in a drainage problem and has caused the loss of some orchard trees. Since the water supply comes entirely from wells, high ground water is not likely to occur. A small amount has already been expended on drainage ditches, and small additional sums will be necessary as the area develops.

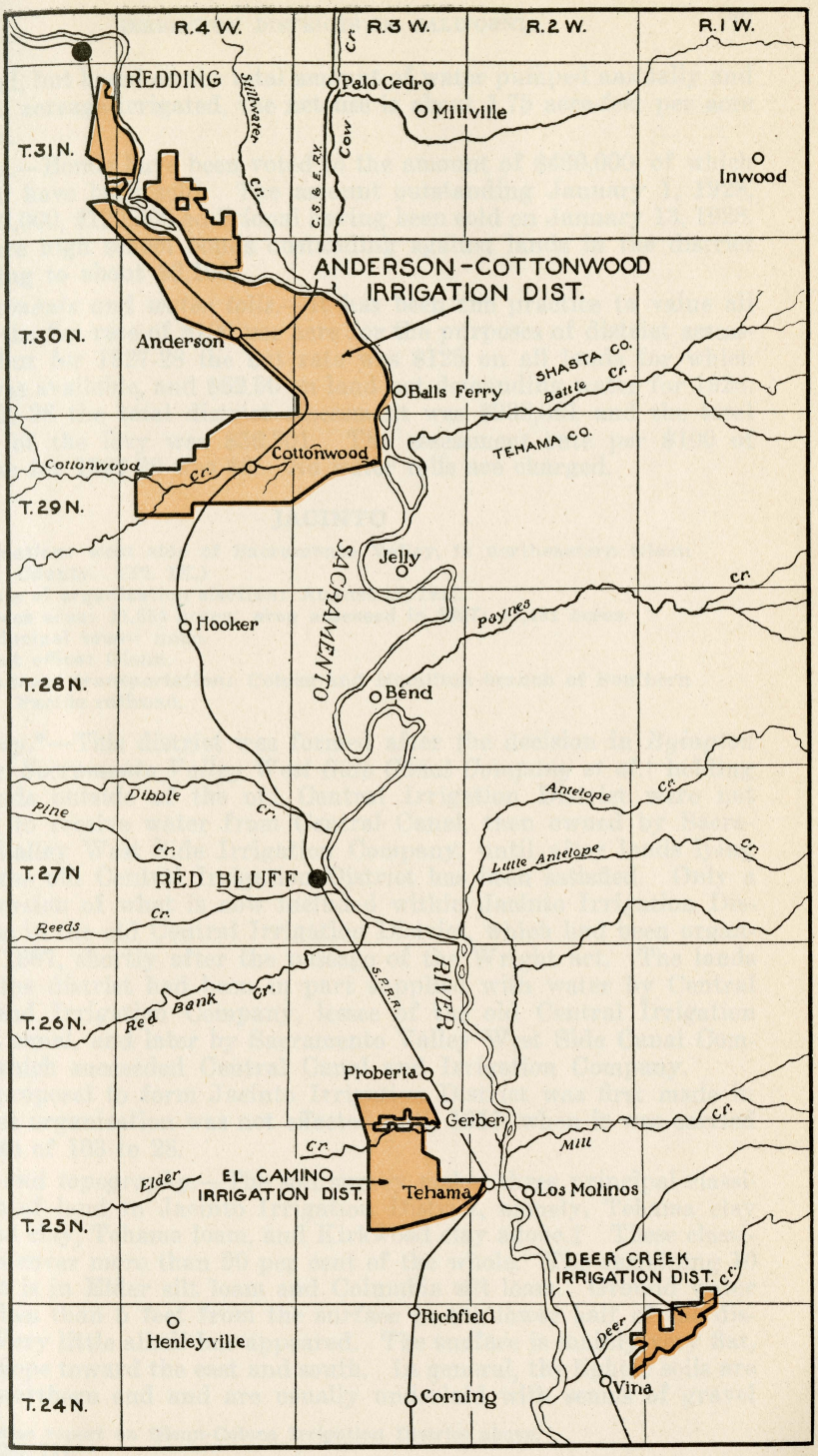
Development.—The district is about 35 per cent irrigated, 3868 acres still being in three large holdings of 218 acres, 950 acres, and 2700 acres. The total number of holdings is 250 and the average area is 30 acres. There are no towns in the district, but there is a population of about 600. Plantings are largely deciduous fruits, but with substantial areas of field crops and alfalfa. The main west-side state highway passes through the district. The estimated assessed value of the land in 1927–28 for county purposes was $350,000. The district is being colonized steadily, although not very rapidly. Colonists are coming mainly from the middle West and are substantial farmers.

Water supply.—Water is obtained from 30 wells, from which about 6500 acre-feet was pumped in 1927. The district estimates that with present pumping equipment they will be able to obtain 20,000 acre-feet annually. The district holds permit 1278 from the Division of Water Rights, with priority of December 16, 1926.

Works.—Being a small compact system supplied with water from wells within the district, irrigation works are not elaborate. Of the 30 wells, 26 are equipped with deep-well turbines varying in size from 10 inches to 18 inches. These have rated capacities of 1.33 to 5.00 cu. ft. per sec. and a combined capacity of 66 cu. ft. per sec. The units are direct-connected, electrically driven. The pumping lift is about 65 feet. Water is distributed through about 35 miles of 12-inch to 18-inch concrete pipe and about 30 miles of farmers' lateral pipe lines ranging in diameter from 8 to 12 inches. The main pipe lines cover the district, but considerable areas are not yet supplied with laterals. The total investment in works to December 31, 1927, was $256,200.

Use and delivery of water.—Water is delivered to each landowner at the highest or most convenient point, the average delivery unit area at present being 13 acres. However, delivery is not provided at the expense of the district to areas less than a single lot, as shown on the subdivision maps of El Camino Rancho. Individual deliveries are not

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Red Bluff Area, California, and Reconnoissance Soil Survey of the Sacramento Valley, California.



Location and boundary map of irrigation districts in northern Sacramento Valley.

measured, but based on the total amount of water pumped annually and the total acreage irrigated, the net use is about 1.75 acre-feet per acre per year.

Bonds.—Bonds have been voted to the amount of $430,000, of which $423,000 have been sold. The amount outstanding January 1, 1928, was $303,000, $120,000 additional having been sold on January 13, 1928. There are high school bonds oustanding against lands in the district amounting to about $3,100.

Assessments and water tolls.—It has been the practice to value all land at the flat rate of $100 per acre for the purposes of district assessments, but for 1927-28 the flat rate was $125 on all lands for which water was available, and $62.50 on land not demanding water for 1928. For 1927-28 the total district assessment was $938,361 and the total amount of the levy was $56,301. The assessment rate per $100 of valuation for 1927-28 was $6. No water tolls are charged.

JACINTO

Location: west side of Sacramento Valley, in northeastern Glenn County. (Pl. IX.)
Date of organization election: August 15, 1917.
Gross area: 11,554 acres; **area assessed in 1927:** 11,481 acres.
Principal town: none.
Post office: Glenn.
Railroad transportation: Colusa and Hamilton branch of Southern Pacific railroad.

*History.**—This district was formed after the decision in *Byington et al.* vs. *Sacramento Valley West Side Canal Company et al.*† holding that lands outside of the old Central Irrigation District were not entitled to receive water from Central Canal, then owned by Sacramento Valley West Side Irrigation Company, until after lands lying within the old Central Irrigation District has been satisfied. Only a small portion of what is now included within Jacinto Irrigation District was in the old Central Irrigation District, which had been organized in 1887, shortly after the passage of the Wright act. The lands within the district had been in part supplied with water by Central Canal and Irrigation Company, lessee of the old Central Irrigation District canal, and later by Sacramento Valley West Side Canal Company, which succeeded Central Canal and Irrigation Company.

The proposal to form Jacinto Irrigation District was first made in 1916, but organization was not effected until 1917, when it was carried by a vote of 103 to 28.

Soils and topography.—The soil survey makes three principal classifications of land in Jacinto Irrigation District, namely, Tehama clay loam and clay, Tehama loam, and Kirkwood clay adobe.‡ These classifications cover more than 90 per cent of the whole. The remaining 10 per cent is in Elder silt loam and Columbia silt loam. Ground water stands less than 5 feet from the surface in the lower half of the district. Very little alkali has appeared. The surface is mainly very flat, with a slope toward the east and south. In general, the lighter soils are in the northern end and are usually underlaid with seams of gravel

* See also report on Glenn-Colusa Irrigation District above.
† 170 Cal. 124.
‡ U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California.

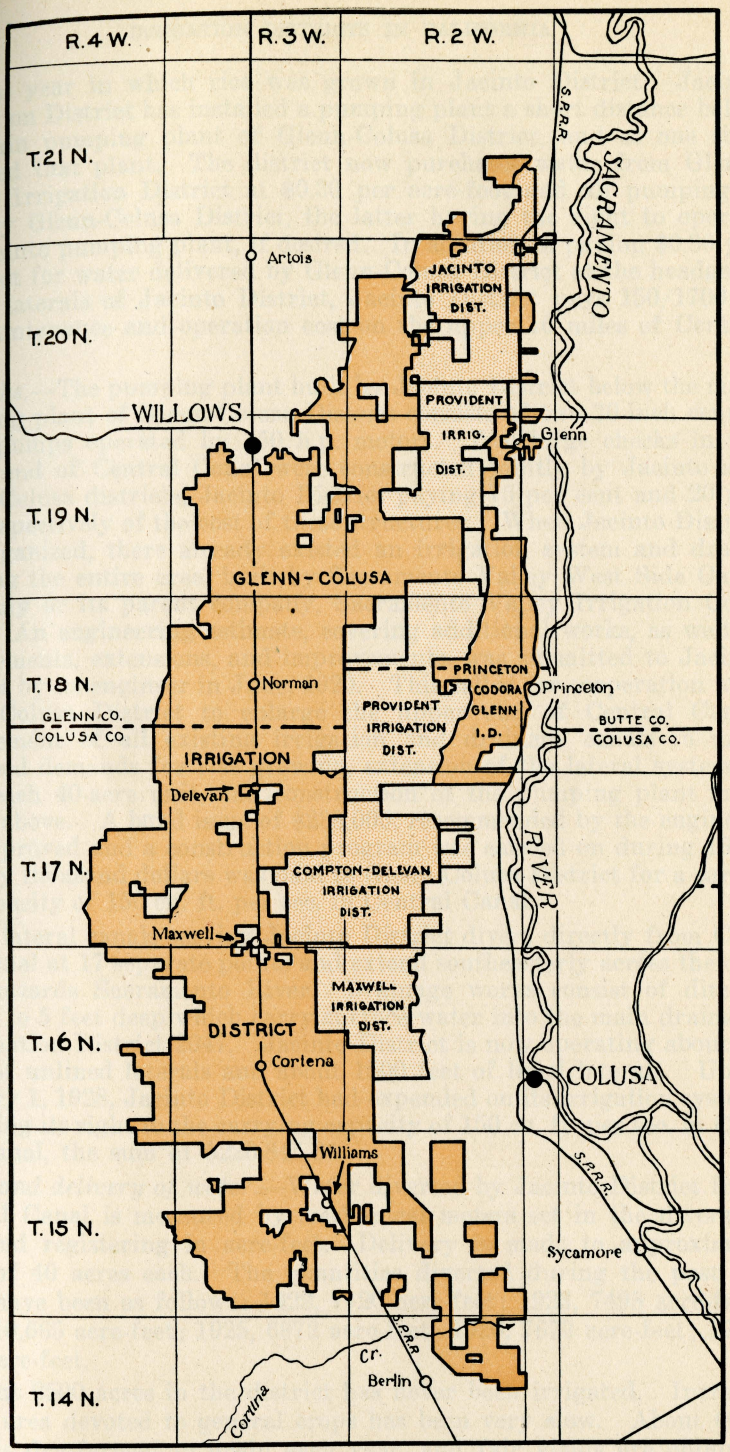
which provide better drainage than is found in the heavier soils toward the southern part of the district. A drainage system covers the district, but it is not deep enough to lower the ground water below the present elevation. Some provision has been made for removal of surface run-off.

Development.—Only a little more than one-third of the district is irrigated, owing partly to opposition to rice growing and partly to non-resident ownership of about half of the district. The Superior California Farm Lands Company, which succeeded to the ownership of lands formerly held by Sacramento Valley Irrigation Company, still holds 4130 acres in the district, and there are two holdings of 328 acres and 320 acres. Exclusive of the larger holding, there are now 185 separate farm ownerships, averaging 40 acres. About 700 acres of deciduous orchards have been planted in the northern end of the district, but dry-farmed grain is the principal crop at present, with corn and alfalfa the principal irrigated crops. Prior to 1921 some rice was grown. The total population of the district is about 325.

Water supply.—With the exception of a small amount obtained from Stony Creek in the spring, water for the district is obtained from Sacramento River through the upper 16 miles of Central Canal, now owned by Glenn-Colusa Irrigation District. No separate water filings have been made by Jacinto, the district relying on filings made by Central Canal and Irrigation Company October 28, 1903, for 5000 cu. ft. per sec. from Sacramento River, and on November 14, 1904, for 5000 cu. ft. per sec. from Stony Creek; also upon a Congressional grant of 900 cu. ft. per sec. made in 1906 to Central Canal and Irrigation Company. A second filing for 5000 cu. ft. per sec. from Sacramento River was made by Sacramento Valley Irrigation Company November 5, 1909. The claim of Jacinto Irrigation District to water under these old filings and this old Congressional grant is the fact that the lands of Jacinto Irrigation District were included in those set forth in the old filings and in the area proposed to be served by Central Canal and Irrigation Company and its successor, Sacramento Valley West Side Canal Company. Before purchase of Central Canal from Sacramento Valley West Side Canal Company by Glenn-Colusa Irrigation District, Jacinto Irrigation District entered into an agreement with Sacramento Valley West Side Canal Company by which 150 cu. ft. per sec. would be carried for Jacinto District in Central Canal. The Central Canal system was later purchased by Glenn-Colusa District subject to this agreement with Jacinto District.

The right of Jacinto Irrigation District to 150 cu. ft. per sec. was contingent upon Glenn-Colusa District establishing a right to 1700 cu. ft. per sec. for Central Canal. The agreement further provided that if the right of Glenn-Colusa was established at less than 1700 cu. ft. per sec., any diminution between 1700 and 1600 cu. ft. per sec. should be borne equally by the two districts, and that if fixed below 1600 cu. ft. per sec. the Jacinto rights should be reduced by 5 per cent of such reduction. Rights of Glenn-Colusa Irrigation District have not been definitely established.

Jacinto District reports diversions by it, or on its behalf by Glenn-Colusa Irrigation District, since 1921 ranging from 6972 acre-feet to 19,549 acre-feet per annum, the larger figure being for 1921, which was



Location and boundary map of irrigation districts on west side of Sacramento Valley in Glenn and Colusa counties.

the last year in which rice was grown in Jacinto District. Jacinto Irrigation District has installed a pumping plant a short distance below the main pumping plant of Glenn-Colusa District, and at one time operated that plant. The district now purchases water from Glenn-Colusa Irrigation District at $0.30 per acre-foot and all pumping is done by Glenn-Colusa District, the latter having the right to operate the Jacinto pumping plant, if desired. In addition to paying $0.30 per acre-foot for water delivered by Glenn-Colusa District at the headgates of the laterals of Jacinto District, Jacinto District pays 150/1700 of the maintenance and operation cost on the upper 16 miles of Central Canal.

Works.—The pumping plant built by Jacinto District below the main pumping plant of Glenn-Colusa District consists of two 30-inch centrifugal pumps operated by 150 h.p. motors. Two large checks in the upper end of Central Canal were constructed jointly by Jacinto and Glenn-Colusa districts, Jacinto District paying 75 per cent and 20 per cent respectively of the cost of these structures. When Jacinto District was organized, there already existed an irrigation system and drains covering the entire area, built by Sacramento Valley West Side Canal Company or its parent company, Sacramento Valley Irrigation Company. An engineering estimate, covering additional works, as well as enlargements, extensions, and improvements, was submitted to Jacinto District by its engineer in June, 1920. This called for cooperation with Glenn-Colusa District to enlarge the upper end of Central Canal, enlargement of all existing irrigation and drainage canals to meet increased demands for rice growing, extension of the lateral system to serve each 40-acre unit, and construction of the pumping plant mentioned above. A bond issue of $238,000, recommended by the engineer, was approved and a construction program was carried on during 1921. Seventy thousand dollars was paid to Glenn-Colusa District for a carrying capacity of 150 cu. ft. per sec. in Central Canal.

The lateral canals serving Jacinto District divert directly from Central Canal at 17 separate points and extend southeasterly across the district towards Sacramento River. Drainage works consist of ditches from 2 to 5 feet deep which carry surface water into the main drains of Reclamation District 2047. Jacinto District is now operating about 68 miles of unlined laterals and about 1500 feet of lined laterals. Up to January 1, 1928, Jacinto District had expended on its irrigation system, including its right to the carrying capacity of 150 cu. ft. per sec. in Central Canal, the sum of $220,845.64.

Use and delivery of water.—Water diverted by Jacinto District from Central Canal is measured by mechanical meters set in the diversion gate and registering in acre-feet. Delivery is made to approximate units of 40 acres each. The quantities diverted during the past six years have been as follows: 1922, 7720 acre-feet; 1923, 7498 acre-feet; 1924, 10,665 acre-feet; 1925, 6972 acre-feet; 1926, 7673 acre-feet; 1927, 9453 acre-feet.

About 3500 acres in the district has never been irrigated. Increase in the area devoted to general crops has been very slow. About 6000 acres is dry-farmed to grain each year, and fair yields are obtained where the water table is high.

Opposition to rice growing in the district grew up as a result of the rise in ground water following rice irrigation. In order to discourage the irrigation of rice, the district in 1922 set a flat rate of $10 per acre per year for rice, or a metered rate of $1 for the first 2 acre-feet or less per acre irrigated, $2 for each additional acre-foot irrigated up to 8 acre-feet, $3.50 per acre irrigated for the ninth acre-foot and $4 for each additional acre-foot per acre over 9 acre-feet. The metered rate made a charge of $9 per acre per annum if 6 acre-feet was used, or $11.50 per acre if 7 acre-feet per acre was used. The rules and regulations for 1928 specify that the district will not deliver more than 2.5 acre-feet during a season to any one acre of land, which, of course, eliminates rice.

Bonds.—The bond issue of Jacinto District amounts to $238,000. Bonds retired to January 1, 1928, totalled $41,000, leaving $197,000 outstanding. Other bonds against lands in the district have an estimated total of $107,650, of which $96,200 are for Reclamation District 2047, $8,650 are Glenn County general bonds, $1,860 Hamilton High School bonds, and $940 Glenn County High School bonds. Bonds of Reclamation District 2047 apply only to 7400 acres, or the lower two-thirds of Jacinto District. Within this area the bonded debt for Reclamation District 2047 ranges from $9 to $21 per acre.

Assessments and water tolls.—Previous to 1922, all lands in the district were assessed for district purposes at $30 per acre, but from 1922 to date the rate has been $60 per acre. The total district assessment for 1927-28 was $688,882. For each of the past six years the district assessment rate for each $100 valuation has been $4.75, and in 1927-28 the amount of the district levy was $32,721. In addition to assessments the district charges water tolls at the rate of $1 per acre per year for general crops, $0.50 per acre for a single irrigation. The total water tolls collected in 1927 amounted to $2,719. Delinquency in payments of assessments and water tolls was small up to December 31, 1927, and all delinquency prior to 1925 had been cleared up before that date. On July 1, 1928, however, Superior California Farm Lands Company, which owns over one-third of the district, went delinquent on district taxes, making a prospective financial problem for the district. However, sufficient funds were on hand in July, 1928, to insure payment of bond interest and principal due January 1, 1929.

GLENN-COLUSA

Location: west side of Sacramento Valley, from northeast of Willows to southeast of Williams, in Glenn and Colusa counties. (Pl. IX.)
Date of organization election: March 2, 1920.
Gross area: 121,592 acres; **area assessed 1927:** 121,592 acres.
Principal towns: none; **principal adjacent towns:** Willows, Williams, Maxwell.
Post office: Willows.
Railroad transportation: west-side line of Shasta Route, Southern Pacific railroad.

*History.**—The history of Glenn-Colusa and neighboring irrigation districts really began with the organization of Central Irrigation District November 22, 1887, or about eight months after the approval of

*See also State Dept. of Eng., Bul. 2, 11–14; U. S. Dept. of Agr., Office of Experiment Stations Bul. 207, 9–11, 59–64; Orders and Opinions of the Railroad Commission. Vol. 7, 113–153.

the original Wright irrigation district act. That district embraced 156,550 acres in what was then Colusa County, covering an area substantially identical with that now embraced in Glenn-Colusa District other than the portion lying west of Central Canal; also about one-third of Jacinto Irrigation District, about half of Provident Irrigation District, and most of Compton-Delevan, Maxwell, and Williams irrigation districts, as later organized. Plans were made for construction of Central Canal to divert water from Sacramento River near the present boundary between Tehama and Glenn counties. After crossing Stony Creek, the canal was to run southwesterly past Willows and southerly to Cortina Creek, south of Williams. The plan of construction adopted called for an expenditure of about $639,000, and bonds to the amount of $750,000 were authorized for that purpose. Revised estimates increased the anticipated cost to about $940,000. The proposed canal was partially constructed to a point a few miles south of Maxwell, but owing to opposition and litigation and resulting impossibility of obtaining funds, work on the system ceased the latter part of 1891, and for eleven years the project stood entirely abandoned. Central District never conveyed water through its partly constructed system.

In 1903 Willard M. Sheldon and associates formed Central Canal and Irrigation Company for the purpose of completing a portion of Central Canal sufficient to irrigate certain lands in Glenn and Colusa counties not far from Sacramento River. Prior to this, these parties had obtained from the defunct Central Irrigation District a lease of its entire property for a period of 50 years. On October 28, 1903, Central Canal and Irrigation Company made a filing for 5000 cu. ft. of water per sec. from Sacramento River, and another filing was made November 14, 1904, for 5000 cu. ft. per sec. from Stony Creek. In 1906, owing to the fact that Sacramento River was a navigable stream, Central Canal and Irrigation Company obtained from Congress a right to divert from Sacramento River "while and so long as such diversion shall not seriously injure the navigation of said river, an amount of water which, at a stage of said river of two feet above low water, as determined by the United States engineer in charge of improvement of said river, or at any lower stage, shall not exceed nine hundred cubic feet per second, to be used for irrigating the lands of the Sacramento Valley, on the west side of the Sacramento River."*

Thereupon, Central Canal and Irrigation Company completed Central Canal to the extent necessary to carry water within 6 miles of Willows, and also constructed what is known as River Branch Canal to carry water as far as 5 or 6 miles south of Princeton. A pump was installed on Sacramento River and this started delivering water to Central Canal in 1906. An affiliated company purchased land along the lines of the newly constructed system and irrigation was begun on a number of farms.

Three years later the entire system and the lands still owned by the affiliated company were purchased by parties who later organized Sacramento Valley Irrigation Company and Sacramento Valley West Side Canal Company. The outstanding bonds of Central Irrigation District were purchased at $0.35 on the dollar, and 135,000 acres of land was

* H. R. 11796, Public, No. 151.

purchased. Sacramento Valley Irrigation Company then proceeded to extend the irrigation system and to subdivide and sell their lands, giving with each acre of land sold one share of stock in Sacramento Valley West Side Canal Company.

It was the intention of Sacramento Valley Irrigation Company to limit its irrigation service, in the main, to lands controlled or sold by it. However, after operating on that basis for several years, certain owners of land not controlled by Sacramento Valley Irrigation Company who had no contract from the old Central Canal and Irrigation Company for water delivery, demanded irrigation service on the grounds that Sacramento Valley West Side Canal Company was a public utility, and on the further ground, as to some lands, that they were entitled to receive water because included within the old Central Irrigation District. The matter was tried before the Colusa County superior court in *Byington et al.* vs. *Sacramento Valley West Side Canal Company et al.*, and the claimants to water service from Sacramento West Side Canal Company were upheld, with the further order that lands within the old Central Irrigation District were first entitled to receive water from the system. This decision was later affirmed by the Supreme Court of California, April 29, 1915.*

Before the complications arising out of the Byington decision could be cleared up, Sacramento Valley Irrigation Company and Sacramento Valley West Side Canal Company were thrown into receivership through failure of the interests by which they had been organized. This was in 1914. At that time the area irrigated by Sacramento Valley West Side Canal Company was approximately 12,000 acres, although about 16,500 acres had been irrigated in 1913. Central Canal was reported by the hydraulic engineer of the Railroad Commission to have a carrying capacity sufficient to irrigate 46,000 acres, with the possibility of increasing this to 60,000 acres after making certain improvements. The canal is reported to have been designed to carry 1250 cu. ft. per sec. and is also reported to have had that capacity at the intake and in some sections farther down, but certain portions had not yet been brought down to grade. The entire matter of the capacity of the canal system and the area it was then capable of irrigating was considered at length by the Railroad Commission in decision 2483. During the next few years the demand for water greatly increased with the planting of larger acreages to rice.

Up to 1915 Sacramento Valley Irrigation Company claimed to have expended a total of $2,573,500 on the irrigation system. This included $331,823 paid for the old Central Irrigation District bonds, $223,272 paid for the stock of Central Canal and Irrigation Company, and an allowance of $378,976 for rights of way through lands of the company at $150 per acre.

Before the final decision in the Byington case, complaint was filed with the State Railroad Commission with reference to the rates charged for water by Sacramento Valley West Side Canal Company. Although this company had taken over the service obligations under contracts issued by Central Canal and Irrigation Company, and had organized as a public utility for the purpose of exercising the power of eminent

* *Byington et al.* vs. *Sacramento Valley West Side Canal Company et al.*, 170 Cal. 124.

domain, it was still claiming the status of a mutual water company bound to serve only the lands owned or sold by Sacramento Valley Irrigation Company. After a lengthy review of the case, the Railroad Commission held Sacramento Valley West Side Canal Company to be a public utility, and ordered a revision in rates. It also advised that the best solution of the difficulties in which the community had become involved would be the formation of an irrigation district to take over the system. Decision was therefore reached to form Glenn-Colusa Irrigation District to include most of the lands along Central Canal not already organized into irrigation districts or other projects which were entitled to water under the Byington decision.

The bondholders' committee and the receiver of Sacramento Valley West Side Canal Company agreed to sell the system to the proposed district for $1,000,000. Before negotiations for purchase could be completed, the demand for water from the system greatly increased, owing to the rice boom of the period. In order to meet this demand, the district, pending completion of negotiations and the issuance of bonds, leased the canal system for the season of 1920 for $60,000, and immediately began the work of enlargement, paying for this with construction warrants.

The engineer of the district had estimated that reconstruction would require a bond issue of $1,587,000, with an additional $1,000,000 for the purchase of Central Canal. On September 30, 1920, the bonds were authorized by vote of 166 to 6. Uncertainty on the part of the state engineer as to established water rights of Central Canal led him to withhold, for the time being, approval of the bond issue for certification, but on November 15, 1920, uncertified bonds to the amount of $1,189,150 were sold by the district at 90, and $1,010,000 of these bonds were exchanged at par for Central Canal in 1921. Later, the entire issue was certified.

Central Canal, when taken over by Glenn-Colusa District, had a capacity of about 1000 cu. ft. per sec., which the district proposed to increase to 1700 cu. ft. per sec. in order to provide 1550 cu. ft. per sec. for itself and 150 cu. ft. per sec. for Jacinto Irrigation District. Reconstruction work on the canal was discontinued before the proposed capacity of 1700 cu. ft. per sec. was reached. The collapse of the rice market caused a decline in the planted area, and a consequent decline in the demand for water.

Prior to the formation of Glenn-Colusa Irrigation District, Jacinto Irrigation District, which had been formed previously, had entered into an agreement with Sacramento Valley West Side Canal Company by which Jacinto District was to pay $70,000 to that company for a right in Central Canal, and Glenn-Colusa District purchased the canal subject to that agreement on April 2, 1921. Later, Glenn-Colusa and Jacinto districts made a new agreement concerning their respective rights. In this agreement, the right of Central Canal to water from Sacramento River was taken to be 1700 cu. ft. per sec., and on that basis Jacinto District was to have a right to 150 cu. ft. per sec. In the event that the right in Central Canal should be established at less than 1700 cu. ft. or more than 1600 cu. ft., the diminution in the amount was to be shared equally by the two districts. Below a total of 1600 cu. ft. per sec. the right of Jacinto District was to be decreased by 5 per cent

of such decrease. The agreement further specified the percentage of maintenance and operation costs on the canal structures above Stony Creek each district should pay. The usual allocation of these costs was 1550/1700 for Glenn-Colusa District and 150/1700 for Jacinto District.

Glenn-Colusa Irrigation District has thus been an operating district since the season of 1920. In 1924, however, the district was enlarged to include Williams Irrigation District and also certain additional lands adjoining the latter. The resolutions favoring such consolidation were passed by the two districts March 4, 1924, and consolidation was authorized by the state engineer May 22, 1924. It became effective June 16, 1924.

Williams Irrigation District was formed April 13, 1920, by vote of 5 to 0, and included 9169 acres south and east of Williams, in Colusa County. Because of uncertainty as to water rights, approval of organization was not given by the state engineer, but in accordance with section 2 of the California irrigation district act, a second petition was presented to the supervisors and was approved by them.

The formation of Williams Irrigation District differed from most irrigation districts in two important particulars. First, the land was in a few large holdings; second, the irrigation system was built by the promoters of the project prior to organization, but with the intention of forming an irrigation district to take it over. On December 5, 1919, the landowners entered into an agreement with certain parties, employing and authorizing them "to act as superintendents for the organization and construction of an irrigation system, and authorizing them to use their best efforts to promote the formation of an irrigation district under the 'California irrigation district act,' out of said land, and to apply to the proper authority for the right to divert water from the Sacramento River for the irrigation of said lands, and from 'The Trough' for the purpose of irrigating said lands temporarily, and until the right to take water from the Sacramento River can be determined." As compensation for these services, these parties were to receive 2½ per cent of the gross crops raised during each of the first three crop seasons after the water was supplied, or 5 per cent of the cash rent if the land should be leased to tenants. This agreement was to terminate February 1, 1924. The reason for haste in the matter was the high price of rice at that time.

The irrigation system was constructed under the above agreements and as a temporary measure, water was diverted from the trough of Colusa Basin, instead of from Sacramento River. The cost of the works constructed is not known, but $465,000 was paid for them by the district. Funds were obtained from a bond issue of $600,000 voted June 4, 1921, and from assessments. These bonds were not approved for certification by the Bond Certification Commission, but they were sold in the amount of $453,000 between June 29, 1921, and May 22, 1922, at prices varying from 82.50 to par. Subsequent to purchase by the district, $41,913 was spent on the system, this being paid for in construction warrants.

Due to high operating costs for the district pumping plants and low price of rice, the system was shut down in 1923, and no land was irrigated in 1924. By this time it had become apparent that the best course for Williams Irrigation District would be to join with Glenn-

Colusa Irrigation District. Water in sufficient quantities was no longer available in the trough of Colusa Basin, and works for diversion from Sacramento River had never been constructed.

At the time of consolidation, the bonded debt of Williams District amounted to $466,000. The plan of consolidation provided for Williams District to refund this issue and vote additional construction bonds to pay for the extension of the Glenn-Colusa canal system. Refunding bonds in the sum of $466,000 and $115,000 new construction bonds were accordingly voted December 7, 1923, and $17,000 additional construction bonds on May 10, 1924. All of these bonds were approved for certification by the Bond Certification Commission. These refunding and construction bonds are a lien against the lands of the Williams District areas, and in addition, those lands are charged with their proportion of the outstanding indebtedness of Glenn-Colusa Irrigation District. The consolidation agreement provided further that before the Williams District area should be entitled to receive water from Glenn-Colusa District, Williams District should pay to Glenn-Colusa District the sum of $18,868.50, in addition to the payment for canal extension. This sum was raised by selling a portion of the pumps and electric motors in the Williams district's pumping stations.

When Williams Irrigation District was merged with Glenn-Colusa Irrigation District, an area of 2800 acres was added to Glenn-Colusa District. This additional land, known as the 'southern extension,' was charged with an inclusion fee of $5.50 per acre, payable in annual installments of $0.75 per acre, plus interest at 6 per cent. It was agreed that these payments were to be applied exclusively to the retirement of bonds of Williams Irrigation District.

Consolidation with Glenn-Colusa Irrigation District did not, however, solve the difficulties of the Williams Irrigation District area. A large proportion of the assessments in Williams District are delinquent and on December 31, 1927, bond interest to the amount of $44,340 was in default. Water tolls were delinquent to the amount of $25,693, and there was bond principal due but in default amounting to $11,000. Glenn-Colusa District has brought suit to collect some of these delinquent water tolls and judgment has been obtained on some of them. At this writing (November, 1928), an effort is being made to work out a plan of adjustment with Williams District bondholders.

Soils and topography.—The soil survey shows the predominating soil classifications in the district as Willows clay adobe, Willows clay, Willows loam, Tehama clay loam and clay, and Tehama loam.* Loams and clay loams are the most suitable for general crops, and Willows clay adobe is considered best for rice. Alkali is usually associated with Willows clay. The poorer grades of this soil near the center of Colusa Basin are known as 'goose-lands.' They were used only for grazing purposes until the high prices of rice from 1917 to 1919 caused some of them to be irrigated. Speaking generally, the 'goose-lands' have not been profitable under rice at the prices prevailing during the past few years, and are now mainly used as pasture. The elevation in Glenn-Colusa Irrigation District varies from 35 to 350 feet.

Drainage is a problem in Glenn-Colusa Irrigation District, particularly in the rice areas, or in areas that have been affected by the heavy

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of Sacramento Valley, California.

irrigation incident to rice growing. About 95,000 acres of the district is within Reclamation District 2047, which has an assessable area of 218,743 acres. District 2047 has constructed the main surface drains in Colusa Basin. Lateral drains are being constructed progressively by Glenn-Colusa Irrigation District.* The policy of Glenn-Colusa District is to provide drainage for general crop areas wherever the owners desire to develop the land. From 1922 to 1927, it expended on dragline drainage work $242,833, average costs ranging from $0.118 to $0.142 per cu. yd.

Development.—The area irrigated in Glenn-Colusa Irrigation District in 1925 was 29,600 acres; in 1926, 42,217 acres; and in 1927, 36,188 acres. In 1927 about 70 per cent of the irrigated area was in rice. The area in rice naturally fluctuates from year to year with the price of rice. The area in general crops for 1927, including pasture, was 10,783 acres. It is evident that in this district rice must be classed as a principal crop. Much of the land, however, is suitable for orchards, alfalfa and general field crops and it can be assumed that these crops will increase as economic conditions warrant.

The west side of Sacramento Valley has always been an area of large farms, and while the development under irrigation has split up many of these, there are still some holdings so large that they can not ordinarily be devoted to irrigated crops. In 1927 there were still five holdings which together embraced about 24,000 acres, one of these having 10,400 acres. The total number of farms within the district approximates 451, averaging 243 acres, counting net irrigable area only. The estimated population of the district is 1200. The combined population of the adjacent towns of Willows, Williams and Maxwell is 5000. The main west-side state highway passes north and south through the entire length of the district.

Water supply.—Previous reference was made under "History" to the water filings of the predecessors of Glenn-Colusa Irrigation District in the ownership of Central Canal. In addition to the filings by the old Central Canal and Irrigation Company in 1903 and 1904, calling for 5000 cu. ft. per sec. from Sacramento River and 5000 cu. ft. per sec. from Stony Creek, and also the Congressional grant referred to above from Sacramento River, made in 1906, the district succeeded to another filing of 5000 cu. ft. per sec. made by Sacramento Valley Irrigation Company, November 5, 1909. The district has made no application to the Division of Water Rights for permit to divert Sacramento River water, preferring to rely on these old filings and on beneficial use.

It is stated by the manager of the district that 1620 cu. ft. per sec. was carried through Central Canal for a period in the middle of June, 1926. He further states that the limiting factor at that time was not canal capacity, but rather the capacity of the pumps in service at the intake. The report of the Sacramento-San Joaquin water supervisor for 1926 shows a daily diversion into Central Canal on June 15 and June 16 of 3213 acre-feet, which was equivalent to a mean daily flow of 1606 cu. ft. per sec.

*Univ. of Cal., Agr. Exp. Sta., Bul. 464, Drainage in the Sacramento Valley Rice Fields, by Walter W. Weir.

FIG. 1. Rice field in a west-side Sacramento Valley irrigation district.

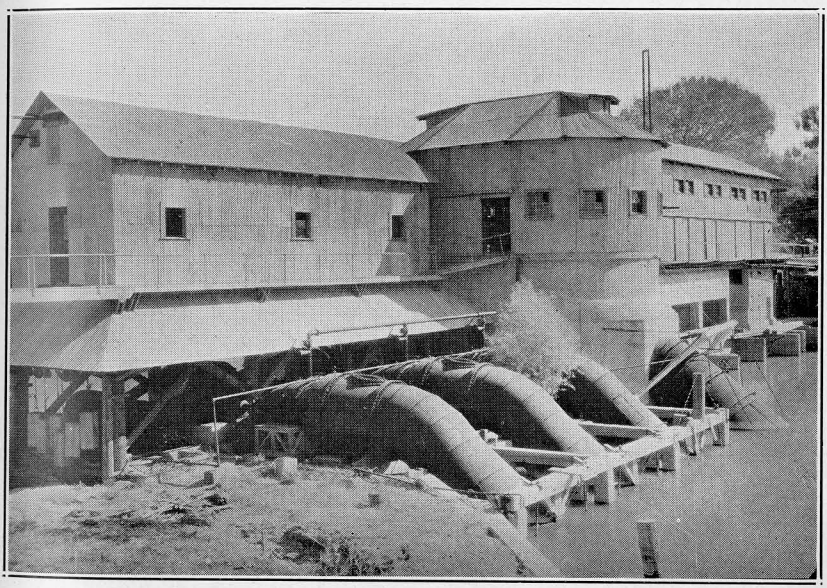


FIG. 2. Pumping plant of Glenn-Colusa Irrigation District for diverting water from Sacramento River into Central Canal.

On consolidation of Williams with Glenn-Colusa districts, Glenn-Colusa District succeeded to any rights that may accrue under three filings by Williams District. These are covered by permits 796, for 83.27 cu. ft. per sec., 797, for 32.01 cu. ft. per sec., and 798, for 5.50 cu. ft. per sec., or a total of 120.78 cu. ft. per sec from Sacramento River and the Colusa Basin trough. These filings have priority dates ranging from December 3, 1919, to February 5, 1920. In 1927, with the exception of 16,248 acre-feet diverted by gravity from Stony Creek, all of the water carried by Central Canal was pumped from Sacramento River, the amount in that year reaching 353,191 acre-feet. The main pumping lift at Sacramento River varies with the water stage in the river, but the maximum usually does not exceed 10 feet.

Of the combined gravity and pumping diversion in 1927, amounting to 369,439 acre-feet, 28,325 acre-feet was delivered outside of Glenn-Colusa District. The district obtains some irrigation water from an 8-inch turbine drainage pump installed in a well near Williams. In addition to carrying water through Central Canal for Jacinto Irrigation District, for which the latter pays $0.30 per acre-foot plus a pro-rata cost of maintenance and operation, Glenn-Colusa District delivers a small amount of water to Provident District and a full supply to Compton-Delevan District. The diversions for the latter districts, however, are made under the respective rights of those districts. The Compton-Delevan agreement with Glenn-Colusa District provides for the delivery of not over 120 cu. ft. per sec. at Funks Crossing, a charge of $5.25 per acre of rice irrigated being made. The usual charge for water delivered to Provident District is $5 per acre of land irrigated, although some water is delivered to that district at the rate of $0.45 per acre-foot.

Works.—Water is pumped into Central Canal from a dredged intake channel about one mile long, which joins Sacramento River near the Tehama-Glenn county line. The intake structure is a low dam across the canal heading. The pump house, extending across the canal, forms a part of the structure. A massive flood gate is located in the canal about 2000 feet below the headworks. Central Canal runs in cut a distance of 6 miles to Stony Creek, which is about 700 feet wide, and which is crossed by means of a temporary levee constructed across the lower side of the canal each season. That part of Central Canal constructed solely by Glenn-Colusa District is 50 miles in length, the Williams District extension continuing for about 12.5 miles. Lateral canals within Glenn-Colusa District are not owned by the district, although the district directors hold about 300 miles of laterals in trust for the landowners. These are maintained by the district. In Williams District, however, a complete system of laterals has been built, and this is owned by the district.

The main pumping plant of Glenn-Colusa Irrigation District consists of three 72-inch and one 100-inch horizontal screw pumps, the 72-inch pumps having a capacity of 220 and the 100-inch pump of 350 cu. ft. per sec.; one 72-inch vertical screw pump with a capacity of 220 cu. ft. per sec; two 50-inch and one 42-inch horizontal centrifugal pumps, with capacities of 140, 160 and 110 cu. ft. per sec., respectively. There are also two vertical turbines with a capacity of 225 cu. ft. per sec. each.

In addition to the pumps in the main pumping plant, Glenn-Colusa District operates two 36-inch horizontal centrifugal units, with a com-

bined capacity of 110 cu. ft. per sec. each, which belong to Jacinto Irrigation District. These are situated a short distance below the main pumping plant of Glenn-Colusa District. About 12 private booster pumps lift water to lands above Central Canal. The total investment in Glenn-Colusa Irrigation District, charged to capital improvements, January 1, 1928, was $3,152,876, of which $524,150 covers the system in the Williams District area.

Use and delivery of water.—There is no definite area to which water is delivered within the district, since practically all water is served on an acreage basis. It is estimated that the loss from the main canal is 30 per cent of that diverted. During the past three seasons from 68 to 78 per cent of the irrigated acreage was in rice. The use of water on rice in Sacramento Valley generally ranges from 5 to 7 acre-feet per acre per year when rice is restricted to the good rice lands.*

Bonds.—The first bond issue of Glenn-Colusa Irrigation District was for $2,587,000. Bonds to the amount of $129,350 were to mature January 1 of each year from 1922 to 1941. Early maturities were a hardship during agricultural depression, but they were met directly during the first three years. A refunding issue of $300,000, however, was voted October 16, 1924, the amounts and maturity dates of the refunding bonds being so arranged that the sum of the principal and interest payments due annually would be approximately equal without extending the final maturity date. Funding bonds have been used to the amount of $270,000 to take up in part the bonds maturing 1925 to 1933, and the remaining part of these issues have been paid as due. Up to January 1, 1928, inclusive, $535,600 of the first issue had been retired, leaving outstanding on that date, $1,598,000 of the first issue, and $270,000 of the refunding issue. The $1,010,000 in bonds exchanged for Central Canal were taken at par. Bonds to the amount of $1,189,150 were sold before certification. The first issue of bonds voted by Williams District totaled $600,000. Only $453,000 of these bonds were sold. A total of $58,000 was paid, $332,000 have been refunded, and $63,000 were outstanding December 31, 1927. Of these outstanding bonds $6,000 which matured on January 1, 1927, and $5,000 which matured a year later were defaulted and have been registered. A refunding issue of $466,000 was voted December 7, 1923, of which $379,000 are outstanding. At the same time the refunding issue was voted, a second issue of construction bonds amounting to $115,000 was authorized, and an additional issue of $17,000 was voted May 10, 1924. On December 31, 1927, the total bonds outstanding amounted to $574,000, and there were $87,000 of the refunding bonds in the treasury.

Other obligations against lands in the district are estimated at $1,514,760, of which $155,760 are against lands in the Williams District area. A total of $1,332,000 of the above are bonds of Reclamation District 2047, and $760 is a portion of an assessment levied by Sacramento-San Joaquin Drainage District. This assessment applies to lands in the Williams area; the balance of the bonds are county and school district bonds.

Assessments and water tolls.—Good farm lands in Glenn-Colusa District served by laterals maintained by the district are assessed for district purposes at $44 per acre, and the same class of lands not served

* For data on duty of water in rice irrigation and methods of rice irrigation in Sacramento Valley see Univ. of Calif. Agr. Exp. Sta. Bulletins 279, 325 and 450.

by district-maintained laterals are assessed at $40. Lands carrying 1 to 3 per cent alkali are assessed at $30 per acre and lands nominally assessed, at $7 per acre. The total district assessed valuation for the consolidated district in 1927–28 was $4,981,274. From 1924 to 1927 the Glenn-Colusa assessment per each $100 of valuation on all land within the consolidated district, with an assessable area of 121,592 acres in 1927–28, was $6.50.

Of the lands within the Williams District area, 9169 acres assessed in 1927–28 at $403,440, however, have carried additional assessments per $100 of valuation of $14.90 in 1924–25, $11.70 in 1925–26, $10.41 in 1926–27, and $10.59 in 1927–28. The 'southern extension,' with an assessed area of 5780 in 1927–28, was assessed an average of $0.982 per acre in addition to the regular Glenn-Colusa levy.

The total of all assessments levied in 1927–28 amounted to $391,811, segregated as follows: $282,022 on land (106,623 acres) within boundaries of Glenn-Colusa District before consolidation; $68,948 on lands within Williams District area; $21,015 on lands within 'southern extension,' and $19,826 of delinquent water tolls. Of the delinquent water tolls, $7,297 was against lands in the 'southern extension,' and $13 was against lands in Williams District.

In addition to district assessments, annual tolls are collected at the rate of $5 per acre for rice, $1 per acre for general crops, and $0.50 per acre for one irrigation only. Total water tolls collected in 1927, including collections from outside sales, amounted to $155,276. The amount of tolls received from sales outside of the district was $16,499.

PROVIDENT

Location: in the trough of Colusa Basin, east of the northern portion of Glenn-Colusa Irrigation District, in Glenn and Colusa counties. (Pl. IX.)
Date of organization election: April 27, 1918.
Gross area: 22,805 acres; **area assessed 1927:** 22,805 acres.
Principal town: none.
Post office: Willows.
Railroad transportation: main west-side line of Shasta Route of Southern Pacific railroad, 4 miles west, and Colusa-Hamilton branch of Southern Pacific railroad, 2 to 3 miles east of the district.

*History.**—Lands in this district were within the area purchased in 1909 by Sacramento Valley Irrigation Company; also they were a part of the area which the Byington decision held could not be served with water by Central Canal until lands lying within the original boundaries of Central Irrigation District should have first been supplied. Following the failure in 1914 of the interests which controlled Sacramento Valley Irrigation Company, Superior California Farm Lands Company was organized to take over certain of the lands of Sacramento Valley Irrigation Company. Certain large tracts were then purchased from that company by a group of individuals who then organized Provident Irrigation Syndicate for the purpose of constructing an irrigation system to supply these lands with water independently of Sacramento Valley West Side Canal Company, then owner of Central Canal. The project was started in the latter part of 1916, and applica-

* See also report on Glenn-Colusa Irrigation District above.

tions were filed with the State Water Commission to divert water from Sacramento River at Sidd's Landing. Because of the high price of rice during the war period and the resulting heavy demand for water, construction of the irrigation system was rushed during 1917, with the idea of providing for the irrigation of 21,000 acres of rice.

In order to reimburse themselves for their expenditure on the irrigation system, the landowners presented a petition to the board of supervisors of Glenn County, March 4, 1918, for the formation of an irrigation district. The irrigation system was then nearing completion. The organization election, held May 16, 1918, was carried by a vote of 13 to 0. A report presented to the board of directors stated that the reproduction cost of the system under conditions prevailing in 1918 would be $952,970. In addition to this, betterments and improvements, estimated to cost $60,000, were contemplated. It was proposed that Provident Irrigation Syndicate should complete the work on the system and that it should then be turned over to the district for a price of $1,000,000. An agreement to this effect was made August 28, 1918. During the first two years of operation it was found that additional work was necessary. In the early part of 1921, 2000 acres adjoining the district petitioned for inclusion. To meet the increased cost, a second bond issue of $190,000 was authorized to reimburse Provident Irrigation Syndicate for enlarging the main canal, and for the canals and pumping equipment necessary to irrigate the additional lands taken in.

To understand the history of this district, it is necessary to remember that the land included was not in established farms, but was developed rapidly during the war period by large landowners who were speculating in rice. These landowners borrowed large sums in connection with their operations, and when the price of rice collapsed, accompanied in 1920 by a very unfavorable year for harvesting, much of the land went into the hands of those who had advanced money on it. At the present time (1928) 6936 acres is in the hands of four banks, 307 acres is in the hands of an insurance company, and 13,140 acres is held by 9 individuals and companies.

Delinquency in payment of district assessments has been large. The district has already acquired 1859 acres by tax deed, and unredeemed tax certificates are held on an additional 3032 acres. One bank and one of the other large landowners failed to pay their assessments due in June, 1928. Thirty-two per cent of the lands in the district are now delinquent. In 1928 the district planted to rice 800 acres of land to which it had taken tax title, and returns from this crop are counted on to offset to some extent the assessments on other lands which it holds. With an annual payment of $89,000 due on the bonded debt, and only one-third of the total area of the district being cropped, the district faces a serious financial problem.

Soils and topography.—The lands of the district are generally heavy. The soil survey classification shows 6800 acres of Willows clay, 6600 acres of Tehama clay loam and clay, 6621 acres of Willows clay adobe, and 740 acres of Sacramento clay, the remainder being loam and silt loam of the Elder, Columbia, Tehama and Willows series.* About 2500 acres is estimated to have an alkali concentration ranging from light

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California.

to heavy. Topographically the land is a flat valley plain in the trough of Colusa Basin. Deep drains of Reclamation District 2047 cover the district; lateral drains built by the irrigation district discharge into these. These lateral drains are deep enough to carry water from the rice fields, but not to lower the water table, which stands less than 5 feet from the surface.

Development.—The financial condition of landowners, scarcity of tenants, the practice of resting rice land one year in about three, and the quality of some of the soil, have combined to hold the irrigated area to 8000 to 8500 acres during the past three years, mostly in rice. Reference has already been made to the large holdings. The population is about 250. The estimated assessed valuation in 1927–28 for county purposes was $914,000, of which about one-third is in Colusa County and the remainder in Glenn County.

Water supply.—The district has permits 303, 304, 416 and 494 from the Division of Water Rights, which call for a total of 660 cu. ft. per sec. from Sacramento River. These permits have priorities ranging from September 15, 1916, to August 13, 1918. Water is also purchased from Glenn-Colusa District to irrigate 203 acres of high rice land which can not be reached from Provident Canal. Provident District pays for this water at the rate of $5 per acre per season. There is a growing tendency to obtain more water from Glenn-Colusa District, if satisfactory arrangements can be made, since Glenn-Colusa District, with its lower pumping lift, can deliver water at a cost lower than Provident District can pump it. With a view to trying out such a plan, some additional water was purchased from Glenn-Colusa District during 1928 at the rate of $0.45 per acre-foot. The amount of water diverted by Provident District during the past four years has been as follows: 1924, 94,184 acre-feet; 1925, 94,097 acre-feet; 1926, 101,005 acre-feet; 1927, 99,018 acre-feet.

Works.—The pumping installation of the district on the bank of Sacramento River at Sidd's Landing consists of four 42-inch centrifugal pumps, which deliver 50,000 g.p.m. each, operating under a head of 30 feet, and one 36-inch centrifugal pump, with a capacity of 30,000 g.p.m. The large units are driven by 500 h.p. electric motors, and the smaller unit by a 300 h.p. electric motor.

A main canal extends due west 2.5 miles from Sacramento River and then turns south, following the highest ground and running close to the west side of the district. After crossing Willow Creek, it extends southerly to serve the lower unit of the district, which is separated from the upper unit by a distance of about 2 miles. In the lower unit it divides into three main laterals. The main canal was originally constructed to carry 400 cu. ft. per sec., but its capacity was increased to 550 cu. ft. per sec. prior to inclusion of more lands in 1921.

Due west from Sidd's Landing 3.5 miles, a booster plant is located to lift water 8 feet into a higher ditch system, where two 18-inch centrifugal pumps are located, driven by a single 100 h.p. motor.

The district also operates two additional booster plants. One, taken over with the land petitioned into the district, consists of two 12-inch, one 15-inch, and one 24-inch centrifugal pumps, operated by 20 to 50 h.p. electric motors; the other, installed to pump water from Colusa drain and to augment the supply from the river, consists of one 20-inch

pump, operated by a 75 h.p. motor, and one 14-inch pump, operated by a 30 h.p. motor. One landowner in the southeastern corner of the district has installed a private pumping plant, irrigating 400 acres by lifting from a creek with a box pump, operated by a 25 h.p. motor.

In all, the district operates 30 miles of main and 60 miles of lateral canals, all unlined. Up to December 31, 1928, the district had invested $1,280,500 in irrigation and drainage works, most of which were acquired from Provident Irrigation Syndicate.

Use and delivery of water.—Deliveries of water are made from the main canal and main laterals only, the usual unit area being 160 acres. Deliveries are not measured. The district rules and regulations provide for delivery by rotation; they further provide that the draining of water from the rice fields in the fall shall be under the direction and control of the superintendent. The rules also designate definitely the main canals and main laterals of the district.

Bonds.—Reference was made to district indebtedness under "History." The first issue of bonds amounts to $1,000,000 and the second to $190,000. These issues were turned over at par to Provident Irrigation Syndicate, which constructed the system. Bonds of the second issue to the amount of $118,000 have been retired, leaving $1,072,000 outstanding January 1, 1928. The estimated amount of other bonds or obligations against lands within the district includes county road and school bonds, $23,420; bonds of Reclamation District 2047, $456,000; and Assessment No. 6 of Sacramento-San Joaquin Drainage District, $5,088; a total of $484,508.

Assessments and water tolls.—Assessments for district purposes range from $60 to $80 and average $75 per acre. The basis of the assessments is the quality of the land and its adaptability to agricultural purposes. The total district assessed valuation in 1927–28 was $1,616,520. During the past five years the district assessment rate for each $100 valuation has varied between $6.09 and $9.07 and was $8.50 in 1927–28. The district levy for 1927–28 amounted to $137,404.

The district also charges for water for rice at the rate of $6 per acre per year, and for general crops at the rate of $1.50 per year. For flooding, the district charges $2.50 per acre per year. In 1920, when rice was at its peak, the total water tolls collected amounted to $312,211, but the income from tolls dropped to $23,807 in 1923, and was $51,770 in 1927.

The district supplies water to certain lands in Princeton-Codora-Glenn Irrigation District, the area so covered in 1927 having been 385 acres.

PRINCETON-CODORA-GLENN

Location: along the west bank of Sacramento River, in Glenn and Colusa counties. (Pl. IX.)
Date of organization election: December 9, 1916.
Gross area: 13,656 acres; **area assessed 1927:** 13,656 acres.
Principal town: none; **principal adjoining town:** Princeton.
Post office: Princeton.
Railroad transportation: Colusa-Hamilton branch of Southern Pacific railroad.

*History.**—This district was organized to take over from the receiver of Sacramento Valley West Side Canal Company the river branch of

* See also report on Glenn-Colusa Irrigation District above.

Central Canal, which was constructed in 1906 by Central Canal and Irrigation Company. Although originally expecting to receive water under the project of Sacramento Valley Irrigation Company, the owners of the area under River Branch Canal later learned through the Byington decision that their lands were not entitled to receive water from Central Canal except after all demands made for lands within the boundaries of the old Central Irrigation District had been met. After the decision in the Byington case was affirmed by the Supreme Court of California, and in order to avoid further litigation and perhaps serious loss, the irrigators under River Branch Canal decided to purchase that canal and transfer the point of diversion from Central Canal northeast of Willows to Sacramento River.

It was at first proposed to form a mutual water company, covering 8000 to 10,000 acres, and to install pumps with a capacity of 100 cu. ft. per sec., to be located at Sidd's Landing on Sacramento River. Instead of adopting this proposal it was decided to form an irrigation district embracing a larger area. The original capacity of River Branch Canal was about 125 cu. ft. per sec., whereas the demand for the larger area was estimated at 240 cu. ft. per sec. Rather than to enlarge the upper portion of River Branch Canal, it was decided to pump into it from Sacramento River at Sidd's Landing, at the northern end of the district, and at Shadd Ranch, 5 miles north of the southern end of the district.

In the summer following the organization election, an engineer was employed to lay out a plan and prepare cost estimates. Both pumping from ground water and from Sacramento River were considered, and the latter was decided upon. The engineer's estimate called for an expenditure of $173,150, which included $78,500 for the purchase of River Branch Canal. The plan was adopted and bonds to the amount of $175,000 were voted May 15, 1918.

Soils and topography.—The soil survey shows about 5300 acres of Sacramento clay and about 8300 acres of Columbia silt loam,* the latter being one of the best types of soil in Sacramento Valley. The surface is flat, sloping to the south and west. Drainage conditions are satisfactory; ground water ranges from 8 to 22 feet from the surface, being closer to the surface on the west side farthest from the river. Drains of Reclamation District 2047, which includes all of the land within the irrigation district, border the district on the west and local lateral drains feeding into these have been constructed by landowners. Very little land shows alkali. The elevation of the district varies from about 100 feet in the north to about 70 feet in the southwest corner.

Development.—About half of the irrigated area in the district is devoted to general crops and deciduous fruits, chiefly prunes; the other half of the district is in rice. Most of the nonirrigated area is used for growing grain and grain hay. In 1927, between 400 and 500 acres of the irrigated land was double-cropped. A total population of about 1000 resides in the district. Princeton, which the district surrounds, has a population of about 250. There are three landholdings of 1208, 1121 and 993 acres, respectively. The 1927 assessment rolls show 185 holdings which average 74 acres; exclusive of the large holdings the average is 60 acres. The estimated assessed valuation of land within the district for county purposes in 1927 was $445,800 in Glenn County and

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California.

$756,500 in Colusa County. A district official familiar with the holdings in the district states that a conservative estimate of the value of farm improvements would be $5,000 per holding, or a total of $925,000. Most of the holdings are owned by resident farmers. A paved highway passes through the district, connecting Colusa and Williams.

Water supply.—The district has obtained permits 463 and 464 from the Division of Water Rights, each calling for 120 cu. ft. per sec. from Sacramento River, priorities dating from February 3, 1916, and September 5, 1917. Diversion from Sacramento River is made at Sidd's Landing, near the northern end of the district, and at Shadd Ranch about 2 miles north of Princeton. For the past four years diversions from the river have been as follows: 1924, 37,448; 1925, 44,208; 1926, 46,567; 1927, 52,705.

Works.—The two main pumping plants of the district at Sidd's Landing and Shadd Ranch are of the same size and design. Each includes three 24-inch centrifugal pumps operated by 150 h.p. motors. Each has an approximate capacity of 240 cu. ft. per sec., and at each the lift averages 24 feet. A 12-inch centrifugal booster pump, operated by a 10 h.p. motor, lifts water at the northern end of the district about 3.5 feet to supply 150 acres.

The district system includes 15 miles of unlined main canal, about 60 miles of unlined laterals, and 2 to 3 miles of lined laterals. The laterals are owned by the landholders, being held by a board of trustees and operated by the district. The district also operates 2 miles of lateral pipe line, varying from 18 inches to 36 inches in diameter.

On January 1, 1928, the district had expended on works a total of $185,684.92.

Use and delivery of water.—Water is delivered to each holding. The rules and regulations adopted by the district require written applications accompanied by advance payment of $1 per acre for rice and $0.35 per acre for general crops. Two mechanical meters were in operation in 1928, but very few measurements are made, water being sold on an acreage basis. Landowners are responsible for care of laterals; in fact all extensions and enlargements of the canals or laterals are made at the expense of the landowners benefited. The district does not agree to furnish water to any irrigator in excess of 3 cu. ft. per sec. to each 100 acres of rice land nor in excess of 1 cu. ft. per sec. to each 100 acres of general-crop land. Irrigation heads are fixed generally at from 4 to 8 cu. ft. per sec.

The total amount of water diverted in 1927 was not recorded. Based on the reports of the Sacramento-San Joaquin water supervisor, the gross diversions of water during the past four years, in acre-feet per acre, have been as follows: 1924, 6.7; 1925, 9.0; 1926, 9.0; 1927, 8.8. These figures include about 500 acres irrigated with water from Provident Irrigation District, but not the amount of water received from that district. At any rate, the duty of water is low, considering that only about half of the irrigated area is in rice.

Bonds.—Only one bond issue has been put out, this amounting to $175,000. Besides the irrigation district bonds, there are outstanding obligations against lands in the district as of December 31, 1927, as follows: Glenn County school and county bonds, $8,300; Colusa County

school and county bonds, $11,965; Reclamation District 2047, $198,000; Assessment No. 6, Sacramento-San Joaquin Drainage District, $18,719, exclusive of interest; total $236,974.

Assessments and water tolls.—Lands are assessed for district purposes at $65 to $70 per acre, the total district assessed valuation for 1927–28 being $920,640. During the past five years the annual assessment rate for each $100 of valuation has ranged from $3.05, in 1923–24, to $4.61, in 1925–26 and 1926–27, and was $4.30 in 1927–28. The total district levy for 1927–28 was $39,829. The district charges $5 per acre for rice and $1.75 per acre for general crops irrigated, in addition to the annual district assessments. In 1927 the total collected from water tolls was $19,149.

COMPTON-DELEVAN

Location: north and east of Maxwell and west of main trough of Colusa Basin, in Colusa County. (Pl. IX.)
Date of organization election: August 16, 1920.
Gross area: 12,652 acres; **area assessed 1927:** 12,572 acres.
Principal town: none.
Post office: Maxwell.
Railroad transportation: west-side line of Shasta route of Southern Pacific railroad at Maxwell, and Hamilton-Colusa branch of Southern Pacific railroad 2 miles east of district.

*History.**—Lands in Compton-Delevan District were included in the Sacramento Valley Irrigation Company project which began operations about 1909, and there was some subdivision and irrigation started under that project. In 1914 certain parties purchased land for rice growing in the area and started the construction of an irrigation system. A pumping plant was located on the west bank of Sacramento River about three miles south of Princeton and a main canal was run west. A second pumping plant to boost water to a higher level was installed on this main canal west of the trough of Colusa Basin. In 1915 about 2800 acres was put under irrigation.

During 1915 the interests of the original company were taken over by a new company, and the following year about 3500 acres was irrigated. During 1916 the irrigation system was extended to include an additional 2230 acres, the capacities of the two pumping plants being increased and a third pumping plant being installed farther to the west. In that year about 5200 acres was irrigated.

In 1918 the system was further extended to take in additional lands, and the interests of the second company were taken over by a third company known as Maxwell Irrigated Farms Company. In 1919 a fourth pumping plant was installed and more lands brought under irrigation. It is reported that in that year 9000 acres was in rice, 1100 acres in general crops, and that the remainder was lying idle for eradication of water grass. In 1920 there was further extension, and the capacity of pumping plant No. 3 was increased. In that year it was reported that 9000 acres was in rice, 800 acres in barley, 300 acres in wheat, 700 acres in Egyptian corn, and about 3400 acres idle.

While the above mentioned development was under way, it was decided to transfer the cost of construction to the land through the organization of an irrigation district. Accordingly, a petition was presented to the county supervisors, March 30, 1920. There were then

* See also report on Glenn-Colusa Irrigation District above.

eighteen separate holdings, of which ten ranged from 10 to 160 acres and five ranged between 1280 and 5447 acres. The total cost of the irrigation system was reported by Maxwell Irrigated Farms Company to be $624,200, or an average of about $44 per acre. Most of the area was being farmed by tenants, the cash rental in one case reaching from $50 to $60 per acre over a 3-year period, the prevailing rental rate being one-third of the crop and $10 cash per acre.

At the time of the petition for organization, about 4200 acres was held by eight non-resident owners, and 5447 acres was owned by Maxwell Irrigated Farms Company, a corporation maintaining its principal place of business on the land. There were ten voters at the organization election, all voting in favor of the district. Most of the voters were owners of small holdings, some being employees of the larger landowners. At a bond election held November 27, 1920, bonds to the amount of $575,000 were authorized by a vote of 9 to 0. The entire issue was approved for certification, December 17, 1920, and Maxwell Irrigated Farms Company was given $523,000 in bonds at par for the system, which was then supposed to be free from encumbrances. Later these encumbrances had to be cleared by the district.

From the beginning, the district was in financial difficulties. The price of rice had slumped and the fall of 1920 was a difficult one for rice harvest. The bond interest due July 1, 1921, was paid by Maxwell Irrigated Farms Company and district warrants taken, these being later applied on the 1921 district assessment. Only about half of the assessments were paid in 1921, and bond payments due January 1, 1922, a little more than one year after organization, were defaulted.

About January, 1923, the bankers who were financially interested in the project, and who had disposed of its bonds, acquired Maxwell Irrigated Farms Company. In that year, $54,070 was paid to redeem tax sales certificates, and the bonds which fell due were taken up. After major delinquencies were covered, a refunding bond issue of $445,000 was voted on September 29, 1924, $384,000 of which were recommended for certification by the Bond Certification Commission August 6, 1927.

Up to December 31, 1927, $52,000 of the first issue had been canceled, $139,000 had been paid, and $208,000 had been refunded, and there were no outstanding defaults on either bond interest or principal. Tax delinquencies are, at present, moderate. The district has taken tax title to 720 acres, 640 acres of which has been sold on contract. In 1927 only 2695 acres of the district was in crop, and there were only nine landowners on the assessment roll.

Soils and topography.—The district soil classification, as taken from the soil survey, shows 350 acres of Willows clay, 900 acres of Sacramento clay, 9425 acres of Willows clay adobe, 642 acres of Columbia silt loam, and 1335 acres of Willows loam.* The land slopes gently from east to south from a maximum elevation of 75 feet to a minimum of 50 feet. The surface is very smooth, and practically the entire area is checked for rice. Ground water is within 5 feet or less of the surface. The entire district is included within Reclamation District 2047. The district is traversed by a number of natural channels which discharge

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California.

into the trough of Colusa Basin, where the main drain of Reclamation District 2047 is located. This drain runs along the east boundary of Compton-Delevan District for 2.5 miles.

Development.—Development has been mainly covered under "History." At present, the only irrigated crop is rice. Although about 9000 acres was in this crop in 1919 and 1920, the area in rice dropped to 4000 acres in 1921. The maximum area in rice since then was 4600 acres in 1922. Of the 12,652 acres in the district, 9368 acres is held in the name of one individual and one company. The estimated assessed value of the district for county purposes for 1927–28 was $361,000.

Water supply.—The district acquired from its predecessors Division of Water Rights permits 29 and 452 to divert water from Sacramento River and the trough of Colusa Basin, the former having a priority date of March 3, 1915, and the latter of February 7, 1918. The two permits call for an aggregate of 200 cu. ft. per sec., of which 40 cu. ft. per sec. is from the trough of Colusa Basin. Records of diversion are not available prior to 1924, when 2788 acre-feet was pumped from Sacramento River and 28,690 from Colusa Basin trough. In 1925 the district began to obtain water from Glenn-Colusa Irrigation District under a revocable permit, this giving Compton-Delevan District water cheaper than it can pump with its own equipment. It received 20,320 acre-feet from that district in 1926 and 19,332 acre-feet in 1927, as shown by the records of the Sacramento-San Joaquin water supervisor. This water is taken by gravity from Central Canal through Funks Creek channel, and payment is made to Glenn-Colusa Irrigation District at the rate of $5 per acre of irrigated land. At present the entire supply of Compton-Delevan District is supplied in this way.

Works.—There have been some additions to the works of the district since taken over from Maxwell Irrigated Farms Company. The expenditures on these have amounted to $66,227, of which $22,793 was for connection to Central Canal of Glenn-Colusa Irrigation District, $6,171 was for pump at Willow Creek, and $32,119 was for drainage. The works taken over by the district included the main pumping plant at Sacramento River and booster plants 2, 3 and 4. The main pumping plant has one 36-inch and two 24-inch centrifugal pumps, with a combined capacity of 160 cu. ft. per sec., lifting 18 feet. Booster plant No. 2 has two 36-inch and two 24-inch pumps, with a combined capacity of 200 cu. ft. per sec., and a lift of 9 feet. Booster plant No. 3 has two 36-inch and one 24-inch centrifugal pumps, with a combined capacity of 160 cu. ft. per sec., and lifts 8 feet. Booster plant No. 4 has one 36-inch and one 24-inch centrifugal pump, with a combined capacity of 100 cu. ft. per sec., and a lift of 7 feet. The motors operating these plants have a combined capacity of 1525 h.p. Areas irrigated by the various successive lifts when the pumping system is operated are as follows: 18 feet, 300 acres; 9 feet, 3000 acres; 8 feet, 4500 acres; and 7 feet, 5000 acres.

The main canal from the river has a capacity of 150 cu. ft. per sec., and reduces to 100 cu. ft. per sec. at the end above booster plant No. 4. These capacities are less than the capacities of the pumps, but laterals near the pumping plant and the main canal make up sufficient capacities to utilize fully the discharge from the pumps. In all, the district operates 12 miles of main and 46 miles of lateral canals. The total investment in works to December 31, 1927, was $589,627.

Use and delivery of water.—No data are available as to the amounts of water delivered to irrigators, and there are no special features with reference to water delivery methods.

Bonds.—The bonded indebtedness has been partially covered under "History." Of the first issue of $575,000, $52,000 has been canceled, $139,000 has been paid, $208,000 has been refunded and $176,000 is outstanding. It is the intention to refund the outstanding bonds of this issue as soon as this can be arranged. Of the $384,000 of the refunding issue which have been certified, $208,000 was outstanding December 31, 1927. The total bonds outstanding on that date amounted to $384,000. There are also outstanding against lands in the district Colusa County and other bonds estimated to amount to $268,000, as follows: county bonds, $13,000; school bonds, $11,000; Reclamation District 2047 bonds, $226,000; and Assessment 6, Sacramento-San Joaquin Drainage District, $18,000.

Assessments and water tolls.—The usual district valuation for assessment purposes is $75 per acre, land amounting to 535 acres being valued at $10 per acre and 50 acres at $1 per acre. In 1927–28 the total assessed valuation was $894,090. During the last five years the district assessment rate per $100 of valuation has ranged from $9.07, in 1923–24, to $11.17, in 1925–26. In 1927–28 it was $4.34. The heavy assessment in 1925–26 included $4.15 for outstanding warrants. In 1927–28 the total levy was $38,870. The district also charges a water toll. During the past three years the rate has been $7 per acre for rice and $2 per acre for general crops.

MAXWELL

Location: south and east of Maxwell, west of trough of Colusa Basin, in Colusa County. (Pl. IX.)
Date of organization election: June 8, 1918.
Gross area: 8819 acres; **area assessed 1927:** 8819 acres.
Principal town: none.
Post office: Sacramento.
Railroad transportation: west-side line of Shasta Route of Southern Pacific railroad, 2 miles west of district at Maxwell, or 4 miles west at Cortena.

History.—This district, like Provident and Compton-Delevan districts, was organized during the very prosperous period of the rice industry that grew out of the war; also, like these two districts, it was promoted by a few owners of large tracts of land who desired to devote these holdings to rice growing. At the time of formation, only two landowners within the district were themselves farming their land, and their holdings were only of 10 acres each. The principal landowners were not freeholders in the district and so could not vote on organization or on the bond election which followed organization. The vote on organization was 9 to 0. In 1918, the year of organization, 7500 acres was said to be in rice, and inspection in that year indicated that much of the land was well suited to that crop. In fact, it was being leased that year, with water furnished, at $40 per acre cash rent, or for 35 per cent of the crop.

In 1918 rice was a comparatively new crop in California, having been grown commercially in the state only 5 or 6 years. Little was known of the capacity of rice lands to yield income during low-price periods, or of the water-grass problems associated with rice growing. It was

under these circumstances that both organization of the district and its bond issue were approved by the state authorities.

The irrigation system which had been built by the landowners and which it was proposed should be purchased by the irrigation district reached about 8000 acres of land. Water was obtained by a main pumping plant on the west bank of Sacramento River about 0.75 mile south of the pumping plant of Compton-Delevan District. The main canal had been constructed due west from the pumping plant a distance of approximately 9000 feet, and from that point it extended south and southwest something over two miles. Pumping plants had been located along this canal to boost water against the grade. An appraisal of the system by those who had constructed it totaled $254,513, and it was agreed that the district should pay them $260,000 in bonds of the district, this to include costs of organizing the district and of preparing the bonds. A $260,000 bond issue for this purpose was accordingly voted September 3, 1918, and these were certified January, 1919. On April 29, 1919, a special assessment of $52,355 was levied for additional construction expenses, and an audit shows that $59,249 was spent by the district secretary on works in the spring of that year.

Affairs of the district went well enough the first year because the income from the land in rice was high. The bonds of the district had been given maturities of 1922 to 1941, so that at first there were only bond interest and operation and maintenance expenses to pay. With the collapse of the rice boom in the fall and winter of 1920 conditions changed. Landowners and lessees became financially involved and much land passed into the control of banks during the next few years, but very little of the land was in crop. District assessments went delinquent and beginning with the bonds due January 1, 1924, payments on bond principal defaulted. During this period management of the district was in effect in the hands of the secretary, and the usual records required by law either were not kept or have been lost or destroyed. An investigation for the Bond Certification Commission, made in August, 1925, disclosed mismanagement and a badly tangled condition of affairs. This was also brought out by subsequent investigations made on behalf of the state engineer. District assessments and water tolls had been levied, but payments had not been forced. The amounts then due from landowners amounted to $63,408, not counting interest on certain unpaid assessments. In spite of the fact that water tolls were not paid, water continued to be served. About $12,000 was lost to the district through failure of the secretary to record a resolution of the board of directors including certain lands within the district, the court holding that these lands were not within the district until recording of the acceptance.

During this period of depression, from 80 to 90 per cent of the lands in the district passed into the hands of gun clubs, who used the rice paddies for duck ponds. The gun clubs acquired the land without a full understanding of the outstanding obligations, and when the real financial condition of the district was disclosed to them they refused to pay their district assessments and formed an association to deal with the situation. This association succeeded in ousting the one-man management of the district and gaining control in the summer of 1925. Thereafter they elected one of their own members secretary.

The district continues to be operated in the main in the interests of the duck clubs. Each year the lands are flooded in the fall for duck pond purposes. In 1925, 1025 acres of rice was irrigated within the district and 244 acres outside; in 1926, 1375 acres within the district and 234 acres outside; and in 1927, 394 acres within the district and 478 acres outside. The district levies the annual assessments as required by law, but none of them are paid, all operation costs being obtained by water tolls. On January 1, 1928, the district was in default to the amount of $65,000 on principal of bonds, $9,100 on accrued interest on delinquent principal, $35,460 on defaulted interest, and registered warrants with accrued interest amounted to $35,445. Tax certificates outstanding December 31, 1927, totaled $386,461.91.

For several years a bondholders' committee, led by the investment banking house which purchased the bonds, endeavored to work out a readjustment. It was proposed by them in 1925 to bring about dissolution of the district, and to form a land company to take over its assets and liabilities. The scheme provided for meeting all obligations of the district over a period not exceeding 30 years, annual charges of $2.85 per acre to be levied against the land until delinquencies should be canceled. In January, 1929, an agreement was about to be consummated under which bonds in the amount of $230,000, together with accrued interest amounting to $51,047, were to be taken up by the payment of $50,128.50. In addition, warrants were to be paid off at $0.20 on the dollar, without interest.

Soils and topography.—About three-fourths of Maxwell District is classified as Willows clay adobe, about one-sixth as Willows clay, and the remainder chiefly as Sacramento clay.* In general, Willows clay adobe constitutes the better rice lands on the west side of Sacramento Valley. Heavy alkali concentrations occur in a considerable portion of the district, although these have been somewhat reduced by the flooding given with the rice growing. The main drain of Reclamation District 2047 runs along the east boundary of the district and some lateral drains have been provided, but not enough for adequate control of the ground water if the land is to be farmed. Elevations vary from 50 to 75 feet.

Development.—Reference to development has been made under "History." At present, as already indicated, most of the district is controlled by gun clubs, 5208 acres having been flooded by these clubs for hunting purposes during 1927. In that year 394 acres of rice and 882 acres of other crops were irrigated. The assessment roll for 1927–28 showed 31 separate holdings. The estimated assessed value of the land in the district for county purposes for 1927–28 was $306,000. About the only buildings in the district are those of the gun clubs. The permanent population is given as only 5.

Water supply.—The district has the following permits from the Division of Water Rights: 72, for 42 cu. ft. per sec., with priority of November 22, 1915; 341, for 142 cu. ft. per sec., with priority of February 28, 1917; 432, for 100 cu. ft. per sec., with priority of January 29, 1918. During recent years, as indicated above, water has been used principally for flooding duck ponds. To a large extent, water used for this purpose is return drainage. When the district was

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California

organized, it assumed obligations to supply water to the Packer ranch outside of the district at the cost of pumping, and, pursuant to this obligation, delivered water to 244 acres in 1925, 234 acres in 1926 and 478 acres in 1927. All of the water used by the district is pumped. The records of the Sacramento-San Joaquin water supervisor indicate that diversions from the river during the past four years have been as follows: 1924, 13,040 acre-feet; 1925, 9424 acre-feet; 1926, 10,952 acre-feet; 1927, 7994 acre-feet. Diversions from the trough of Colusa Basin during the same years have been 5623 acre-feet in 1924, 9903 acre-feet in 1925, 13,575 acre-feet in 1926 and 10,817 acre-feet, for duck clubs only, in 1927.

Works.—The main pumping plant of the district still remains on Sacramento River about 0.75 mile south of the pumping plant of Compton-Delevan District, or about 4 miles south of Princeton. The canal system as originally built, and as previously described under "History," is also still in use. Some of the original pumping plants have been somewhat changed.

The main plant consists of one 36-inch, two 30-inch and two 18-inch pumps, with a combined capacity of 182 cu. ft. per sec. lifting 22 feet; plant 2 consists of three 36-inch pumps, lifting 4.5 feet; plant 3 of three 26-inch pumps, lifting 8 feet; plant 4 of one 24-inch pump and one 15-inch pump, with a combined capacity of 27 cu. ft. per sec., lifting 10 feet. At all of the installations horizontal centrifugal pumps are used. The total installed horsepower is 1640. The total length of main canals is 3.5 miles, and of laterals, 40 miles.

The total amount invested in works is unknown, owing to the lack of district records. As already stated, the price paid for the system was $260,000 in bonds. A special assessment of $52,355 for construction was voted April 29, 1919, but records regarding its collection and expenditure are not clear.

Use and delivery of water.—As the district is now primarly operated in the interests of the duck clubs, no information has been collected regarding the use and delivery of water. No measurements of deliveries are made.

Bonds.—A bond issue of $260,000 has been put out by the district. The present status of these bonds has been indicated above under "History." Bond and assessment obligations other than those of the irrigation district are estimated at $175,500, of which $11,000 are Colusa County bonds, $7,200 are school bonds, $147,000 are bonds of Reclamation District 2047, and $10,300 constitute part of Assessment No. 6 of Sacramento-San Joaquin Drainage District.

Assessments and water tolls.—As already indicated, assessments are levied annually by the district, but not collected. The basis of assessment is a flat rate of $100 per acre, the total district assessed valuation for 1927–28 being $881,955. The district assessment rate per $100 valuation during the past six years has been as follows: 1923–24, $7.19; 1924–25, $7.14; 1925–26, $15.46; 1926–27, $18.00; 1927–28, $23.80. The total levy for 1927–28 was $209,905. It is obvious that these assessments can not be paid out of income from the land. Operation costs are covered by annual water tolls, the total amount of these being $12,894 in 1927. During 1919 and 1920, when the maximum rice area was irrigated, water tolls amounted to more than $36,000 annually. The tolls collected in 1927 were only about half the amount collected in 1925 and nearly $10,000 less than collected in 1926.

POTTER VALLEY

Location: about 15 miles northeast of Ukiah, in Mendocino County. Pl. XI.)
Date of organization election: April 1, 1924.
Gross area: 5042 acres; **area assessed 1928:** 4942 acres.
Principal town: Potter Valley.
Post office: Potter Valley.
Railroad transportation: Northwestern Pacific railroad about 8 miles distant at Calpella.

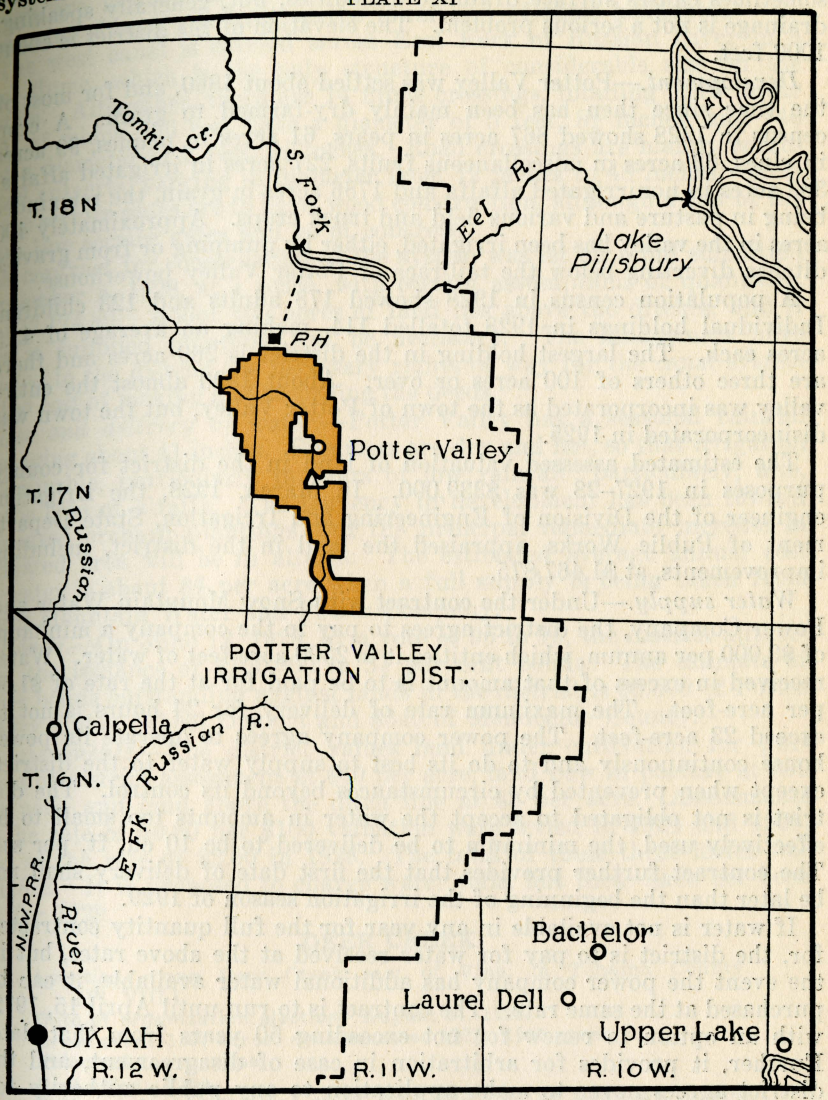
History.—The first definite steps to form an irrigation district in Potter Valley were made at a meeting of the landowners on the evening of October 7, 1920. A committee was appointed to fix boundaries and confer with Snow Mountain Water and Power Company with reference to obtaining an irrigation water supply from that company at the tail-race of its power plant at the upper end of Potter Valley. The first petition for organization was filed November 9, 1920, but at an election April 26, 1921, organization failed by a vote of 76 to 82. A second petition, eliminating lands of certain opponents which were included in the first petition, was presented May 5, 1923, and organization carried at an election April 1, 1924, by a vote of 110 to 3.

The chief cause of the delay in organization was the inability of the landowners to reach a satisfactory understanding with Snow Mountain Water and Power Company with reference to a water supply. This same difficulty continued for some time after organization, but a provisional agreement was executed in September, 1926, to be in force only when the power company should receive a permit from the State Division of Water Rights to use water stored in Lake Pillsbury for agricultural purposes, by diversion at the tail-race of Potter Valley power house. The company had, "prior to February, 1907," filed on 20,000 miners inches from South Fork of Eel River, to be conveyed through a tunnel to a power plant in Potter Valley. This filing was for both power and irrigation. Subsequently, the power company constructed a storage dam on South Fork of Eel River in Gravelly Valley. Under applications 1719, 1720 and 1934 the company had initiated rights for storage in the Gravelly Valley reservoir, now known as Lake Pillsbury, to the amount of 215,000 acre-feet annually, to be used for municipal purposes in the cities east of San Francisco Bay, and for power, but in none of these applications had the use of water for irrigation been specified. The company had, however, constructed the dam at Lake Pillsbury to give a storage capacity of 95,000 acre-feet. In order to clear up the matter and make the contract with Potter Valley Irrigation District effective, the company, on January 20, 1928, obtained permit 2954, with priority of August 15, 1927, to divert 4500 acre-feet annually from the tail-race of the Potter Valley power plant for agricultural purposes.

After the organization of Potter Valley Irrigation District in 1924 an engineer was employed to lay out and estimate the cost of an irrigation system. No move, however, was made to begin construction until permit 2954, above referred to, had been granted. Anticipating a dry season in 1928, the landowners formed Potter Valley Ditch Company as a holding company and proposed, through this company, to construct the irrigation system that had been outlined by the engineer of the district, this to be acquired by the district as soon as the procedure for the issuance of bonds should be completed. This proposal was later dropped

and the beginning of construction was put off until after a bond issue had been voted and approved by the Bond Certification Commission. At this writing construction is under way with a view to having the system ready for the irrigation season of 1929.

PLATE XI



Location and boundary map of Potter Valley Irrigation District, Mendocino County.

Soils and topography.—The district includes the main portion of the floor of Potter Valley. The main floor of the valley is flat, although small areas near the outside boundaries are gently rolling. The soil of about 80 per cent of the area is classified as Yolo loam and Yolo silt, gravelly, silty clay, and fine silty loam.* About 4 per cent of the total

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Ukiah Area, California.

area is classified as Dublin clay, about 3 per cent as rough mountainous land, and the remainder as loams of various series. Main drainage is furnished by the channel of East Fork of Russian River which passes through the center of the valley. Heavy rainfall in the winter season sometimes causes surface drainage difficulties, but, generally speaking, drainage is not a serious problem. The elevation of the district is about 1000 feet.

Development.—Potter Valley was settled about 1860, and for most of the time since then has been mainly dry-farmed to grain. A crop census in 1928 showed 867 acres in pears, 61 acres in prunes, 99 acres in vines, 63 acres in miscellaneous fruits, 227 acres in irrigated alfalfa, 383 acres in nonirrigated alfalfa and 1786 acres in grain, the remainder being in pasture and various field and truck crops. Approximately 400 acres in the valley has been irrigated, either by pumping or from gravity ditches diverting below the tail-race of Potter Valley powerhouse.

A population census in 1928 showed 178 adults and 123 children. Individual holdings in 1928 totalled 114, making an average of 43.5 acres each. The largest holding in the district is 260 acres and there are three others of 100 acres or over. About 1890 almost the entire valley was incorporated as the town of Potter Valley, but the town was disincorporated in 1925.

The estimated assessed valuation of land in the district for county purposes in 1927–28 was $339,000. In March, 1928, the irrigation engineer of the Division of Engineering and Irrigation, State Department of Public Works, appraised the land in the district, including improvements, at $1,467,875.

Water supply.—Under the contract with Snow Mountain Water and Power Company, the district agrees to pay to the company a minimum of $3,000 per annum, which entitles it to 2500 acre-feet of water. Water received in excess of that amount is to be paid for at the rate of $1.50 per acre-foot. The maximum rate of delivery for 24 hours is not to exceed 23 acre-feet. The power company agrees to operate its power house continuously and to do its best to supply water to the district, except when prevented by circumstances beyond its control. The district is not obligated to accept the water in amounts too small to be effectively used, the minimum to be delivered to be 10 cu. ft. per sec. The contract further provides that the first date of delivery shall not be later than the beginning of the irrigation season of 1929.

If water is not available in any year for the full quantity contracted for, the district is to pay for water received at the above rates, but in the event the power company has additional water available, it can be purchased at the same rate. The contract is to run until April 15, 1972, with an option to renew for not exceeding 50 years from that date. Further, it provides for arbitration in case of disagreement, and the district agrees never to make application to any public authority for water in excess of the maximum specified to be delivered by the company. The estimated duty of water in the district is 1.25 acre-feet per acre net, or 1.6 acre-feet gross.

Works.—The works of the district, now under construction, are of a simple nature and are relatively inexpensive. The irrigable lands begin at the tail-race of Snow Mountain powerhouse, so that no main supply canal is required. The main canals lead from the powerhouse down

the east and west sides of the valley, the two aggregating 19 miles in length, all unlined. Each of these canals has a capacity of 20 cu. ft. per sec. About 16 miles of unlined laterals lead from these main canals toward the center of the valley. Concrete headworks of similar design are located on each side of the tail-race. Concrete Venturi measuring flumes are built in the lower end of these headgates.

The west canal is carried across East Fork of Russian River in a steel flume, which is the only structure of considerable size on the system. Altogether, there are 14 flume crossings, totalling 1170 linear feet, of which 430 feet have a diameter of 5 feet, 8¾ inches, and 740 feet a diameter of 3 feet, 2¼ inches. Road crossings are mainly corrugated culverts, varying in diameter from 12 inches to 48 inches. Most of the service gates are to be of wood construction, although a few of the main line service gates will be of concrete.

A contract for construction of the system was let on a bid submitted September 8, 1928, at a price, with certain assumptions of quantities, of $73,174.80. About 400 acres of land lies above the ditches, and if this is supplied pumping will be necessary. The landowners have deeded to the district the necessary rights of way for the canal system at the cost of making and recording the deeds.

Use and delivery of water.—Potter Valley has a seasonal rainfall averaging about 41 inches. Summers are dry and hot, so that irrigation is desirable, particularly in years of low rainfall; particularly, also, in the case of alfalfa. The tendency in development has been toward increased orchard plantings, but the principal immediate increase in irrigated area will be in alfalfa. The estimated average annual cost of water is about $4 per acre when a full supply is being taken from Snow Mountain Water and Power Company.

Bonds.—On June 12, 1928, by a vote of 95 to 15, the district authorized the issuance of $100,000 in 5½ per cent bonds. The estimate of other bonds outstanding against lands in the district is $5,500 of Potter Valley Union School District and $340 of Mendocino County.

Assessments.—The district values land under cultivation for purposes of district assessment at $60 per acre, land now in pasture at $30 per acre, and land above the ditch line at $3 per acre. Assessments at the rate of $0.80 per $100 valuation were levied in 1924 and 1925, and at the rate of $2.50 in 1928. The total of these three levies was $10,622. It is proposed to charge water tolls, but these have not been set for 1929.

DEER CREEK

Location: along Deer Creek east of Vina, in Tehama County. (Pl. VIII.)
Date of organization election: August 31, 1926.
Gross area: 1907 acres; **area assessed 1927:** 1907 acres.
Principal town: none.
Post office: Vina.
Railroad transportation: main east-side line of Southern Pacific railroad.

History.—This district was formed to consolidate diversions by 5 small independent ditches constituting the 'upper group' on Deer Creek, and to furnish an agency for better administering rights that had been adjudicated to the owners of those ditches by a court decree of November 27, 1923. This court decree resulted from a superior

court suit brought by Stanford Vina Ranch and other lower users of water from Deer Creek for the purposes of fixing and establishing the rights of all users from Deer Creek. The upper users were decreed 35 per cent of the flow of the stream for use on 2218.59 acres of land, including 23.32 acres originally not included through error. Three owners holding 356.53 acres of this total were, at their own request, omitted from the district, but other small areas brought the total to 1907.10 acres.

Soils and topography.—The soils are mainly Vina sandy and silt loams, with small areas of Tuscan loams.* Lying mainly directly along Deer Creek, the land is naturally well drained. It is mostly irrigable.

Development.—The area in the district is largely developed and has been for some 30 years or more. A crop census in 1926 showed 1475 acres, or 79 per cent, in crop, with 425 acres in alfalfa and 750 acres in deciduous fruits. Nonirrigated land is mainly in pasture as part of the rotation locally practiced. The population is about 30. The prorated county assessed valuation of land for 1927–28 was about $128,000. There are 13 holdings averaging 143 acres, with one of 364 acres.

Water supply.—As previously indicated, the district, together with several holdings not included, is entitled under court decree to 35 per cent of the flow of Deer Creek. The average summer flow in Deer Creek is about 150 cu. ft. per sec. The 5 ditches consolidated into the district system were the Champlin, Heywood Reed, Cone and Kimball, Dicus and Baker Brand ditches. In 1926 their aggregate maximum capacity, as based on diversions during three years or more, was 47 cu. ft. per sec.

According to the records of the Deer Creek water master appointed by the superior court, the aggregate diversions amounted to 2860 acre-feet from May 15 to August 1, 1924; 2880 acre-feet from June 17 to August 12, 1925; and 2400 acre-feet from June 14 to August 7, 1926. No record is available for 1927. For full development, storage would be required. A storage site exists at Deer Creek Meadows with ample water available above it, but it is understood that storage there would be expensive, and that it is not being seriously considered at this time.

Prior to formation of the district it was agreed that each landowner would transfer his or her water rights to the district with the understanding that upon such transfer, each owner would have his or her proportionate share in the total right. This agreement was signed by 18 users.

Works.—The district has built a main concrete diversion dam on Deer Creek and a main canal about 6.25 miles long. About 900 feet of pipe 20 to 24 inches in diameter has been laid across sloughs and swales. The diversion dam is equipped with diversion weirs. The total expenditure being made on works is $25,000, all obtained from bonds. In October, 1928, the district system was practically complete, but had not yet been accepted from the contractors.

Use and delivery of water.—Water is delivered to each holding. Recent duty of water studies in the vicinity by the College of Agriculture show a consumptive requirement for mature deciduous orchards of about 30 acre-inches per acre per year. Joint diversion has reduced seepage.

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California.

Bonds.—The district has sold a bond issue of $25,000. High school bonds amount to only about $380, or $0.20 per acre, and grammar school bonds to about $3,800, or $2 per acre.

Assessments and water tolls.—The district assesses silt lands for district purposes at $100 per acre, 'red loam' at $40 per acre, 'red' lands at $10 per acre, and land in drainage channels at $1 per acre. In 1927, 1453 acres was assessed at $100 and 210 acres at $40 per acre. The total district assessed valuation was $150,714. The assessment rate for 1927–28 was $3.13 for each $100 valuation, the total levy being $4,717. No water tolls are charged.

PARADISE

Location: on ridge between Little Butte Creek and west branch of North Fork of Feather River, about 10 miles east of Chico, in Butte County. (Pl. XII.)
Date of organization election: March 7, 1916.
Gross area: 11,260 acres; **area assessed 1927:** 11,260 acres.
Principal town: Paradise.
Post office: Paradise.
Railroad transportation: Chico-Stirling City branch of Southern Pacific railroad.

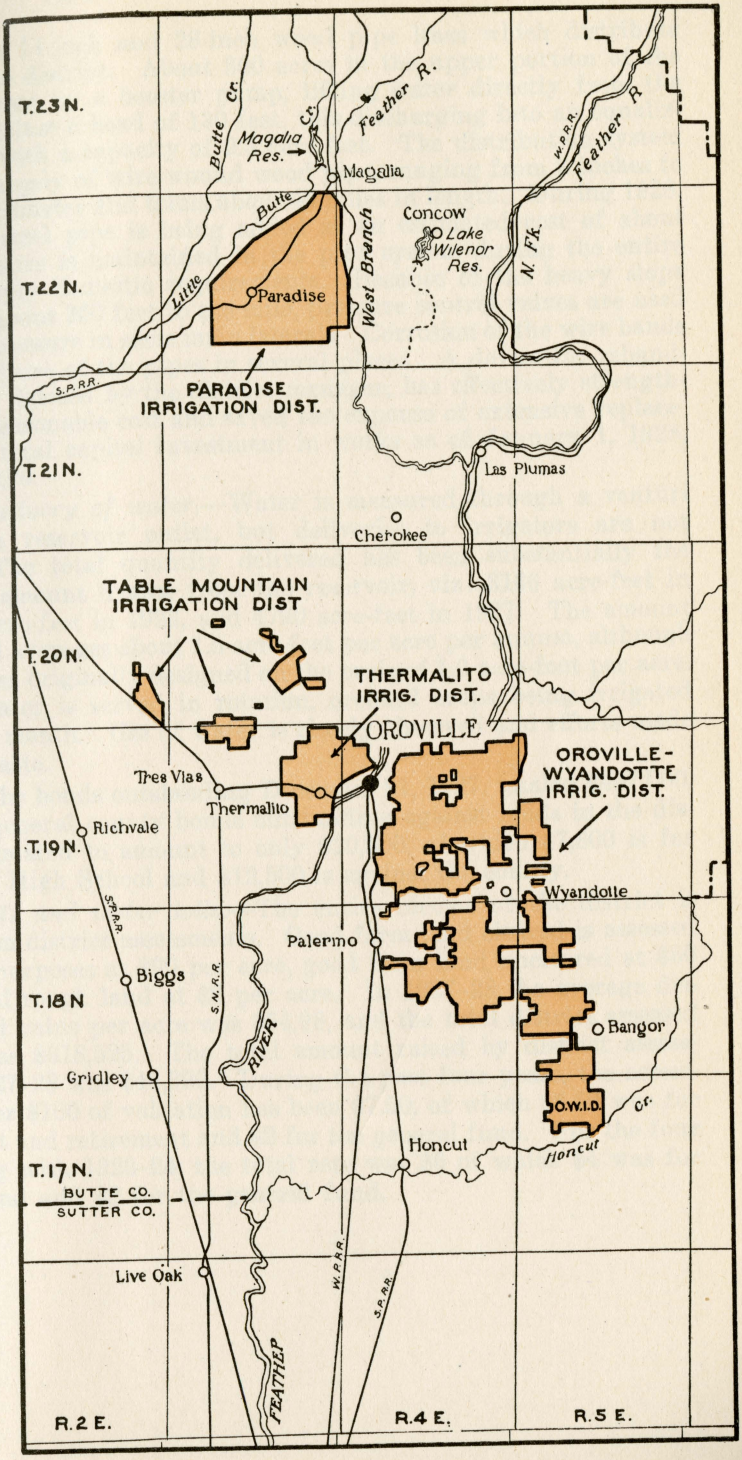
History.—The community at Paradise first began active steps toward acquiring an additional water supply about 1912, when they requested the State Conservation Commission to make an investigation of their irrigation situation. A representative of the Conservation Commission recommended the formation of an irrigation district as probably the best way to proceed, this district to purchase the Magalia storage site as its principal water source. At that time water was being supplied to something under 1700 acres, mainly orchard, by old ditches originally built during the period 1858 to 1870 for mining purposes, and later taken over by power companies for hydro-electric generation. After the district was organized, various storage sites other than Magalia were investigated, but the plans adopted provided for the purchase of Magalia site from Pacific Gas and Electric Company, and the construction of an entirely new pipe distribution system. Construction costs, including the first unit of a pipe system, were originally estimated at $282,180, and a bond issue of $350,000 to cover them was carried February 7, 1917, by a vote of 224 to 24. These bonds were sold at 98¼ but the purchaser was unable to keep his contract. A large part of the construction was financed by issuing registered warrants, the interest on these to December 31, 1921, amounting to approximately $22,000. Construction costs exceeded the estimates, and on May 5, 1918, after the system was in operation, the total investment was $380,956. The dam at Magalia was not yet completed, nor was the main ditch connecting the reservoir with the distribution system lined. The State Board of Control purchased $50,000 of the unsold bonds and the remaining $92,000 was sold in June, 1918. The proceeds from these sales enabled the district to pay part of its debts. On March 8, 1921, the Irrigation District Bond Commission approved a second issue of $140,000 for the continuance of construction, and for paying outstanding indebtedness amounting to $40,000. With these additional funds all old accounts were paid, the crest of Magalia Dam was raised, and the canal connecting the reservoir with the distribution system was enlarged to a capacity of about 40 cu. ft. per sec. and lined with concrete.

Soils and topography.—The soils are red residual loams and cl loams with some rock outcrops, but generally deep and fertile. Eleva tions range from 1200 to 2300 feet. The district is generally fa shaped, with the apex near Magalia, the irrigable areas stretching o along ridges and diverging to a width of about 5 miles at the southern end. Owing to the heavy slopes, a drainage system is not needed. total of 1760 acres is classed as nonirrigable, 1424 acres of this bein nonagricultural. In the main, land not irrigated has not yet be cleared and settled.

Development.—Like other foothill orchard areas, Paradise Distri is developing slowly, owing largely to the necessity for clearing lan before planting. The financial condition within the district has affecte the situation adversely, but the suburban value of the property t residents in northern Sacramento Valley has helped carry the ente prise forward. There is still one 640-acre tract and a few of 160 acre but there are 400 individual holdings, averaging about 24 acres. In th past three years the irrigated area has increased about 100 acres pe year. There are no incorporated cities within the district. The popula tion is about 3000. The estimated assessed valuation of the land fo county purposes was about $220,000 in 1927, assuming an average o about $20 per acre. A paved highway joins the community of Paradis with Chico.

Water supply.—The present water supply comes entirely from abou 11 square miles of the watershed of Little Butte Creek above Magali Reservoir, this being covered by permits 271 and 2326 of the Division of Water Rights, which have priority dates of September 21, 1916, an July 31, 1915, respectively. The former calls for 9500 acre-feet an the latter for 4148 acre-feet from Little Butte Creek. The reservoi has a capacity of 3012 acre-feet, but the annual draft was 3166 acre-fee in 1925, 4171 acre-feet in 1926, and 4790 acre-feet in 1927. The amoun lost by seepage has amounted to very little. It is recognized that a additional water supply is necessary. To furnish this it is propose to raise Magalia Dam to give a storage capacity of 9500 acre-feet, esti mated to cost $256,200, and to obtain additional water from West Branch of the Feather by the reconstruction of the old Snow Ditch and its enlargement to a capacity of 33 cu. ft. per sec., estimated to cost $19,800, which will carry the water to Little Butte Creek, from which Magalia Reservoir receives its water. Permits 2327 and 2328 from the Division of Water Rights, with priority dates of June 21, 1922, and May 23, 1927, cover the proposed diversion from West Branch. Other storage possibilities exist on Little Butte Creek, Mosquito site, immediately below the junction of Little Butte and Mosquito creeks, being reported as the most desirable.

Works.—Magalia Dam and the pipe distribution system constitute the main features of the works of the district. The main portion of Magalia Dam was constructed with about 180,000 cu. yds. of hydraulic fill, and was raised 4 feet, to a maximum height of 90 feet, by placing 2000 cu. yds. of rolled fill on the crest. Water leaves the reservoir through 300 feet of 36-inch continuous wood-stave pipe discharging into a concrete-lined canal 2.5 miles long with a capacity of about 40 cu. ft. per sec. The lower end of this canal discharges into a concrete-lined equalizing reservoir with a capacity of 3 acre-feet, from this feeding



Location and boundary map of irrigation districts in Butte County.

into the main 14-inch and 28-inch wood pipe lines which distribute water over the district. About 300 acres in the upper portion of the district is served by a booster pump, lifting water directly from the main canal against a head of 130 feet, this discharging into an equalizing reservoir with a capacity of 2.5 acre-feet. The distribution system is composed largely of wire-wound wood pipe, ranging from 4 inches to 28 inches in diameter and totals about 40 miles in length. During 1928, 8600 feet of steel pipe is being added at an estimated cost of about $5,600. Pressure is maintained in the pipe system during the entire season to supply domestic requirements. Because of the heavy slope of the ridge, about 250 feet to the mile, pressure control valves are used to lower the pressure in some main laterals. Corrosion of the wire bands has caused failure of the pipes in several places. A device for rebanding this pipe, devised by the district manager, has effectively strengthened it at a reasonable cost and saved the expense of extensive replacements. The total capital investment in works as of January 1, 1928, was $465,550.90.

Use and delivery of water.—Water is measured through a venturi meter at the reservoir outlet, but deliveries to irrigators are not measured. The total quantity delivered has been substantially the same as the amount drawn from the reservoir, viz: 3166 acre-feet in 1925, 4171 acre-feet in 1926, and 4790 acre-feet in 1927. The amount of water used averages about 1.5 acre-feet per acre per annum, although the system was originally designed on the basis of 1.0 acre-foot per acre. Irrigation water is served in rotation, orchard crops being irrigated about once a month. Use of water is closely observed and efforts made to restrict waste.

Bonds.—The bonds outstanding December 31, 1927, totaled $487,000. School and general county bonds outstanding against lands in the district are estimated to amount to only $20,300, of which $7,800 is for Chico Union High School and $12,500 is against the county.

Assessments and water tolls.—The entire income of the district is obtained from district assessments. Good farm land cleared is assessed for district purposes at $90 per acre, good farm land uncleared at $60 per acre, and rough land at $2 per acre. In 1927–28 the average district assessed value per acre was $54.98, and the total district assessed valuation was $618,525. The total amount raised by district assessments in 1927–28 was $46,390. During the past four years, the assessment rate per $100 of valuation has been $7.50, of which $5.50 was for bond interest and retirement and $2 for the general fund. For the four years ending with 1923–24, the total rate was $6 of which $4 was for the bond fund and $2 for the general fund.

THERMALITO

Location: west of Oroville, in Butte County. (Pl. XII.)
Date of organization election: March 24, 1922.
Gross area: 3110 acres; **area assessed 1927:** 3040 acres.
Principal town: none.
Post office: Oroville.
Railroad transportation: Sacramento Northern; also main line of Western Pacific railroad and Oroville branch of Southern Pacific railroad at Oroville.

*History.**—Agricultural development was started in the Thermalito area in 1886 after cessation of hydraulic mining. A company purchased the old Miocene mining ditch and launched Thermalito Colony. By 1914 the colony comprised about 1000 acres, mostly in oranges, olives and figs. In 1901 Miocene Ditch was purchased by Oro Water, Light and Power Company, which made additions and improvements to the distributing system in Thermalito Colony. About 1918 the system was taken over by Pacific Gas and Electric Company, which, under order of the Railroad Commission, undertook to renovate and repair the water distributing system at Thermalito, but war-time conditions postponed these improvements.

In 1921 the landowners began negotiations for the formation of an irrigation district to take the system over and to develop storage on Concow Creek. The owners of a neighboring area, mostly undeveloped, also negotiated with Pacific Gas and Electric Company. The result of these negotiations was that Thermalito and Table Mountain irrigation districts were organized at elections held April 4, 1922, the former by a vote of 135 to 6, the latter by a unanimous vote of 7.

Prior to voting a bond issue, Thermalito District entered into a contract with Pacific Gas and Electric Company in which provision was made for participation of Table Mountain. In this contract Pacific Gas and Electric Company agreed to deliver a continuous flow of 9.1 cu. ft. per sec. to Thermalito District from water diverted by Miocene Ditch from West Branch of Feather River. A price of $1.20 per acre-foot is paid by the district for all water thus delivered. Furthermore, the contract granted the participating districts a perpetual carrying right in Miocene Ditch for water from Lake Wilenor and gave them the right to enlarge the ditch, and it was provided that the company would pay the districts 2.5 mills per k.w.h. for all power generated in Lime Saddle and Coal Canyon powerhouses by water released from the districts' storage. Pacific Gas and Electric Company also agreed to sell the Wilenor storage site on Concow Creek to the district for $10,000.

In the agreement between the two districts regarding storage on Concow Creek it was stipulated that the cost and benefits should be shared in the proportion of 45 by Thermalito District and 55 by Table Mountain District. In order to carry out its share of the construction program, Thermalito District voted $270,000 in bonds on February 23, 1923. Table Mountain District requested approval of a bond issue of $294,000, but action by the Bond Certification Commission was unfavorable. Subsequently this district reduced its area from 3941 acres to 2040 acres, and on June 15, 1923, voted $125,000 in bonds.

A contract for construction of Wilenor Dam on Concow Creek to a height sufficient for its own needs was awarded by Thermalito District on September 19, 1923, Table Mountain District not yet having succeeded in obtaining funds for the payment of its share. Later Table

* See also report on Table Mountain Irrigation District below.

Mountain District made an agreement with the contractor to carry Wilenor Dam to the full height of 90 feet necessary to furnish the 8200 acre-feet of storage required for the two districts, although certification of its bond issue had not yet been obtained. Later, however, certification was obtained. Both districts found it necessary to sell second bond issues, Thermalito to the amount of $50,000, and Table Mountain to the amount of $62,000.

Soils and topography.—Soils are mainly classed as Redding gravelly loam. These range in depth from 2 to 4 feet and rest upon hard-pan, which varies in thickness from 6 inches to 2 feet and is underlain by gravel.* The topography is rolling and the elevation ranges from 125 to 325 feet. Numerous ravines provide natural drainage.

Development.—A crop census in 1927 showed about 50 per cent of the area irrigated, the largest plantings being in bearing deciduous and citrus fruits. Citrus and olive orchards covered 842 acres. The remainder of the area has not yet been settled. The total number of holdings in 1927 was 371, giving an average for the net irrigable area of about 8 acres. There is one holding of 220 acres. The estimated assessed value of land for county purposes in 1927–28 was $125,000, or about $40 per acre. This, however, was far less than the actual value. The population of the district is about 600. The proximity of the area to Oroville has caused considerable residential development in recent years.

Water supply.—Water furnished by Pacific Gas and Electric Company from natural flow of West Branch of Feather River is delivered through Miocene and Powers ditches. The filings of these ditches are said to date back to 1871 and 1858. Ninety-five square miles of watershed are tributary to the Miocene diversion. The maximum diversion is 66 cu. ft. per sec., but in the dry year of 1924 the late summer flow fell to 19 cu. ft. per sec. About 55 cu. ft. per sec. reaches Kunkle Reservoir when the maximum of 66 cu. ft. per sec. is diverted. The amount obtained by Thermalito District from the Miocene diversion during the past three years has been as follows: 1925, 3220 acre-feet; 1926, 3050 acre-feet; 1927, 3760 acre-feet. Water stored in Lake Wilenor is delivered through the company ditches to a regulating reservoir near Thermalito. The amounts obtained by Thermalito District from this reservoir during the past three years have been as follows: 1925, 817 acre-feet; 1926, 902 acre-feet; 1927, 285 acre-feet.

Thermalito and Table Mountain districts jointly have permit 1911, with priority date of March 25, 1920, for storage of 8200 acre-feet of water on Concow Creek between December 1 and April 1 of each year, this permit being for agricultural use. They also jointly have permit 1912, with priority of September 16, 1922, for the use of the same water for power, license 737 having been issued on the latter permit. Water supply studies by the engineer of the district led him to conclude that there was sufficient run-off above Wilenor Dam to have filled the reservoir each year of the period 1904–05 to 1924–25, except for the year 1923–24. The 45-per cent interest of Thermalito District in Lake Wilenor storage gives it a gross storage of 3690 acre-feet. At present about 50 per cent of the stored water is lost in transit. Lake Wilenor was drained in 1926.

Works.—Up to January 1, 1928, the district had invested in works a total of $292,180. This includes a 45-per cent interest in Concow

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California; also Univ. of Calif. College of Agr., Agr. Exp. Sta. Bul. 253.

Creek water rights, Lake Wilenor Reservoir, and carrying rights in Miocene Ditch, which still belongs to Pacific Gas and Electric Company. Miocene Ditch diverts from the west bank of West Branch of Feather River about one-half mile northeast of Magalia, then extending for about 7.5 miles almost due south to Kunkle Reservoir, the forebay of the Lime Saddle power plant of Pacific Gas and Electric Company. After dropping through a head of 462 feet at Lime Saddle Power House, the water flows about 8.5 miles to Coal Canyon Power House, where it falls 350 feet to Powers Ditch. The latter follows the west slope of Table Mountain for about 6 miles to the equalizing reservoir of the Thermalito and Oroville water systems.

Concow Creek, on which Thermalito and Table Mountain districts store water at Lake Wilenor, enters West Branch of the Feather from the east about 6 miles below the intake of Miocene Ditch, Lake Wilenor being about 4 miles upstream on Concow Creek. Wilenor Dam is a constant-angle arched structure 90 feet high. Water released from storage is picked up by a reconstructed mining ditch, known as Spring Valley Ditch, which carries it for 8.5 miles to a small ravine. Another old ditch, reconstructed to a capacity of 35 cu. ft. per sec., diverts from the ravine and flows west about 1 mile to an inverted steel siphon 370 feet long across West Branch of the Feather to Miocene Ditch, which it joins about 0.5 mile above Kunkle Reservoir. The head on the siphon is about 750 feet.

Thermalito District purchased the old distribution system within its area from Pacific Gas and Electric Company at a nominal price. This system as reconstructed carries water to almost every tract in the district, 1360 acres having been served by the system when purchased from Pacific Gas and Electric Company. The district has laid about 22 miles of steel pipe ranging from 4 to 24 inches in diameter. Only 2.5 miles of the old pipe line has been retained in the new system. About 2.5 miles of additional lateral pipe will be necessary to supply the entire area, but at present all land requiring water is being served.

Use and delivery of water.—Water deliveries are not measured, so that their amount is not known. Water is delivered by the district to each ownership as of the time the construction bonds were voted. Tracts subsequently subdivided must build their own distribution systems. Deliveries are all made under pressure from the equalizing reservoir at the lower end of the Pacific Gas and Electric Company system.

Bonds.—The first bond issue of the district was for $270,000, and the second issue was for $50,000. Both are still outstanding. A portion of the general county bonds, amounting to about $6,200, and school bonds, amounting to about $3,600, are payable by property in the district.

Assessments and water tolls.—The normal assessed valuation for land for district purposes is $150 per acre, the total district assessed valuation for 1927–28 being $445,650. Since the district was organized, the district assessment rate per $100 has ranged from $2.68 in 1922–23 to $7.35 in 1926–27, and was $7.20 in 1927–28. The total district levy for 1927–28 was $32,086. In 1923–24 and 1924–25, the district charged a toll of $2.48 per acre, with no charge for domestic service. This was increased to $2.50 per acre in 1925–26 and $9 per year for each domestic service. At present no irrigation toll is charged, but the domestic service continues at $9 per service per year, except that the domestic charge is not made if over 5 acres is irrigated. Stored water belonging to Thermalito District which is passed through the Lime Saddle and

Coal Canyon power plants yielded the district $2,229 in 1925, $3,270 in 1926 and $2,084 in 1927, the contract price, as previously indicated, being 2.5 mills per kwh. The amount of power income depends upon the extent to which Pacific Gas and Electric Company is able to obtain direct flow water for use in its power plants, since it is only when direct flow is insufficient that storage water from Lake Wilenor is used. Obviously, in a dry year the power income is likely to exceed that in a wet year. In 1925 Thermalito District sold 695 acre-feet of water to Table Mountain District at $3 per acre-foot.

TABLE MOUNTAIN

Location: north of Tres Vias and northwest of Oroville, in Butte County. (Pl. XII.)
Date of organization election: April 4, 1922.
Gross area: 1955 acres; **area assessed 1926:** 1955 acres.
Principal town: none.
Post office: Oroville.
Railroad transportation: Northern Electric at Tres Vias; main line of Western Pacific railroad and Oroville branch of Southern Pacific railroad.

History.—The history and water supply of this district are partially covered in the report on Thermalito Irrigation District above. Table Mountain District comprises a number of separate parcels of land which were mainly being dry-farmed to grain at the time of organization. None of the land was irrigated and no water supply was then available. Obligations of Pacific Gas and Electric Company called for the delivery of 22.6 cu. ft. per sec. to domestic consumers in Oroville, lands in the Thermalito area, the Berkeley Olive Association, and several other users. While the capacity of the Pacific Gas and Electric Company system was in excess of these obligations, additional water was available only during limited periods. It was believed that by combining such additional flow as Pacific Gas and Electric Company would be able to carry through their ditches with storage at Lake Wilenor on Concow Creek jointly with the Thermalito users, a sufficient supply could be obtained to justify organization.

As pointed out in connection with Thermalito District, the original proposal as to Table Mountain District was to include 3941 acres, this area later being reduced in an endeavor to overcome objections of the Bond Certification Commission. When, in 1927, Table Mountain District was seeking approval of a second bond issue of $62,000, part of the area had been planted to rice, and some of it is reported to have been yielding 38 sacks to the acre in the second year. At that time the probable future crop distribution was estimated by the engineer of the district as follows: alfalfa, 630 acres; silage and forage crops, 440 acres; orchards and vines, 880 acres. Rice was looked upon as a temporary crop.

Soils and topography.—Lands in the western part of the district are of even surface and flat slope, with sediments deposited by Cherokee Canal to the depth of 12 to 18 inches on part of them. The soil is reported to be 3 to 6 feet deep. The central portion is heavier and the depth is reported to be from 2 to 6 feet. In the eastern part, which is stony loam, the depth is reported to be 4 feet or more. The principal general soil classifications for the area are Corning gravelly loam and

Redding gravelly loam, with some in the central portion running into Stockton clay adobe.* The elevation is from 125 to 425 feet. Surface drainage appears to be ample.

Development.—A little more than 25 per cent of the district was irrigated in 1927, most of the irrigated area being in rice. About 100 acres was being irrigated outside of the district. There were 7 ownerships in 1927, the 3 largest being 877, 450 and 352 acres. The population of the district is about 50, and the estimated assessed value of lands for county purposes for 1927–28 was $45,000, or an average of about $23 per acre.

Water supply.—The only certain water supply available to Table Mountain District is its 55-per cent proportion of storage in Lake Wilenor on Concow Creek. Some underground water has been developed just outside of the district boundaries, a portion of which is being used within the district. The district will share in water from the Pacific Gas and Electric system above that which the company is obligated to deliver to others. The contract with Pacific Gas and Electric Company permits Table Mountain and Thermalito districts to enlarge Miocene Ditch.

In 1927 the district purchased 1400 acre-feet of water from Pacific Gas and Electric Company, 290 acre-feet in 1925 and 913 acre-feet in 1926. During these three years the amounts received from Lake Wilenor were 2805 acre-feet in 1925, 2970 acre-feet in 1926 and 2610 acre-feet in 1927. In 1925, 305 acre-feet was obtained from Paradise Irrigation District, by exchange, and, in 1927, about 250 acre-feet was obtained from the underground source previously referred to. The permits for use of Lake Wilenor water for agricultural purposes and power and the license for power issued to Table Mountain and Thermalito districts jointly are referred to under the discussion of water supply in Thermalito District. The total estimated requirement of Table Mountain District is an average flow of 11.6 cu. ft. per sec.

Works.—Table Mountain District obtains water from the Pacific Gas and Electric Company system by direct diversion from Powers Ditch at several points below Coal Canyon powerhouse. The district has constructed about 2 miles of lateral canals in addition to about 3900 linear feet of 18-inch concrete pipe. After diversion from Powers Ditch water for the central area flows down Cottonwood Creek for about 2.5 miles and is then picked up by the Howells and Wicks ditches. The principal supply for the western section flows down Gold Run Creek for about 3 miles before being rediverted.

While surface drainage is generally sufficient, it is necessary to remove drainage water from the rice fields. The district has an agreement with Reclamation District 833, Butte Creek Drainage District, and Drainage Districts 100 and 200, by which, for a charge of $1 per acre, this drainage water is taken care of. Up to December 31, 1927, after major costs had been paid, but with final accounting not yet made, the district had invested approximately $172,000 in works.

Use and delivery of water.—Use and delivery of water are not yet finally worked out, since most of the water has been temporarily used on rice. The general plan is to deliver water to present ownerships.

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California.

Bonds.—The first issue of bonds amounted to $125,000. The district sold $24,000 of these, uncertified, to a local landowner, and gave the contractor on the Wilenor Reservoir $37,000. The remaining $64,000 of the first issue were sold after certification. The second issue amounted to $62,000. All of both issues was outstanding December 31, 1927. General county and school bonds chargeable against lands in the district are estimated to amount to $3,000.

Assessments and water tolls.—Land is assessed for district purposes at an average rate of $125 per acre, the total district assessed valuation in 1927–28 being $240,670. The district assessment rate for the past six years has varied from $0.75 per $100 in 1923–24 to $4.90 in 1927–28. For the three years 1924–25, 1925–26 and 1926–27, the assessment rates were $2.90, $3.33 and $2.70, respectively. The total district levy for 1927–28 was $11,792.

The income to the district from power generated at Lime Saddle and Coal Canyon power houses by Lake Wilenor water was $2,811 in 1925, $3,996 in 1926 and $2,468 in 1927.

OROVILLE-WYANDOTTE

Location: east and south of Oroville and north of Honcut Creek, in Butte County. (Pl. XII.)
Date of organization election: November 6, 1919.
Gross area: 24,100 acres; **area assessed 1927:** 20,089 acres.
Principal town: none; **principal adjacent towns:** Oroville, Wyandotte, Bangor and Palermo.
Post office: Oroville.
Railroad transportation: main line of Western Pacific railroad and Oroville branch of Southern Pacific railroad; also Sacramento-Northern Electric railroad at Oroville.

*History.**—This district is made up of a number of separate parcels of land, of which substantial portions were irrigated prior to the formation of Oroville-Wyandotte District by the systems of South Feather Land and Water Company and Palermo Land and Water Company. South Feather Land and Water Company was the successor of South Feather Water and Union Mining Company, whose properties were purchased by deed dated March 31, 1909. The water system taken over was constructed during the early '50's, principally for mining purposes, but with the decadence of mining in this vicinity the system was gradually converted into an irrigation project. Testimony before the Railroad Commission showed that South Feather Land and Water Company had paid for the system the sum of $30,000, to which substantial amounts were later added for extensions and betterments. The company was frequently before the Railroad Commission in the matter of rates and service. The demand for water was greater than the company could supply and it had been required to refuse additional consumers.

Palermo Land and Water Company was organized in 1888 to purchase about 6000 acres of land in the neighborhood of Oroville and Palermo and several old mining ditches, known as Ophir, Palermo branch, and Montana and Utah ditches. A main canal and certain principal laterals had been constructed about 1885 for hydraulic placer

* See also Univ. of Calif., College of Agr., Agr. Exp. Sta. Bul. 253, 358–359; Opinions and Orders of the Railroad Commission of Calif., Vol. 4, 1392–1404; Vol. 6, 121–24; Vol. 7, 180–95; Vol. 19, 210–14 and 907–08; Vol. 20, 833–35; Vol. 22, 617–22.

mining. As in the case of South Feather Land and Water Company, Palermo Land and Water Company was also at intervals before the Railroad Commission in the matter of rates and service.

In decision 11,334 of the Railroad Commission, South Feather Land and Water Company and Palermo Land and Water Company were authorized to transfer their public utility properties to Oroville-Wyandotte Irrigation District at a price of $200,000 to each company. These properties were transferred to the district subject to their existing obligations to furnish water to all lands then served with water which were not included in Oroville-Wyandotte Irrigation District. The district agreed to supply these lands with water at the rate of 1 miners inch continuous flow for each 4 acres of land. The rate agreed upon for lands under the Palermo Land and Water Company system was $0.22 per miner's inch day (1/50 cu. ft. per sec.) with a minimum charge of $5 per acre per year, while for lands under the South Feather Land and Water Company system the rate was fixed at $50 per miner's inch (1/40 cu. ft. per sec.) per season. With reference to lands not yet supplied with water, but which were covered by contracts for future service, it was agreed that the period of final development and delivery of water should be limited to 10 years.

As originally proposed, Oroville-Wyandotte District was to include all of the land being served by the two companies, but as only a few of the owners of such lands desired to join the proposed district, most of such lands were excluded, leaving only 16,800 acres. Later the area was increased to 24,100 acres through petition of landowners for inclusion.

After receiving authority for the purchase of the systems of South Feather Land and Water Company and Palermo Land and Water Company, the district outlined a plan of progressive development calling for a total expenditure of $2,000,000. This plan called for the construction of 10,000 acre-feet of storage on Lost Creek at a cost of $251,880, a distribution system at a cost of $75,000; ditch reconstruction, $6,000; flume replacement, $13,700; engineering and contingencies, $69,320; total, $815,000. Further development was planned during the period extending up to 1935, this to include both additional storage and additional distribution works. The principal additional storage planned was 44,000 acre-feet at New York Flat on Dry Creek. The plan of development was approved by the Bond Certification Commission. Lost Creek storage was constructed to a reduced capacity of 5760 acre-feet, water being first available in 1925. Lake Wyandotte Regulator, also known as North Honcut Reservoir, was constructed to a capacity of 1000 acre-feet, and a portion of the New York Flat reservoir site was purchased.

When the district was organized in 1919, about 2000 acres was being irrigated by South Feather Land and Water Company and about 2600 acres by Palermo Land and Water Company. About 2130 acres within the district was irrigated in 1925. The land irrigated outside the district represented approximately the area that could be irrigated from the unregulated flow of South Fork of Feather River by diversion of Palermo and South Feather ditches. Therefore the first effort of the district after taking over the systems was to provide the storage above referred to. The area irrigated within the district in 1927 was 3197 acres, and the area irrigated outside the district was 2900 acres.

Soils and topography.—Soils* around Wyandotte and Bangor are mainly residual red clay loams and loams, varying in depth from 2 to 6 feet or more. Soils in the Palermo colonies have been described as alluvial sedimentary deposits of great age, consisting of gravelly loams, sandy loams, loams and clay loams of red to reddish brown color. Gravelly loams range in depth from 2 to 4 feet and rest upon hard-pan 6 inches to 2 feet deep. The sandy loams have a depth of 2 to 6 feet and the loams and clay loams a depth of 1 to 4 feet. The general classification in the soil survey is mainly Redding gravelly loams. The topography is rolling, especially in the Oroville-Wyandotte area, where the uncleared land is covered with brush, scrub oaks and Digger pine. Elevations vary from about 250 to about 1150 feet. The rolling topography gives ample general drainage.

Development.—About 10,000 acres is irrigable from the present distribution system of the district. About 14,000 acres remain undeveloped and for their development an additional water supply must be provided. The 1927–28 assessment roll showed 238 holdings, averaging 101 acres. There are still 6 large holdings of 2494, 2490, 2000, 1700, 1200 and 1200 acres, respectively. The largest plantings are in olives, oranges, lemons and deciduous fruits and nuts. The estimated population is about 700, of whom 200 are in a 30-acre area in the district which is included within the adjacent city of Oroville. The estimated assessed valuation of land within the district in 1927 was $363,000. Oroville-Wyandotte District is in the foothill orchard belt. Citrus plantings have proved successful on the higher and better-protected slopes. The more level and gently sloping areas are being used largely for olives, figs, deciduous fruits and berries.

Water supply.—The district, of course, took over the old rights of South Feather Land and Water Company and Palermo Land and Water Company. The entire supply comes from South Fork of Feather River or its tributaries. The district has obtained the following permits from the Division of Water Rights: 1267, with priority of February 2, 1920, for the diversion of 200 cu. ft. per sec. from South Fork of Feather River for storage, amounting to 109,012 acre-feet between October 1 and July 1 of each year at Little Grass Valley storage site; 1268, with priority of December 17, 1920, for storage of 5000 acre-feet on Lost Creek and 40,000 acre-feet at the New York Flat site on Dry Creek, the period for storage being specified as October 1 to July 1 of each year; 1269, for storage of 5000 acre-feet at the New York Flat site on Dry Creek between January 1 and December 31 of each year; 2492, with priority of March 6, 1922, for storage of 25,000 acre-feet on Lost Creek in the period October 1 to July 1 of each year; 1270, with priority date of August 12, 1922, for 150 cu. ft. per sec. from Dry Creek between April 1 and October 15 of each year; 1271, with priority date of August 12, 1922, for 185 cu. ft. per sec. from Lost Creek between April 1 and October 1. The district has filed application 4834 under date of November 13, 1925, for various quantities from South Fork and Lost Creek for power purposes. The Division of Water Rights, on January 3, 1923, issued an order declaring the water granted and the work to be done under the 5 permits to be a single enterprise.

* Univ. of Calif., College of Agr., Agr. Exp. Sta. Bul. 253 and U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California.

Diversion of the natural flow of South Fork of Feather River is made by Palermo Ditch about 12 miles east of Oroville and diversion from Lost Creek is made through Forbestown Ditch at Lost Creek Dam. The diversion capacity of Palermo Ditch is about 40 cu. ft. per sec. and of Forbestown Ditch, about 30 cu. ft. per sec. As previously indicated, the present capacity of Lost Creek Reservoir is 5760 acre-feet. The total amounts of water diverted are not recorded by the district, but the total quantity delivered during the years 1923–1927 is shown under "Use and delivery of water." The mean annual run-off of South Fork of Feather River above Palermo Ditch is about 250,000 acre-feet. This water, however, is not all available for Oroville-Wyandotte Irrigation District and the consumers they are obligated to serve, since the South Feather supply is part of that used by other systems on the main Feather below Oroville. In the low-water year of 1923–24 the entire run-off of South Fork, including Lost Creek, was only 47,760 acre-feet. The additional storage contemplated by the district is 15,000 acre-feet at the Lost Creek site, 75,000 acre-feet at the Little Grass Valley site and 44,000 acre-feet at the New York Flat site.

Works.—The old South Feather and Palermo systems constitute the nucleus of the present district system. Palermo Ditch enters the district about 2 miles east of Oroville, near the 350-foot contour, after extending about 12 miles along the south slope of South Fork Canyon. This ditch terminates near Palermo. Forbestown Ditch diverts at Lost Creek Dam near the 3100-foot contour and conveys water to the higher Wyandotte and Bangor areas. Thirty miles below its intake, this canal terminates at the Lake Wyandotte regulating reservoir, at an elevation of 1400 feet. At times, water from Pinkard, Orolewa, Dry, North Honcut and South Honcut creeks is turned into Forbestown Ditch. After leaving Lake Wyandotte regulating reservoir, water flows down North Honcut Creek about 2.5 miles when it is diverted by the Wyandotte, Oroville and Bangor laterals. When purchased in 1922 the South Feather system consisted of about 36 miles of main canal and about 21 miles of main laterals, and the Palermo system of 22 miles of main canals, 12 miles of laterals, and, in addition, the small waterworks in the town of Palermo. The district operates at present about 58 miles of main canal and 150 miles of laterals. The system includes about 2 miles of main pipe line 22 inches to 30 inches in diameter, and about 3 miles of lateral pipe lines from 10 to 24 inches in diameter. The district has installed a 6-inch centrifugal booster pump to raise water 25 feet to about 100 acres. Lost Creek Dam is a constant-angle arched structure 112 feet high. The dam at Lake Wyandotte is an earth fill 45 feet high.

The total investment by the district in works to December 31, 1927, was $896,134.25. Outside of the purchase of South Feather and Palermo systems for $400,000, the largest items in construction have been $210,654 for Lost Creek Reservoir, $71,839 for Lake Wyandotte, $51,812 for reconstruction of South Feather system, $37,190 for distribution laterals and $24,931 for general expenses.

Use and delivery of water.—Water is delivered to the users through delivery boxes or gates installed by the district, miners-inch boxes being used for measurement. Measurements at the point of delivery are recorded daily by the ditchtenders. Applications for water are required

to be filed not later than January 15 of each year, but further application must be made by the water users for each delivery. Each user is notified approximately 24 hours in advance of each delivery. The amounts of water delivered to lands both within and without the district during the past five years have been as follows: within the district, 1923, 1913; 1924, 1210; 1925, 2854; 1926, 2316; 1927, 3001; outside the district, 1923, 4472; 1924, 2708; 1925, 4169; 1926, 4118; 1927, 4247.

Bonds.—A bond issue of $2,000,000 has been authorized and voted. Of these, $1,000,000 have been disposed of. Other bonds or obligations against lands in the district are estimated at $30,000. These are school and general county bonds.

Assessments and water tolls.—All 'good' land in the district is assessed for district purposes at $100 per acre, similar land with rock outcroppings at $85 per acre, and land of doubtful value except for grazing at $10 per acre. The total district assessed valuation for 1927–28 was $2,235,320. The district assessment per $100 valuation for each of the past four years has been $2; for 1923–24 it was $1. The total district levy for 1927–28 was $44,798. Inside the district a water toll of $5 per acre-foot is also charged. The toll for water outside the district was $5.50 per acre-foot, but was raised in 1928 to $7.50 per acre-foot. The total income from tolls for irrigation service inside the district in 1927 was $12,942. Outside, the total tolls charged amounted to $23,358. In addition, the district received $2,061 from domestic service.

BROWNS VALLEY

Location: north side of Yuba River about 15 miles northeast of Marysville, in Yuba County. (Pl. XIII.)
Date of organization election: September 19, 1888.
Gross area: about 40,000 acres; **area assessed 1927:** no assessment.
Principal town: none.
Post office: Browns Valley.
Railroad transportation: Southern Pacific and Western Pacific railroads at Marysville.

History.—The early history of this district has been covered in previous publications.* Briefly, as may be noted from the data given above, this was one of the early "Wright" irrigation districts. Like most of the others of those districts, it was formed without adequate engineering study and passed through financial difficulties and litigation. The area included was at least seven times that which the works constructed and the water supply available could serve. It finally took up its old indebtedness on the basis of 30 cents on the dollar and made an agreement with the predecessor of Pacific Gas and Electric Company by which the ditches would be maintained and water would be brought to the district without expense to the district. In this way the community continued to receive water and the district organization was maintained, and that situation continues to exist to this day.

When studied in 1915 the area irrigated was estimated at not to exceed 2500 acres. In 1927, however, the district reports that this has increased to 6438 acres. More than one-third of the irrigated area is in irrigated pasture.

* U. S. Dept. of Agr., Office of Experiment Stations Bul. 100, 131–132; also, State Dept. of Eng., Bul. 2, 14–15, and 65–66.

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* U. S. Dept. of Agr., Office of Experiment Stations Bul. 100, 131–132; also, State Dept. of Eng., Bul. 2, 14–15, and 65–66.

Soils and topography.—Soils are of the Aiken and Redding series, loams and gravelly loams predominating.* The surface is rolling and the depth not great. About 13,000 acres is above the Browns Valley ditch, and about 16,000 acres below the ditch is considered of no value for irrigation, leaving a net irrigable area of about 11,000 acres. Natural drainage is ample and no alkali is reported.

Development.—There are now about 170 holdings in the district, of which 21, devoted to poultry and berry growing, have from one to five acres each. There are still a number of large holdings, four ranging between 1200 acres and 3000 acres. Of the gross area of about 40,000 acres, 28,728 is classed as nonirrigable. Horticultural crops include deciduous and citrus fruits and grapes. Approximately one-fourth of the irrigated area is in annual field crops, the soil not being sufficiently deep for alfalfa. The total population in the district is about 800, of which 46 are reported living in Browns Valley and 42 in Glen Olive.

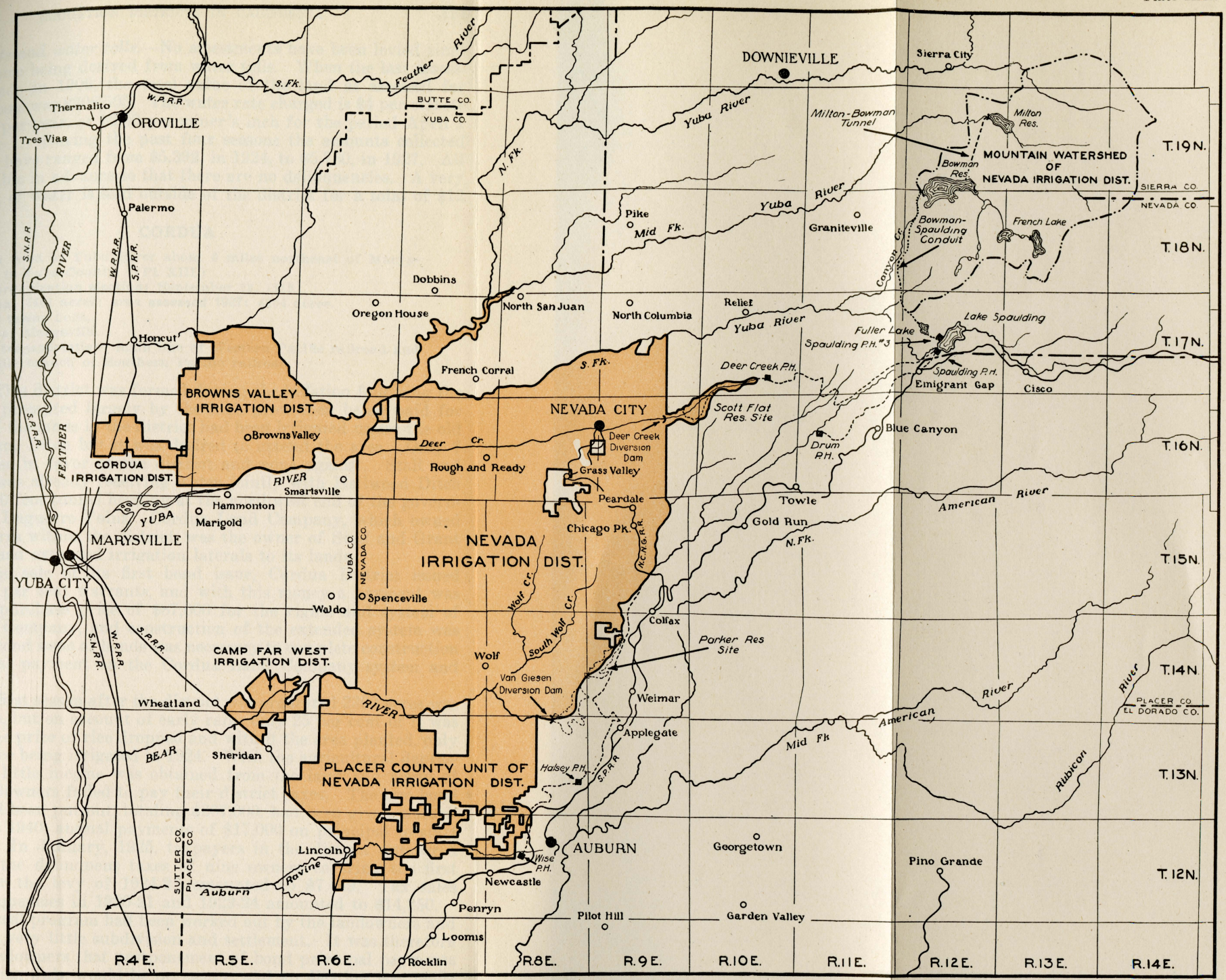
Water supply.—Water is diverted from North Fork of Yuba River under an old appropriation right which has its measure in past and present use. The water delivered to the district by Pacific Gas and Electric Company amounts to 47.2 cu. ft. per sec. Deliveries to the district since 1909, not counting 1917 for which no record is available, have varied from 14,200 acre-feet per annum, in 1909, to 17,000 acre-feet per annum, during each of the years since 1923.

Works.—The works owned by the district include a concrete diversion dam in North Fork of Yuba River, this dam extending 12 feet above the river bed and having a crest length of 40 feet; 47.3 miles of unlined main canals; 1.2 miles of main pipe line 30 to 36 inches in diameter; 42.1 miles of unlined laterals; 18 miles of unlined farm ditches and 0.6 mile of lateral pipe lines 10 to 18 inches in diameter. Under the contract with Pacific Gas and Electric Company, in return for the right to pass water for power purposes through the district ditch, the company maintains 8 miles of flume and 47 miles of ditch, paying to the district the nominal rental of $100 per annum. There is no accurate information available as to the capital investment of the district in works, since these works have been handed down from the early days of the district.

Use and delivery of water.—The district is governed by three directors, the president of the board being in charge of maintenance and distribution and having under him, as needed, three ditch tenders. The approximate unit to which water is delivered is 40 acres. Deliveries are made through miner's inch boxes under a 6-inch pressure. The use during the past four seasons, as computed by the district, has ranged from 9500 acre-feet, in 1924, to 10,400, in 1927. Water is delivered to olive and citrus groves at the rate of 1 miner's inch continuous flow to 2 acres, and to other fruits at the rate of 1 miner's inch to 3 acres.

Bonds.—The district has issued no bonds since the $140,000 put out in 1888 and bought back mainly prior to 1915 at 30 cents on the dollar. Other bonds outstanding are only those of Marysville Union High School, of which about $7,500 must be paid by lands within Browns Valley Irrigation District.

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California.



Location and boundary map of irrigation districts obtaining water from Yuba and Bear rivers.

Assessments and water tolls.—No assessments have been levied since 1906, all income being derived from water tolls. When the last assessment was made in 1906, the total value of the land as assessed for district purposes was $308,505. The water rate charged is $4 per statute miner's inch per year, or $2.50 per miner's inch for the period April 1 to September 1. During the past four seasons the amounts collected in water tolls have ranged from $5,392, in 1924, to $5,780, in 1927. All tolls are payable in advance so that there are no delinquencies. A very small amount of water is sold outside of the district for a total of $12 per year.

CORDUA

Location: west of Yuba River about 6 miles northeast of Marysville, in Yuba County. (Pl. XIII.)
Date of organization election: September 22, 1919.
Gross area: 5461 acres; **area assessed 1927:** 4604 acres.
Principal town: none.
Post office: Marysville.
Railroad transportation: main line of Western Pacific railroad and Oroville branch of Southern Pacific railroad.

History.—This district was formed during the inflation following the war and was prompted largely by the high price then being paid for rice. Some of the lands in the district had been irrigated under the old Stall and Grant Ditch but it was desired to extend the area. Only 7 votes were case in favor of the district and none against. Stall and Grant Ditch was already receiving water jointly with Hallwood Ditch through a 1000-foot tunnel heading at the northwest end of the government weir at Daguerre Point. Cordua Land Company, which owned about 1500 acres within the district, was the owner of Stall and Grant Ditch and it had extended irrigation laterals to its lands.

Prior to the sale of its first bond issue, Cordua District issued $100,000 in 7 per cent warrants, and with this money a payment was made on the purchase price of $87,000 for the rights and system of Cordua Land Company, and construction of the extended system was started. A second issue of bonds was necessary to complete construction and make final payment on the Cordua Land Company system and rights.

During the first season after the district was organized 2300 acres was planted to rice, but on account of early rains only 25 per cent of it was harvested. The price of rice dropped and with it the area planted, only 800 acres of rice being irrigated in 1924. With the agricultural depression on, very little income was obtained from the land and many of the larger landowners failed to pay their district taxes. The two bond issues that had been put out, totaling $267,000, had been given maturities of 1925 to 1940, annual payments of $17,000 on principal to start July 1, 1925. In January, 1925, taxpayers in the district numbered nineteen and the delinquent taxes of nine owners covering the first installment for the levy of 1924-25 amounted to $7,459. Tax sales covering delinquencies in 1920-21 and 1923-24 amounted to $14,250.

No agricultural program had been worked out by the landowners and there had been very little subdivision and settlement. It was therefore clear to the landowners that postponement of bond principal payments due the following July would be necessary, and application was made to the Bond Certification Commission for permission to issue refunding

bonds under the act of May 25, 1919. This permission was given and refunding bonds in the amount of $187,000 were voted April 6, 1926. These are being sold annually as needed to retire the maturing bonds. Rice is still the principal irrigated crop, 1100 acres being grown in 1927.

Soils and topography.—The soils are loams and clay loams, mainly of the Madera and San Joaquin series, and are generally heavy and shallow and underlain by hard-pan 18 to 36 inches below the surface.* The surface is rolling on the east but level valley land on the west. Except for a few hundred acres along Nigger Jack Slough, ground water is 10 to 50 feet below the surface. Some special drains have been excavated into Nigger Jack Slough.

Development.—This has already been touched on under "History." There are still only nineteen farm holdings, including one of 627 acres, one of 632 acres and one of 1100 acres. The population in the district is about 50. The area irrigated in 1927 was 1042 acres, or a little more than half of that irrigated in 1926. The principal reduction in irrigated area has been in rice, of which 930 acres was irrigated in 1927 as against 1850 acres in 1926.

Water Supply.—The water right in Yuba River purchased from Cordua Land Company is claimed to be 75 cu. ft. per sec. It is based on an old appropriation right, which it is claimed dates to 1874, and on subsequent filings. The joint diversion of Cordua Irrigation District and Hallwood Ditch is stated to be 225 cu. ft. per sec., this being divided on the basis of 75 to Cordua District and 150 to Hallwood Ditch by agreement recorded February 5, 1912. In most years the flow in Yuba River at the Daguerre Point weir is sufficient for these two districts. In some years, however, such as 1924, there is a deficiency. The records of the Sacramento-San Joaquin water supervisor give the total diversion for Cordua and Hallwood ditches as 34,053 acre-feet in 1926 and 38,482 acre-feet in 1927.

Works.—The joint canal of Cordua Irrigation District and the Hallwood Company extends about 1000 feet down stream from the west portal of the tunnel to a concrete division weir. From there Cordua Canal, with a capacity of 75 cu. ft. per sec., extends for 2 miles to Nigger Jack Slough, which it crosses on a metal flume about 3000 feet in length. The main canal then continues westerly, following generally the north boundary of the district. A second flume about 1000 feet in length carries about 60 cu. ft. per sec. across a west branch of Nigger Jack Slough. The total length of the main canal is 8 miles, all unlined, and the length of laterals is 19 miles, also unlined. All outlet and check structures are of concrete. The quality of construction on the system has been proved to be good, with resulting low maintenance costs. Drainage works constructed by the district are not expensive. Nigger Jack Slough was cleaned out in 1920 and 1921 in cooperation with the Hallwood Company. The total expenditure by the district on works to January 1, 1928, has been $239,000.

Use and delivery of water.—Water is delivered to the high point on each 160-acre holding. Measurements of deliveries are not made.

Bonds.—The outstanding bonded indebtedness on January 1, 1928, was $257,000, of which $51,000 is of the refunding issue. The first

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California.

issue was for $192,000, and the second issue $75,000, $10,000 of which has never been sold. The remainder of the first and second issues mature at the rate of $17,000 annually. The refunding bonds for which they are being exchanged mature during the 10-year period 1941–1951. There are no county bonds against lands in the district, but there are outstanding school bonds estimated to total $4,700.

Assessments and water tolls.—Prior to 1926 the district income was obtained entirely from district taxes, but beginning with 1926 tolls have also been collected. Prior to 1927–28 land of generally flat surface was assessed for district purposes at $100 per acre, that with rolling topography at $85 to $90 per acre, and 140 acres above the gravity supply at $30 per acre. For the year 1927–28 the above assessed valuations have been reduced 25 per cent, making the total assessed valuation for that year $390,162, and the total levy $21,186. During the past five years the assessment rates per $100 valuation have been as follows: 1923–24, $3.48; 1924–25, $6.70, with a rebate of $2.58; 1925–26, $3.80; 1926–27, $4.36; 1927–28, $5.43. Tolls charged beginning with 1926 have been $3 per acre for rice and $1.25 for general crops. In 1927 water was sold for 400 acres of rice outside of the district at $7 per acre. The income from all tolls in 1927 was $4,210.

NEVADA

Location: Sierra Nevada foothills, between South Fork of Yuba River and Bear River, in Nevada County, and generally between Auburn Ravine and Bear River west of Auburn and east of Lincoln and Sheridan, in Placer County. (Pl. XIII.)

Date of organization election: August 4, 1921.

Gross area: 268,500 acres; **area assessed 1927:** 267,633 acres.

Principal towns: none; principal adjacent towns: Nevada City, Grass Valley, Auburn, and Lincoln.

Post office: Grass Valley.

Railroad transportation: Nevada County Narrow Gauge connecting with Southern Pacific railroad at Colfax for northeastern portion of district; Overland route and east-side Sacramento Valley line of Southern Pacific railroad for southwestern portion.

History.—Development of an adequate irrigation water supply for western Nevada County through the formation of an irrigation district was first seriously considered in 1917 under the leadership of the newly appointed farm adviser of Nevada County. At that time the main conception of the problem was a project that would save for the foothill areas water supplies originating in the mountain territory east of there. It was feared that unless some action were taken to secure these waters for the foothill section they would soon either be utilized in hydroelectric development incompatible with full irrigation development in the foothills, or be acquired for lands in the floor of Sacramento Valley. A preliminary reconnoissance of the mountain watersheds was made by a local committee in May, 1918, and several water filings were made. A little later Yuba-Nevada-Sutter Water and Power Association was formed to consider and promote a project.

Early in 1921, it was realized that chief interest in an irrigation movement centered in Nevada County. Under the leadership of the Nevada County Farm Bureau, therefore, a local irrigation committee was organized, and on March 15, 1921, this committee presented to the supervisors of Nevada County a petition for the formation of an irrigation district carrying 797 signatures. Prior to the filing of this

petition, the state engineer had instituted an investigation, and two earlier reports had been prepared by engineers employed by Yuba-Nevada-Sutter Water and Power Association, in which the basic facts with reference to water supply were set forth. A later preliminary report was made by the engineer employed by the district.

It was realized at the outset that the organization of an irrigation district embracing a large area of foothill land, of which a very considerable proportion would be non-irrigable because of its roughness or because of the character of its soil, presented problems outside of California irrigation district experience. The fact was also appreciated that any feasible irrigation project would need to include hydro-electric development for carrying the major part of the cost. Several other irrigation districts in the state had found hydro-electric development a necessary feature of storage,* but it was seen in the case of Nevada District that the initial financial structure must be almost wholly built on prospective power income.

After a rather heated campaign, an election on organizing the district was carried by vote of 636 to 168. Immediately after this election an engineering staff was set to work to develop a construction program and negotiations were begun with Pacific Gas and Electric Company with reference to a power contract.

Western Nevada County was not entirely without irrigation facilities when the district plan was started. For some years Pacific Gas and Electric Company had been supplying water from its South Yuba system to lands about Nevada City and Grass Valley, its principal ditches there being the Snow Mountain and Cascade. South Yuba Water Company represented the consolidation and absorption of a number of water and ditch companies which were organized subsequent to 1850 to furnish water to mines, not only about Nevada City and Grass Valley, but also in Placer County. Gradually, irrigation and domestic use predominated over mining use under the South Yuba system, especially in Placer County, water for these purposes being carried down through Colfax, Auburn, Newcastle, Penryn, Loomis, Rocklin, and Lincoln. The South Yuba system had also been extensively developed for power and had become the nucleus of the extensive hydro-electric system of Pacific Gas and Electric Company. Water for areas west of Grass Valley was being supplied principally by Excelsior Water and Mining Company, whose main supply came through Excelsior Ditch diverting from South Yuba River, continuing as China Ditch from the Deer Creek crossing, and from Newtown and Rough and Ready ditches diverting from Deer Creek near Nevada City. Southwest of Grass Valley the principal irrigation source was Tarr Ditch, which diverted from Wolf Creek about two miles south of Grass Valley, and extended 28 miles through Indian Springs to Smartsville. The early history of the many ditches supplying Nevada County has been covered in a previous publication.†

In spite of the numerous existing ditches in western Nevada County, only a relatively small area was being irrigated when the district was formed, the maximum estimate of the irrigated area being 6600 acres.

* See reports on Oakdale, South San Joaquin, Modesto, Turlock, and Merced districts below.

† U. S. Dept. of Agr., Office of Experiment Stations Bul. 100, 118-128, and 130-154.

Evidence before the Railroad Commission indicated that about 3000 acres was being watered under the Excelsior system in 1920.*

The irrigation ditches of the various systems were mainly small, having been originally built mostly for mining purposes, and the areas irrigated were scattered. The crops receiving water were chiefly orchards, vineyards, and pastures. Very little community growth was possible without bringing in more water, and there were large areas to which no ditches led.

The development of plans, the making of surveys, the acquirement of necessary rights and rights of way, and necessary negotiations relating to power were not easy under the complicated conditions existing in Nevada District, and it was not until May 7, 1924, that the report of the district engineer, outlining the project in detail, was adopted by the directors of the district, and presented to the Bond Certification Commission as a basis for the approval of a bond issue of $6,063,400.

Water rights applied for by the district were contested before both the State Division of Water Rights and the Federal Power Commission, final approval by the latter not being obtained until October 28, 1925. In the meantime, the State Division of Water Rights had given approval of the basic water-right applications of the district; the district had entered into a power contract with Pacific Gas and Electric Company, which was signed April 29, 1924; the district had purchased the properties of Excelsior Water and Power Company for $350,000; the Bond Certification Commission had reported favorably on a bond issue of $7,250,000, after increasing the estimates of the district from $6,063,400, which was the estimate of actual cash expenditures; $6,000,000 of this bond issue had been certified and sold; the four major contracts for construction work in the mountain division had been prepared; and negotiations had been practically completed for the purchase by the district of Bowman Lake and related properties, storage at Bowman Lake being the key feature in the works of the mountain division.

Immediately after final issuance of the Federal Power Commission license which authorized necessary rights of way over public lands, the four major contracts previously referred to were let, and construction work was actively started in the mountains November 5, 1925. On November 25, 1925, the Bowman Lake properties were purchased for $273,000; on April 18, 1926, Tarr Ditch and properties were purchased for $100,000; and on November 23, 1926, the Deer Creek distribution system of Pacific Gas and Electric Company, including mainly the Snow Mountain and Cascade ditches, was purchased for $350,000. Ownership of these properties gave the district control of all existing distribution systems and attached rights within Nevada Irrigation District.

During the time Nevada Irrigation District was getting its construction program under way, landowners in Placer County between Auburn Ravine and Bear River became interested in an increased water supply for their lands. Since this part of Placer County is adjacent to the southern portion of Nevada Irrigation District and within reach of the water supply being developed by that district, an investigation of the needs of this area and of the best means of supplying it with more water was made by the engineer of Nevada District. He proposed certain changes in the previous plan of Nevada District by which water

* Decision 7022, p. 667.

could be taken to the Placer County areas by diversion at the Combie Crossing damsite on Bear River. This plan was agreed to, and on December 10, 1926, approximately 66,500 acres in Placer County was annexed to Nevada Irrigation District, bringing the total area to about 268,500 acres.

After practically completing the works in the mountain division other than the Milton-Bowman tunnel, as called for by plans that had been adopted, Nevada District began delivering water to Pacific Gas and Electric Company at Lake Spaulding through the Bowman-Spaulding conduit on July 1, 1927. There was still, however, much to be accomplished in connection with the construction of the distribution system within the district and supplying water to the Placer unit. The district still had a substantial sum left for construction purposes from the original bond issue. On May 15, 1928, the district voted a second bond issue of $2,592,000 mainly to take care of increased costs due to inclusion of the Placer County unit. Construction of storage on Deer Creek at the Scotts Flat site owned by the district, general extension of the distribution system in the Nevada County unit, construction of Van Giesen Dam on Bear River, purchase from Pacific Gas and Electric Company of its Gold Hill and Ophir irrigation systems in the Placer County unit, and general extension of the distribution system in Placer County, were the principal items in the revised plans.

Negotiations are under way between the district and Pacific Gas and Electric Company with reference to an added income to the district to be derived by the routing of 135 cu. ft. per sec. of district water through the Halsey and Wise powerhouses of the power company, instead of delivering it to the district in Bear River below the Drum power plant.

A chapter in the history of Nevada Irrigation District which has brought much comment, and which has vitally affected affairs of the district during the last two years, relates to a contract entered into by the district and a corporation known as Pacific Electric and Development Company on June 28, 1927, which was to run until January 1, 2025.

Under the terms of this contract it was proposed that the district should turn over to Pacific Electric and Development Company all right to develop at the latter's expense and for its own profit all power resources available under the water rights of the district, and also to turn over to the company complete control and management of the entire works of the district, subject in the matter of irrigation service to such rules and regulations as the directors should from time to time establish.

Negotiations with reference to this contract were carried on by the directors and the representative of the company over a period of about six months. The promoter of the company was, in fact, the general manager of the district. When news of the signing of the contract became generally public, much bitter comment resulted. Legal action to invalidate the contract was threatened, but none was brought. The promoter of Pacific Electric and Development Company was unable, however, to finance his project and carry out the obligations placed on his company by January 1, 1928, as provided in the contract, and this date was extended to July 1, 1928; nor was he able to do so within

the extended period. Before July 1, 1928, the contract was abrogated, partly for failure of the company to live up to its terms, and partly in response to the opposition that had arisen.

The contract with Pacific Electric and Development Company just mentioned has not been the only source of dispute. Petitions are now before the board of directors for the exclusion of a considerable acreage in the Placer County unit. On two occasions certain Placer County unit landowners have sought permission of the attorney general of the state to bring *quo warranto* proceedings to invalidate the inclusion of their lands, but in each case the petition was denied.

At this writing, the affairs of the district are in a somewhat uncertain state because of lack of funds needed to retire outstanding warrants and to build the distribution system to Placer County lands. A satisfactory supplemental contract with Pacific Gas and Electric Company covering income to be derived by rerouting certain district water will do much to clear up this situation. It is evident, however, that assessments on the lands of the district, which the district has sought to escape, will be necessary. While it is expected by the district that the original contract and the pending supplemental contract with Pacific Gas and Electric Company will yield sufficient revenue to pay the interest on all bonds now outstanding or validated for certification, amounting to $7,942,000, revenues from water sales alone will not carry operating charges, the construction cost of the remainder of the distribution system, and meet bond maturities.

Soils and topography.—Nevada District comprises a typical foothill area of rolling to steep topography, characterized by numerous ridges, spurs, and ravines. Elevations extend from about 500 to about 3500 feet in the Nevada County unit, and from 150 to 1600 feet in the Placer County unit. In the latter unit, below the 500-foot contour, the surface gradually merges from rolling foothills to gently rolling plains above the floor of Sacramento Valley. There are few wide valleys in the upper portion of the district, the principal exception being Penn Valley, situated about six miles west of Grass Valley.

The soils of Nevada District are described in the soil surveys of the Grass Valley and Auburn areas.* In the Nevada County unit, general classifications are Aiken clay loam and stony clay loam and Sierra clay loam. Considerable areas of these are of the shallow phase, particularly from Penn Valley north and in the west-central area. Local areas of rough stony lands, some of considerable size, are scattered through the unit. General classifications in the Placer County unit are Aiken stony clay loam, which predominates in the northern half, except for a considerable area of rough stony land south of Bear River, Aiken clay loam, shallow phase, in the southern portion, and Holland sandy loam extending diagonally through the center. Because of the topography, good natural drainage prevails throughout the district, except for small areas in the southwestern portion and smaller areas of marshy or spring-saturated land.

Several attempts have been made both by the soil survey and by the district to determine the irrigable area of the district. As given by the district it is 126,307 acres in Nevada County and 41,482 acres in Placer County, making a total of 167,789 acres. This figure does not vary widely from that made from the soil survey.

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Grass Valley Area, California, and Soil Survey of the Auburn Area, California.

Where not cleared, the lands in Nevada District are covered with forest growth varying from brush and scrub oaks in the lower portion, to pines and firs in the higher elevations. Land clearing is therefore a necessary preliminary to putting land into production.

Development.—This has been largely covered under "History." It is characteristic of the Sierra Nevada foothill areas to develop slowly under irrigation, because of the extensive clearing that has been found necessary to establish orchards, which have thus far predominated in the development. The present irrigated area of the entire district is given as 11,704 acres, of which 5100 acres is in the Placer unit and 6604 acres is in the Nevada unit. In the former, 4500 acres is in orchard and 600 acres in forage crops, while in the latter, 2052 acres is in orchard and 4552 acres in forage crops. The area in the Nevada County unit already cleared is about 32,000 acres; a larger percentage is cleared in the Placer unit. As is indicated under "Works," the present distribution system controlled by the district covers only about one-third of the Nevada County unit and none of the Placer County unit, the latter still being dependent upon the system of Pacific Gas and Electric Company, which the district has planned to acquire.

The district assessment book shows 1284 separate holdings in the Nevada County unit and 1833 in the Placer County unit. Of six large holdings, the range in acreage is from 2581 to 16,625, with a total in the six of 39,374 acres. The approximate assessed value of land for city and county purposes is $2,750,000 in the Nevada unit and $1,975,000 in the Placer unit, these valuations including both real estate and improvements. County assessed valuations are stated to be low and are not on a comparable basis in the two counties. Using the district assessment valuations gives a total of $14,145,815, of which $6,908,345 is in the Nevada unit and $7,237,470 is in the Placer unit. The basis for fixing these district valuations is given under "Assessments and water tolls."

There are no incorporated cities within the district. The Nevada unit surrounds Grass Valley, which has a population of 4500, and Nevada City, which has a population of 2500. The Placer unit extends nearly to Auburn, Penryn, Loomis, Rocklin, and Lincoln. The estimated population within the entire district is 5500. Transportation through the center of the district is furnished by a paved highway extending from Auburn to Nevada City. A second proposed state highway, known as the "Tahoe-Ukiah" highway, and which is to extend east and west across the northern portion of the district, has been adopted as part of the state system, and grading has been partially completed. The Lincoln highway is immediately south, approximately parallel with the southern boundary of the district, and the main east-side state highway of Sacramento Valley passes along the west side of the Placer unit.

Water supply.—The principal water supply for the district is to come from the upper watersheds of Middle and South forks of Yuba River and their tributaries. The ultimate plan called for an additional mountain supply from the Haypress watershed on North Fork of Yuba River, but no construction work has been carried out on that stream. The mountain supply of the district is supplemented by diversions from Deer and Wolf creeks within the Nevada County unit, it being planned ultimately to increase this local supply by storage on these two streams.

FIG. 1. Clearing land in typical portion of the upper area of Nevada Irrigation District.

FIG. 2. Camino Ridge in El Dorado Irrigation District.

The mountain water supply, as thus far developed, comes from Bowman Reservoir, situated at an elevation of approximately 5500 feet on Canyon Creek, tributary of the South Yuba, supplemented by a tunnel diversion from Milton Reservoir, located on the Upper Middle Yuba at an elevation of 5690 feet. Reference has already been made to the purchase of the Bowman Lake properties. The district has also acquired other storage lakes on upper Canyon Creek, chiefly Saw Mill and French lakes. Elevations of the mountain watershed range from 5300 feet at Bowman Lake to 8500 feet at the summit of English Mountain.

The mean seasonal precipitation, from records extending back to 1871, is in excess of 70 inches. This occurs largely in form of snow. Bowman Lake Reservoir has been constructed with a capacity of 65,000 acre-feet and the smaller lakes on Canyon Creek that have been purchased have a storage capacity of 20,000 acre-feet, making a total storage capacity of 85,000 acre-feet to regulate the run-off.

Texas and Fall creeks both lie south of Bowman Reservoir and water from these streams is picked up by the Bowman-Spaulding conduit.

Nevada District has a large number of water-right applications before the Division of Water Rights, on most of which permits have been issued. Filings date from May 7, 1919, to September 8, 1926, and are for water in Canyon Creek, Texas Creek, Fall Creek, South Branch of Fall Creek, South Fork of Yuba River, Deer Creek, Squirrel Creek, Middle Fork of Yuba River, South Wolf Creek, and Bear River.

As indicated under "History," the mountain water supply of the district is utilized for hydro-electric development. This is covered by contract with Pacific Gas and Electric Company, dated April 29, 1924, and a second contract for which negotiations are pending in January, 1929. Waters developed by the district in the Milton-Jackson areas on the Middle Yuba are diverted through Milton-Bowman tunnel to Bowman Lake, where they are combined with the run-off from the Canyon Creek watershed. Water from Lake Bowman is in turn taken to Lake Spaulding, a Pacific Gas and Electric Company reservoir, through the Bowman-Spaulding conduit, picking up water from Texas and Fall creeks on the way. The power income derived by the district from its contract with Pacific Gas and Electric Company is described in a subsequent paragraph.

The total amount of water estimated by the district to be available from mountain sources as regulated by district works is 144,000 acre-feet per annum.

The ultimate plans of the district, as originally outlined, contemplated construction of storage on Deer Creek at Scotts Flat above Nevada City up to a capacity of 37,000 acre-feet, and in Bear River at the Parker site to a capacity of 120,000 acre-feet. As a step in this program, the district has acquired both the Scotts Flat and the Parker storage sites.

Income from water sold for power.—The hydro-electric feature of the Nevada Irrigation District project frequently referred to above is based on the passing of water developed and controlled by the district through power plants owned and operated by Pacific Gas and Electric Company, the district having no investment whatever in hydro-electric plants. The 108,000 acre-feet of water which the district has contracted to deliver to Lake Spaulding through the Bowman-Spaulding conduit

passes first through the 'Rim,' or Spaulding No. 3, power plant of Pacific Gas and Electric Company, situated on the margin of Lake Spaulding. After leaving Lake Spaulding, the water passes through Drum and South Yuba canals to the Bear River and Deer Creek power plants of the company, in the proportion of 73,000 acre-feet through the former and 35,000 acre-feet through the latter. Payments to the district by the company for use of water for power are to be made at stated prices over a period of fifty years, divided into two twenty-five-year periods.

At the time the power contract was entered into with Pacific Gas and Electric Company, the district estimated a gross income from water delivered to Pacific Gas and Electric Company of $370,500 in the minimum year, $478,950 in the maximum year, and $401,985 in the average year, these figures applying to the first 25 years under the contract.

Works.—Distribution of water to lands in the Nevada County unit of the district is now being made from diversion on Deer Creek above Nevada City, and from South Yuba River through the Excelsior system. Plans contemplated taking water to the lands in the Placer County unit by diversion at Van Giesen Dam, constructed during 1927 and 1928 at Combie Crossing on Bear River, but no connecting canals have been constructed to date.

Construction work on the mountain division has been completed substantially as planned for the initial development. The more important features of this work are as follows:

Milton Diversion Dam—a concrete, arched structure with crest length of 276 feet, rising 27 feet above streambed, and with the elevation on the spillway crest of 5690 feet.

Milton Pipe Line—a woodstave line 7 feet in diameter and 3500 feet in length, connecting Milton diversion dam with the Milton-Bowman tunnel.

Milton-Bowman Tunnel—length, 21,600 feet; dimensions of lined section, 7.5 by 8.5 feet; dimensions of unlined section, 9 by 9.75 feet.

Bowman Main Dam—a rock-fill structure with crest length of 750 feet, rising 167 feet above streambed. The elevation on the crest is 5567 feet.

Bowman South Dam—a concrete arch with crest length of 400 feet, and maximum height of 135 feet. The elevation on the crest is 5563 feet.

Bowman--Spaulding Conduit—length, 10 miles; maximum capacity, 220 cu. ft. per sec. This feature is made up of 2.5 miles of metal flume 10 feet in diameter, 6 miles of open cut through earth and rock, 4 tunnels aggregating 1.33 miles in length, 2 siphons 7 feet in diameter, aggregating 0.33 mile in length.

According to a report filed by the district with the state engineer on October 10, 1928, the total cost of works in the mountain division to July 1, 1928, was $4,114,140.37.

The construction work done by the district within the district division has included diversion dams on Deer Creek and Bear River, additions and improvements to Pacific Gas and Electric Company, Excelsior Water and Power Company, and Tarr Ditch water systems purchased by the district, and construction of 60 miles of distribution ditches and the 'D-S Canal,' connecting the upper and lower distribution systems in the Nevada unit.

Deer Creek Diversion Dam is a concrete arch of variable radius, 390 feet long on the crest and 97 feet high above streambed. The crest elevation is 2902 feet and the elevation of the spillway is 2896.6 feet.

Bear River Diversion Dam, known as Van Giesen Dam, is also a concrete arch with variable radius. It has a crest length of 790 feet and rises 88 feet above streambed. Elevation on the crest is 1608 feet and on the spillway is 1600 feet.

The most notable improvement on the systems taken over has been the extension of the upper distribution system to the Chicago Park area east of Grass Valley. Extensions on the lower distribution system include what are known as the Pine Knob and Indian Springs units. The 'D-S Canal,' connecting the upper and lower systems, makes it possible to irrigate most of the Nevada County unit from the Deer Creek diversion. The canal has a capacity of 100 cu. ft. per sec. at the diversion point. It extends southwesterly eight miles to Wolf Creek, down which channel water is passed to Tarr Ditch and carried several miles below to serve the lower division of the district in Nevada County.

As has been already indicated, no distribution system has yet been built to the Placer County unit from Van Giesen Dam near Combie Crossing. Van Giesen Dam, however, creates a storage of 8400 acre-feet which is available for distribution to lands in Placer County through the Gold Hill system of Pacific Gas and Electric Company.

Including the purchase of the old systems, the district has spent on the district division to July 1, 1928, a total of $2,202,479.08, this figure also having been taken from the report of the district engineer dated October 10, 1928.

In addition to the amounts spent on the mountain and district divisions, the engineer reports the expenditure to July 1, 1928, of the following amounts: expenditures not directly connected with construction work, $183,639.82; interest on bonds, $762,801.78; bond discount and expense, $541,556.95. These last named expenditures, when added to expenditures on the mountain and district divisions above specified, make a total expenditure on works to July 1, 1928, of $7,804,618.

The total length of ditches purchased by the district is given as 212.2 miles, and the total length of ditches constructed by the district as 66.4 miles, or a total of 278.6 miles.

Use and delivery of water.—The district now has a skeleton distribution system which reaches about 40,000 acres in the Nevada unit and water is available for that area when the land has been prepared to receive it. Duty of water studies made by the irrigation investigations of the U. S. Department of Agriculture in 1918 under the Excelsior Water and Mining Company system in Nevada and Yuba counties indicate a requirement of 2.5 acre-feet per acre on meadow lands, 2 acre-feet per acre for orchards, and 3 acre-feet for alfalfa and forage crops, or an average for this system of 2.5 acre-feet per acre. The assumptions used by the district in planning its works corresponded approximately to these figures.

Water is being roughly measured through miners-inch boxes, using the statute inch, equivalent to 11.25 g. p. m. Domestic water is supplied to Grass Valley and Nevada City in the amount of 3000 to 3500 acre-feet per year, while mines in the vicinity of these cities receive from 12,000 to 15,000 acre-feet per year.

In the Placer County unit 5100 acres is under irrigation and an additional 1600 acres, which is being irrigated, is within the exterior boundaries of the district but excluded therefrom.

Bonds.—Several references have been made in previous paragraphs to the bond issues of the district. The first issue, amounting to $7,250,000 is dated July 1, 1925, has maturities from 1936 to 1965, and bears interest at 5½ per cent. Six million dollars of the first issue were favorably reported by the Bond Certification Commission on July 27, 1925.

The second bond issue voted by the district, amounting to $2,592,000, has not yet been sold. On December 15, 1928, the Bond Certification Commission validated for certification $692,000 of the first division of this second issue, these bonds to be dated July 1, 1928, with interest at 5½ per cent, and carrying maturities from 1949 to 1962. On the same date, the commission consented to a private sale of this amount and they were deposited in escrow for use in retiring outstanding warrants and taking care of certain necessary work in the mountain division. Completion of this transaction has been delayed by a suit brought by certain landowners in the Placer County unit of the district who desire to have their lands withdrawn from the district. In their suit these landowners challenge the legality of the second issue on the ground that the Bond Certification Commission had not approved the estimate of the district with reference to the issue. The total bonds outstanding July 1, 1928, amounted to $7,207,000.

It has not been found practicable to estimate the outstanding school, county, and highway bonds against lands in Nevada District.

Assessments and water tolls.—The district system was originally planned on the assumption that the income from water used for power by Pacific Gas and Electric Company would pay the entire bond interest and retirement as well as operating expenses in the mountain division, leaving no burden on the lands and consumers in the district other than the interest and principal of the cost of construction, and the annual cost of operation and maintenance of works in the district division. Acting on this assumption, the district has thus far levied only three small assessments, mainly to take care of organization expenses, with none levied since 1924. The district has each year, however, placed valuations on the land for purposes of assessment. For the season of 1928-29 the valuation of the lands in the Nevada County unit was $6,908,345, and in the Placer County unit, $7,237,470. These valuations are assumed to be based on the actual value of the land. Agricultural lands are valued for assessment purposes at from $25 to $180 per acre, and nonagricultural lands at from $10 to $15 per acre. In the Placer County unit, one or two parcels of land are assessed as high as $300 per acre. The district assessment rates for 1922–23, 1923–24, and 1924–25, were only $0.60, $0.12½, and $0.05, respectively, per each $100 of valuation, and the amounts of the levies in those three years were $42,232, $8,758, and $3,541. When the Placer County unit was annexed to the district, the owners of the lands were supposed to contribute a voluntary assessment at the rate of $0.25 per acre, but only a small part was collected—$1,688 in 1927 and $190 in 1928.

Water rates charged within the district for various types of service range from $0.05 to $0.12½ per 24-hour miners inch. Outside of the district, rates range from $0.12½ to $0.37½ per 24-hour miners inch.

Use of water after August 31 and before May 1 is encouraged by charging half the regular rate charged during the irrigation season. Where water is delivered on a continuous-flow basis, the charge inside the district in Nevada and Placer counties is $18 per miners inch per season, and outside the district, in Yuba County, $28 per miners inch. Rates charged inside the district for water delivered for mining purposes vary from $0.10 per 24-hour miners inch, for quartz mining, to $0.05 per 24-hour miners inch, for placer mining. Outside the district the rates for the same service are $0.25 and $0.12½ per 24-hour miners inch. Inside the district domestic rates are $3.25 for three months in advance for one-quarter inch continuous flow, or $1.15 a month for the same amount. Outside the district these rates are increased to $6 and $2.50, respectively. Different rates are fixed for other purposes and for service outside of Nevada and Placer counties.

The annual receipts from water tolls since the district acquired the distribution system in the Nevada unit have been about $70,000. About 42.9 per cent of this income has been derived from irrigation sales, 40.8 per cent from mining sales, 13.8 per cent from municipal sales, and 2.5 per cent from domestic sales.

CAMP FAR WEST

Location: along Bear River east of Wheatland, in Yuba and Placer counties. (Pl. XIII.)
Date of organization election: September 10, 1924.
Gross area: 4089 acres; **area assessed 1927:** 4089 acres.
Principal town: none.
Post office: Wheatland.
Railroad transportation: east-side line of Southern Pacific railroad at Wheatland.

History.—This district was organized to improve water conditions for lands, mainly owned by three large ranch interests, that had been irrigated from the natural flow of Bear River. Although the mean seasonal run-off of Bear River past the lands of the proponents exceeds 400,000 acre-feet, the summer flow, especially that of late summer, is insufficient. By constructing a dam across Bear River a short distance into the foothills, the immediate late summer requirements could be met and water distribution be improved. It was considered that this could best be done under an irrigation district organization.

At the time of organization, diversions from Bear River were being made by means of brush dams, each ranch having its own distribution system. Over 1300 acres was planted to orchards, mostly prunes, peaches, and pears; about 750 acres to hops, beans, and garden truck; and over 300 acres was in dry-land grain. The county assessed valuation, including improvements, was nearly $400,000, or approximately $100 per acre. There were five holdings of 2120, 818, 778, 200, and 100 acres. The immediate purpose of organizing was rather to improve irrigation facilities for continuing the existing ranch operations. Only one of the principal owners was a resident within the district and eligible to serve as a director. The other owners, however, were all operating their properties.

Soils and topography.—The land is chiefly first bench and upland, the principal soil classification being Columbia sand and sandy loam.*

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California.

About 1400 acres is nonirrigable and useful chiefly for grazing. None of the land is in need of drainage, although, as the landowners sub-irrigate, ground water is rather high in the bottom lands. Some tile drainage had been installed on the hop lands prior to organization.

Development.—As previously indicated, a substantial portion of the district is already in permanent orchard plantings or in hops, beans, or truck. Some of the bottom land needs clearing.

Water supply.—All of the present water users in the district are riparian owners on Bear River, or have acquired prescriptive title to water through beneficial use. However, the district has obtained from the Division of Water Rights permit 2090, with priority of February 11, 1924, for direct diversion of 50 cu. ft. per sec., and permit 2089, with priority of June 13, 1922, for 10,000 acre-feet by storage. As previously indicated, the mean seasonal run-off of Bear River exceeds 400,000 acre-feet. Intermittent current-meter and staff-gage readings indicated a total diversion in 1928 of about 6500 acre-feet.

Works.—The storage dam constructed by the district across Bear River is a concrete gravity structure, arched in plan. It stands 47 feet above streambed, has a crest length of 3000 feet, and creates storage capacity of 3835 acre-feet. The structure has six wood-lined sluiceway openings 8 feet by 12 feet across the streambed to pass the gravel carried during high water. A spillway opening 10 feet high and 160 feet long was left over the center, the elevation of the crest of the spillway being 187 feet. Thirty-inch outlet gates have been provided in the abutments at each end of the dam, but the main distribution canals have not yet been constructed. Water released from storage is still diverted at the old canal headings. The amount expended for works to December 31, 1927, was $183,379.47, the principal item being the cost of the dam, amounting to $128,866

Use and delivery of water.—No record of the amount of water diverted is available. The usual method followed in applying water is sub-irrigation from open ditches. While this leads to a low duty of water, much of the water returns to the river through underground strata.

Bonds.—The district has voted $200,000 in bonds. Three sales have been made, totalling $179,000. Four hundred acres in the district is included in Reclamation District 1001. No record of the reclamation district and school and county bonds against lands in the district is available.

Assessments and water tolls.—The better land is valued for purposes of district assessment at $150 per acre, river wash at $5, and the other lands at $20 to $30 per acre. The total district assessed valuation for 1927–28 was $352,025. For the first two years after organization the district assessment rate for each $100 of valuation was $1.28; for the past two years it has been $5. The total levy for 1927–28 was $17,601. No water tolls are charged.

EL DORADO

Location: foothills of El Dorado County east and west of Placerville. (Pl. XV.)
Date of organization election: September 22, 1925.
Gross area: 30,703 acres; **area assessed 1927:** 29,996 acres.
Principal town: Placerville.
Post office: Placerville.
Railroad transportation: Placerville branch of Southern Pacific railroad.

*History**.—Irrigation water was first brought to the area now included in El Dorado Irrigation District by El Dorado Water and Deep Gravel Mining Company, which constructed El Dorado Canal between 1873 and 1876, primarily for mining purposes. Owing to the passage of the anti-debris act, use of water from the ditch for mining became less important. El Dorado Water and Deep Gravel Mining Company held the property until 1907 when it was acquired by C. N. Beal, who in 1908 deeded it to Sierra Water Supply Company. In 1912 it passed to San Francisco-Oakland Terminal Power Company and in 1916 was acquired in foreclosure proceedings by Placerville Gold Mining Company, which in the same year transferred it to Western States Gas and Electric Company.

Prior to the last transfer, irrigation development had started on Camino Ridge east of Placerville, and extended westerly past the town of Placerville. About 1000 acres was reported under irrigation in 1914. Western States Gas and Electric Company took over the irrigation service, and also constructed the El Dorado power plant. Generally coincident with the construction of the old El Dorado Mining Company system, the Crawford Ditch system, known as Diamond Ridge Ditch, was built to divert water from North Fork of Cosumnes River, with minor diversions from smaller streams. About 500 acres was reported irrigated by that system in the vicinity of Diamond Springs, El Dorado, and Shingle Springs in 1914. Irrigation service was not profitable to either Western States Gas and Electric or Diamond Ridge Water Company, and both sought to promote the formation of an irrigation district to take over the systems and supply the irrigation service. A report by the Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture, was prepared at the request of the water users in 1918 and formation of an irrigation district was recommended, using Cosumnes River for the main supply.

Several years previously, fearing that the use of El Dorado Canal for power generation would jeopardize irrigation supply for the Placerville area, El Dorado Water Users Association was formed. The association went to the Railroad Commission, which rendered decision 5409 on May 20, 1918, holding that there was no preference in public use as between irrigation and hydro-electric development, and suggesting that the water users and Western States Gas and Electric Company come to an agreement regarding the water supply for irrigation. Such an agreement was reached and, in April, 1919, El Dorado Water Company was incorporated by the members of El Dorado Water Users Association to carry this agreement into effect. El Dorado Water Company took over the portion of El Dorado Canal which was required for irrigation at a price of $25,000, with the right to purchase water wholesale

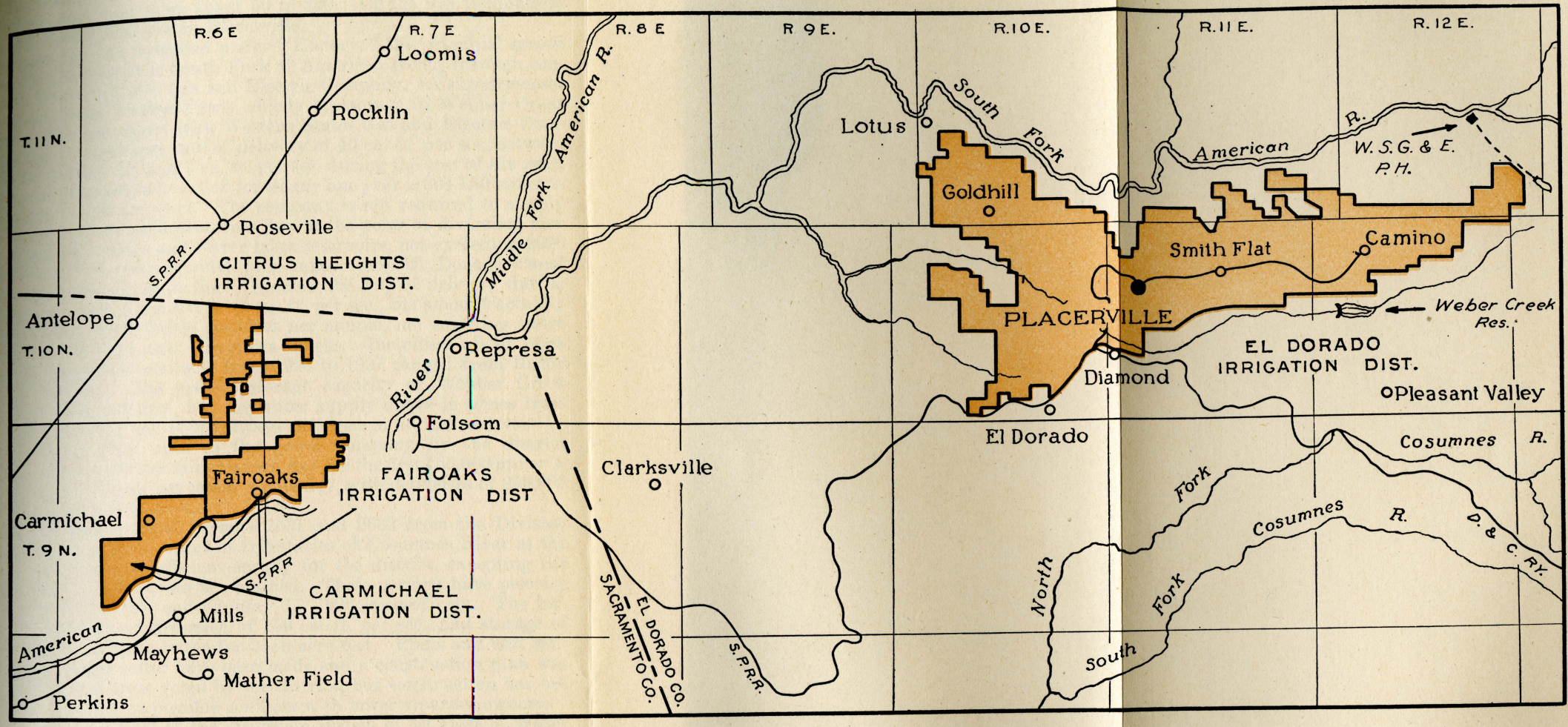
* See also Univ. of Calif. Agr. Exp. Sta. Bul. 253, 365–368, and Railroad Commission of Calif., Decision 5409, 685–6.

from Western States Gas and Electric Company. In an agreement between El Dorado Water Company and Western States Gas and Electric Company, May 31, 1919, the amount of water to be supplied for irrigation was fixed, and it was provided that, if at any future time water should be available to El Dorado Water Company users from other sources at a price equal to or less than that charged by Western States Gas and Electric Company, the latter company should be released from delivering an amount equal to such outside supply.

This agreement between the water users and the power company did not, however, solve all of the water difficulties of the community. El Dorado Water Company was unable to furnish all of the water needed, and after an extended investigation by a local committee, El Dorado Water Corporation was formed for the purpose of acquiring a supplemental supply, and also the properties of Diamond Ridge Water Company. After initiating the necessary rights, construction was started on Webber Dam and Ditch by El Dorado Water Corporation, and in February, 1923, an option was obtained on the Diamond Ridge Water Company properties for $50,000. After expending some $230,000 on the Webber Creek development and $10,000 on the Diamond Ridge option, the company was unable to proceed. Thereupon El Dorado Irrigation District was formed. Sentiment in favor of organization, however, was not unanimous, the affirmative votes numbering 679 and the negative votes 141. The area of the district as originally formed, approximated 40,000 acres, but subsequent exclusions, mainly of non-irrigable areas, reduced the gross area to 30,703 acres, which includes the city of Placerville. The district purchased the El Dorado Water Corporation system April 19, 1927, for $365,527.63, and assumed active charge of operations in June, 1927.

Soils and topography.—Soils are mainly residual and considerably varied, the agricultural value depending largely on their depth. Bedrock outcrops are frequent. Elevations vary from 1500 feet east of the town of El Dorado to 3800 feet below the forebay of the Western States Gas and Electric Company power plant. The district is about one mile wide near its eastern limit, increasing to about 7 miles at the western boundary. Second-growth timber, largely pines and firs, is found in the upper areas of the district not yet cleared. A scrub growth of oaks and brush is common in the lower areas. The surface is somewhat broken and rolling, the irrigable area being largely the tops of the ridges. Natural general drainage is ample.

Development.—Orchard plantings are scattered over the entire district. The normal rate of increase in orchard plantings is from 200 to 300 acres per year, the total plantings now being 5800 acres, of which about two-thirds are bearing. Nearly half of the planted area is in pears. The number of boxes of fresh fruit shipped through the Fruit Growers Association from Placerville in 1926 reached 589,320, which gave a net income to the growers of $736,650. The number of boxes shipped and the gross and net income in 1926 were about double those of 1925. Orchard development in the Placerville area has been slow, due partly to lack of irrigation water for extensions, and partly to the length of time required to clear the foothill land and bring an orchard or vineyard into production. Boom developments are not common under such circumstances and they have not occurred in the Placerville area.



Location and boundary map of American River group of irrigation districts.

Developed holdings are small, averaging 43 acres. There are five large holdings, one of 1067 acres, one of 667 acres, and the others between 500 and 600 acres. Deducting these makes the average developed holding 36 acres. Placerville, the only incorporated city in the district, has a population of 2500, and the population outside of Placerville is about 2000. Camino, a small lumbering town near the eastern end of the district, is also included within the district, and has a population which fluctuates from about 50 to 200. Of the 973 landowners within the district, 531 are in Placerville.

Water supply.—As indicated under "History," the principal source of water for the district is South Fork of American River, through contract with Western States Gas and Electric Company. A supplemental supply comes from Webber Creek, chiefly by storage in Webber Creek Reservoir. The agreement with Western States Gas and Electric Company provides a maximum rate of delivery of 40 cu. ft. per sec. between May 15 and October 15, and 7 cu. ft. per sec. during the rest of the year. The maximum amount to be called for in any one year is 304,150 miner's-inch days, or 15,120 acre-feet. The company is not required to supply water in excess of the natural stream flow at the point of diversion, plus the total storage in Echo and Silver lakes reservoirs, not exceeding 2000 and 5000 acre-feet, respectively, plus inflow into El Dorado Canal through tributaries along its line. Because the rate of delivery during the irrigation season is limited to 40 cu. ft. per sec., the amount actually available is only about 10,000 acre-feet per annum, not counting water received from Webber and Hangtown creeks. Including all of these sources, the quantities available from 1924 to 1927 ranged from 10,350 to 12,230 acre-feet. The present storage capacity of Webber Creek Reservoir is 1450 acre-feet, but the water supply above it comes from only 9.3 square miles, and is not always sufficient to fill the reservoir.

The wholesale rates paid to the power company by the district increase from 7.1 cents per miner's-inch day for the first 150,000 miner's-inch days, up to 10 cents per miner's-inch day, with deliveries of 258,000 to 304,150 miner's-inch days.

The district has received permits 2631 and 2632 from the Division of Water Rights to store water of tributaries of Cosumnes River at the Sly Park site, where a sufficient supply for the district, excepting the high land above Camino, can be obtained. These permits have priority dates of March 22, 1921, and January 15, 1926, respectively. The former calls for the direct diversion of 150 cu. ft. per sec., and storage of 36,000 acre-feet, and the latter for 3580 acre-feet. Plans and cost estimates for using this water have been made and a construction plan was included in a bond issue voted by the district, but construction has not been undertaken due to possible conflicts with lower riparian owners.

Works.—An appraisal of the irrigation system of El Dorado Water Corporation, as of February 1, 1922, showed a depreciated cost of $119,649. The system comprised the main canal, Iowa, Webber, Nigger Hill, Missouri Flat, and Gold Hill ditches, a number of laterals, and Blakely, Placerville, and several small reservoirs, the total capacity of all of the reservoirs being about 240 acre-feet. The Webber Creek development, which was also taken over by the district, consists of a triple-arch concrete dam 90 feet high impounding 1450 acre-feet of water, but designed to be built to a height of 115 feet. To build to this height, however, would necessitate considerable reconstruction. A diversion ditch 5.5 miles long carries water from the resorvoir into Hangtown

Creek through Texas Hill tunnel. The district has purchased for $56,500 about 800 acres of the Sly Park reservoir site in Cosumnes River watershed. The district now operates 63.3 miles of unlined and 0.6 miles of lined canals and laterals, and 3.9 miles of pipe lines ranging from 2 inches to 42 inches in diameter.

The total investment in works, all covered by bonds, was $464,239.18 as of January 1, 1928. The plans proposed for the completion of the system will bring the total investment to an estimated amount of $2,041,532. This will provide the Sly Park storage development, reconstruction of the Webber Creek system, a Placerville water works conduit, reconstruction of laterals, completion of the distribution system, office quarters, etc., and bond interest during construction amounting to $109,952. This completed system is designed to provide for the irrigation of 15,800 acres, with storage up to 26,500 acre-feet.

Use and Delivery of water.—The Placerville area has a mean seasonal rainfall over a 48-year period as measured at Placerville of 43 inches. Due to differences in elevation, the range is from about 30 to over 50 inches. With this rainfall, irrigation requirements are moderate. The deliveries for irrigation in 1927 were 8229 acre-feet, there having been a steady but gradual increase since 1919, when the amount delivered was 4023 acre-feet. Since the irrigated area in 1927 was but 6000 acres, the present use is only about 1.37 acre-feet per acre per year. Water is measured to users over weirs and through miner's-inch orifices. The standard of measurement is the statute miner's inch, equivalent to 1/40 cu. ft. per sec. No fixed unit area is specified in making deliveries.

Bonds.—Bonds in the amount of $1,300,000 were voted February 16, 1927. In addition to these irrigation district bonds, lands within the district are liable for bonds in the estimated amount of $185,000 issued by the city of Placerville, Placerville School District, El Dorado High School District, and El Dorado County.

Assessments and water tolls.—For the purposes of assessment the district assessor has carefully classified all the lands in the district, as follows: class 1, irrigable cleared land, valued at $30 to $155 per acre; class 2, irrigable uncleared land, $30 to $75 per acre; class 3, non-irrigable pasture, $10 to $25 per acre; class 4, waste land, $2 per acre. More than half of the net irrigable area is in classes 1 and 2. The total assessed value within the district in 1927-28 for district purposes was $2,016,129. In the past two years the district assessment rate for each $100 of valuation was $0.80. The total district assessment levied in 1927-28 was $16,129. The larger part of the income is derived from water tolls, these amounting in 1927 to $51,132. The rates inside the district are the same as previously charged by El Dorado Water Corporation, but the rate outside the district has been raised one-third for the season of 1928. This latter rate is applicable to only about 10 inches for 120 days. The following rates have been in effect since July 1, 1924:

Continuous flow for 120 days	$34.00 per miner's inch
Cumulative flow for 120 days	38.00 per miner's inch
Demand rate	0.45 per miner's-inch day
Wholesale rate to city of Placerville	0.24 per miner's-inch day
Dwellings, flat rate	1.25 per month
Private garages, etc., flat rate	0.25 per month
Public garages	5.00 per month
Stores and shops	1.50 per month
Michigan-California Lumber Co.	65.00 per month
Highway Commission	3.00 per day
Watering lawns	0.02 per 100 sq. ft. per month

In addition there is a meter rate with a minimum charge of $1.25 per month, with an allowance of 500 cu. ft., and the following additional charges for use in excess of 500 cu. ft.: 500 to 2000 cu. ft., $0.12 per 100 cu. ft.; all over 2000 cu. ft., $0.06 per 100 cu. ft. Water used within the city of Placerville is purchased wholesale by the municipality, which owns the city distribution system.

CITRUS HEIGHTS

Location: along the Sacramento-Roseville state highway in northern Sacramento County, a small area of 20 acres projecting into Placer County. (Pl. XV.)
Date of organization election: October 13, 1920.
Gross area: 3076 acres; **area assessed 1927:** 3076 acres.
Principal town: none; **nearest town:** Roseville.
Post office: Roseville.
Railroad transportation: main line of Southern Pacific railroad two miles distant at Roseville.

History.—The land in Citrus Heights District was settled as Citrus Heights Colonies and a rudimentary irrigation system constructed in 1910. Water was obtained from North Fork Ditch through the system of American Canyon Water Company. In 1917 American Canyon Water Company was acquired by Fairoaks Irrigation District, which continued to furnish water to Citrus Heights, a water takers' association being organized to control distribution. Citrus Heights users were entitled to receive a continuous flow of 140 miner's inches, but only 120 inches was obtainable. On September 2, 1920, Citrus Heights Water Takers' Association contracted with North Fork Ditch Company to deliver an additional 400 miner's inches contingent upon the organization of Citrus Heights Irrigation District, the water to be paid for at rates established by the State Railroad Commission. This district was accordingly organized by a unanimous affirmative vote of 65. The old irrigation system was abandoned and water is now taken at Penstock Reservoir of North Fork Ditch Company.

Soils and topography.—Soils are classified as San Joaquin and Arnold loams, undifferentiated.* Hardpan is generally 2 to 6 feet below the surface, the latter being rolling. The elevation is 125 to 220 feet. Neither alkali nor drainage is a problem.

Development.—All of the net irrigable area, except about 360 acres, is in plantings of vines and citrus and deciduous orchards and olives. Holdings average about 14 acres, with 5 of 80 acres each. The population is about 600, a number of the residents either working or having business in the nearby town of Roseville. About 150 homes have been built. The eastside state highway from Sacramento north passes through the district, as well as a concrete highway between Sacramento and Folsom.

Water supply.—As previously indicated, water is obtained from North Fork Ditch under contract for delivery of 540 miner's inches, or 10.8 cu. ft. per sec. North Fork Ditch diverts from North Fork of American River under rights said to date back to 1854. The entire supply is delivered by gravity from the Penstock reservoir of the ditch company. The water delivered to the district is recorded with a ven-

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California.

turi meter, but the records have not been computed. The supply available to the district is stated to be adequate.

Works.—Water is conveyed from Penstock reservoir to the district through 4.5 miles of 24-inch steel pipe. Penstock reservoir of North Fork Ditch Company has a storage capacity of 2 acre-feet. Water is distributed through about 19 miles of 4-inch to 18-inch steel lateral pipe lines. The total amount invested in works to December 31, 1927, was $195,235.56, with no depreciation deduction. All but $243 of this amount was obtained from bonds.

Use and delivery of water.—Water is delivered to units of 10 acres, but the amounts delivered are not measured. The distribution system is designed to supply one miner's inch to each 2 acres on lines serving less than 100 acres, and one miner's inch to each five acres on lines serving larger areas. The minimum head under which water is delivered is 20 feet. One 2-inch irrigation tap is allowed on each 10-acre tract. A superintendent, working on an hourly basis, controls distribution and makes new connections and necessary repairs. Water for domestic service is delivered without charge.

Bonds.—Bonds to the amount of $262,000 were authorized July 9, 1921. Bonds to the amount of $210,000 were sold November 17, 1921, and bonds to the amount of $5000 were sold April 19, 1923. Sale of the remaining bonds was not necessary because construction costs fell below cost estimates on account of a decline in unit construction prices after the estimates were made. Bonds to the amount of $10,000 have been paid, leaving $205,000 outstanding on January 1, 1928. Other bond obligations against lands in the district are estimated to total $13,200, of which $7500 are elementary school bonds, $600 are high school bonds, and $5100 are general county bonds.

Assessments and water tolls.—The entire income of the district is obtained from irrigation district assessments, all land being assessed at a flat rate of $100 per acre. The total district assessed valuation for 1927–28 was $307,658 and the amount of the district assessments in that year was $30,765. The district assessment rate per $100 of valuation during the past five years has ranged from $8 to $10, except that in 1925 and 1926 it was made $11.76 and the assessments lowered to give the equivalent of a $10 rate. Water is sold to San Juan High School at $64.65 per miner's inch per year.

FAIROAKS

Location: north of American River, southwest of Folsom, in Sacramento County. (Pl. XV.)
Date of organization election: March 12, 1917.
Gross area: 3900 acres; **area assessed 1927:** 3775 acres.
Principal town: Fairoaks.
Post office: Fairoaks.
Railroad transportation: spur from Placerville branch of Southern Pacific railroad.

History.—Settlement in the Fairoaks area was started shortly after 1894 by the publishers of several farm papers in the middle west. They purchased about 7000 acres of the old San Juan Rancho and laid out Fairoaks colony and townsite. Water was obtained from North Fork Ditch, which was built in 1854-57 for hydraulic mining purposes along American River below Folsom. In 1899 this old ditch became the property of North Fork Ditch Company, which built a concrete dam in North Fork of American River and improved the canal. Water was

served to various colonies through pipe lines leading from a small reservoir at the lower end of the system. Owners of land obtained water through purchase of water-right contracts. Various distribution lines were acquired by individuals, the ditch company furnishing water wholesale. The water service was generally poor, owing largely to numerous breaks in the old pipe lines.

Fairoaks Colony was one of those receiving water in this manner, this service being controlled and operated at the time the district was formed by the O. A. Robertson Water Service. In 1916 a local citizens' committee engaged an engineer to report on the feasibility of forming an irrigation district at Fairoaks. In his report of January 30, 1917, such a step was recommended, and organization was carried about six weeks later by a vote of 184 to 16. Since the O. A. Robertson Water Service was a public utility, the Railroad Commission was requested to make an appraisal of its system supplying Fairoaks District, and in Decision 5163 they fixed the value at $62,500. Including this amount, the report of the engineer called for an expenditure of $193,840, and a bond issue of $200,000 was authorized, of which $160,000 has been sold and the money used in the purchase and reconstruction of the Fairoaks system.

Soils and topography.—The soils are of the San Joaquin and Arnold series.* They are typically red and chocolate in color and are sufficiently sandy to be friable. They are underlaid with hard-pan to depths of from 20 inches to 5 feet. The district lies on a rolling plateau 125 to 150 feet above American River and from 250 to 340 feet above sea level. There is good natural drainage over the entire district.

Development.—More than 80 per cent of the net irrigable area is planted to deciduous and citrus fruits, olives, grapes, and miscellaneous crops. Over 50 per cent of the planted area is in citrus fruits. The assessment for 1927–28 lists 400 separate ownerships and 325 domestic water connections. The average size of individual holdings is 8.5 acres. The non-irrigable area is composed of small scattered tracts, of which some are held for speculation and others are not yet cleared of live oaks. Fairoaks, with a population of 300, is the only town. The population outside of Fairoaks is about 1200. The rolling topography provides fine home sites and many of these are occupied by attractive dwellings. The estimated assessed value of land for county purposes for 1927–28 was $770,800.

Water supply.—As previously indicated, water is obtained from North Fork Ditch Company, which diverts from North Fork of American River. The district pays the company $20 per miner's inch per season. It has established a right by use to receive 735 miner's inches. In 1928 repairs to North Fork Ditch permitted the delivery of 50 miner's inches more than had been received previously.

Prior to 1926, service from the ditch company was not satisfactory, and at that time the district seriously considered installing a pumping plant on American River to provide for emergencies. As conditions improved, however, this plan was abandoned. A considerable amount of work has been done on North Fork Ditch during the last few years

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California.

to prevent seepage and increase its carrying capacity. The compa now has under way plans for the construction of a larger balanci reservoir at the lower end of the system.

No accurate measurements of the water diverted are available. A automatic recording meter has been installed on the main pipe line ne the head of the system, but since the district is billed only for th largest quantity used for any 30 consecutive days, the total annu diversion has not been computed.

Works.—The main district pipe line diverting from North For Ditch ranges in diameter from 20 inches to 28 inches and has a tot length of 5 miles. Lateral distributing pipes are from 2 to 13 inch in diameter and have a total length of 25 miles. The weakest link i the distribution system is the old pipe line which was installed i 1905–06. Considerable repair work has been done in the past, but th entire line will ultimately need replacement, and it is planned to accom plish this gradually by insertion of new sections, to be largely paid fo from annual assessments. The total invested in works to December 3 1927, was $160,000.

Use and delivery of water.—Water is delivered to each 5-acre tra Measurements of deliveries are not made, but each irrigator is suppos to confine his use within 1 miner's inch to 4 acres. Rough checks o use are made during the season to hold it within this figure. Applica tions for water are made to the secretary on forms provided by th district, it being necessary to have these in the office of the secretar by March 1, because the district must make application to North For Ditch Company on or before April 1 of each year. A rotation schedu is established at the beginning of each year. One 2-inch service con nection is allowed to each 5-acre unit, each connection for either irriga tion or domestic being charged for at $20 each.

Bonds.—The $200,000 in bonds previously referred to is the onl issue that has been put out by the district. Of these, $40,000 have no been sold. Bonds retired to January 1, 1928, amounted to $20,00 Additional bonds may be needed to replace the main pipe line fro Penstock Reservoir, but as previously indicated, an attempt will b made to accomplish this by district assessments.

There are portions of three county school districts within the distric boundaries. One of these has outstanding bonds in the amount o $5,000, of which it is estimated $750 is chargeable against lands in th irrigation district. Other outstanding bonds prorated to the distric include $1,400 high school bonds and $11,000 general county bonds making the average bonded indebtedness for general and school pur poses to January 31, 1928, only about $3.50 per acre. An additiona $45,000 of bonds has since been voted for a grammar school.

Assessments and water tolls.—The district obtains income from bot assessments and water tolls. District assessed valuations are at th rate of $200 per acre on town lots, $90 per acre on the best agricultura land, and $45 per acre on gullies and other rough lands. The tota district assessed valuation for 1927–28 was $339,260, and the total levy $16,115. From 1921 to 1925, inclusive, the annual assessment rate fo each $100 valuation was $4.25. For the following year it was $5.25

and for the current year it is $4.75. The annual tolls for the past five years have been $2 to $3 per acre on nonirrigated land, being $2.50 in 1927–28. From 1921 to 1925 the toll on irrigated land was $6 per acre, for 1926–27 it was $4.75 per acre, and for 1927–28 $5 per acre. The water tolls collected for 1927–28 amounted to $21,822. Until 1925–26 domestic water was charged for at $12 per year per connection, but since then the charge has been $18 per connection.

CARMICHAEL

Location: north and west of American River about 12 miles from Sacramento, in Sacramento County. (Pl. XV.)
Date of organization election: January 25, 1916.
Gross area: 3121 acres; **area assessed 1927:** 3121 acres.
Principal town: none.
Post office: Route 5, Sacramento.
Railroad transportation: main line Southern Pacific railroad 6 miles northwest.

History.—The area in this district was formerly part of the San Juan grant. D. W. Carmichael purchased the land and subdivided into Carmichael colonies 1 of 2046 acres and 2 of 1067 acres, also constructing a rudimentary irrigation system of wood and steel pipe in 1909. The system was connected to that of American Canyon Water Company, which also served Fairoaks and Citrus Heights and additions, the water used being purchased from North Fork Ditch Company, which diverts from North Fork of American River east of Auburn. The land in the colonies was placed on sale in 10-acre tracts and after about 600 acres had been sold and planted to orchards, the irrigation system failed to supply the required water. Furthermore, the full amount needed could not be obtained from American Canyon Water Company because of the demands of Fairoaks Colony and other consumers. Facing the necessity of either obtaining an adequate supply elsewhere or ceasing further development, the landowners decided to form an irrigation district to purchase the existing irrigation system and construct necessary additional works. Organization of the district was carried by a vote of 45 to 3.

After considering three alternative plans of water development, the district decided to pump its main supply from American River, adjacent to the district, but to retain a small continuous gravity flow from American Water Company, successor of American Canyon Water Company, for domestic use. After two separate hearings the Railroad Commission, in decisions 3265 and 3260, authorized the sale to the district of the irrigation systems in Carmichael colonies 1 and 2, the former for $7,500 and the latter for $14,200. The estimated further necessary expenditures were $37,835 for reconstructing and extending the existing distribution systems, $15,000 for pumping station and equipment, and $4,700 for engineering. A bond issue of $90,000 to cover these and other necessary expenditures was authorized and in 1917, despite increased costs of labor and materials, the system as contemplated at the time the bond issue was voted was completed. It was, however, necessary to substitute wood pipe for steel to keep within estimates.

During the period 1921 to 1926 further capital expenditures were made. These covered three transformers and a third unit in the pumping plant, the two items totalling $13,898 and being paid out of funds

collected by district assessments; also extensions and replacements in the distribution system and new electrical equipment, covered by a second bond issue of $30,000.

Soils and topography.—The land in the district is gently rolling, the location being on the bluff above American River. The soils are heavy loams and clay loams underlain by hard-pan from 2 to 10 feet below the surface. The general soil classification is San Joaquin and Arnold loams, undifferentiated.* The elevation is 60 to 160 feet. Numerous ravines provide ample general drainage. About 100 acres is on the old flood plain of American River.

Development.—About 2000 acres is planted to orchards and vineyards. Because of nearness to Sacramento, residential development is gradually displacing agriculture, the subdivisional tendency being toward 1-acre and 2-acre tracts. In 1927 there were 250 holdings, averaging 11 acres, the three largest being 183, 80, and 70 acres. The assessed value of lands for county purposes in 1927–28 was about $250,000.

Water supply.—The district holds permit 67 for 15 cu. ft. per sec., with priority of September 28, 1915, and permit 2498 for 10 cu. ft. per sec., with priority of August 22, 1925. Water obtained under these permits is all pumped from American River. The amount of water purchased from North Fork Ditch amounts to 25 miners inches (0.5 cu. ft. per sec.). It is carried to the district by Fairoaks Irrigation District, which is paid an annual carrying charge. This water is used for domestic purposes when the irrigation pumps are shut down in the winter. The records of the Sacramento-San Joaquin water supervisor show diversions during the past three years as follows: 1925, 1577 acre-feet; 1926, 2217 acre-feet; 1927, 3297 acre-feet.

Works.—The district pumping plant, which is housed in a concrete structure, comprises three vertical centrifugal pumps directly connected to induction motors. The pumps are about 8 feet above low water in American River and draw from the river through a steel suction line 80 feet long. Because of the great seasonal variation in the river level, the shafts between the motors and pumps are about 32 feet long. One of the pumps is of 12-inch diameter and is rated at 10 cu. ft. per sec. at a head of 170 feet; the second is 8 inches and is rated at 4 cu. ft. per sec. at a head of 165 feet; the third is 6 inches and is rated at 2.4 cu. ft. per sec. at a head of 165 feet. The pumps discharge into a 20-inch redwood stave pipe, with an additional 8-inch steel discharge line to increase pressure in the northeastern section of the district. About 25 miles of wood and steel distribution pipe 4 inches to 20 inches in diameter carries water to the individual tracts. The total investment in works to December 31, 1927, was $128,554.

Use and delivery of water.—No measurements of deliveries are made by the district. A 2-inch tap is allowed for each 5 acres and water is served on demand. Rotation is provided for if necessary, but has not yet been used.

Bonds.—The first issue of bonds amounted to $90,000 and the second issue to $30,000. Elementary and high school bonds amount to about $15,700, and general county bonds to about $6,700.

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California.

Assessments and water tolls.—The district values land for assessment purposes at a flat rate of $80 per acre, the total district assessed valuation in 1927–28 being $248,662. The district assessment rate during the past five years for each $100 of valuation has been: 1923–24, $6.875; 1924–25, $8.75; 1925–26, $11; 1926–27, $8; 1927–28, $7. The total district levy in 1927–28 was $17,475. Water tolls are charged at the rate of $2.50 per acre per year, the total tolls charged in 1928 being $4,515.

WOODBRIDGE

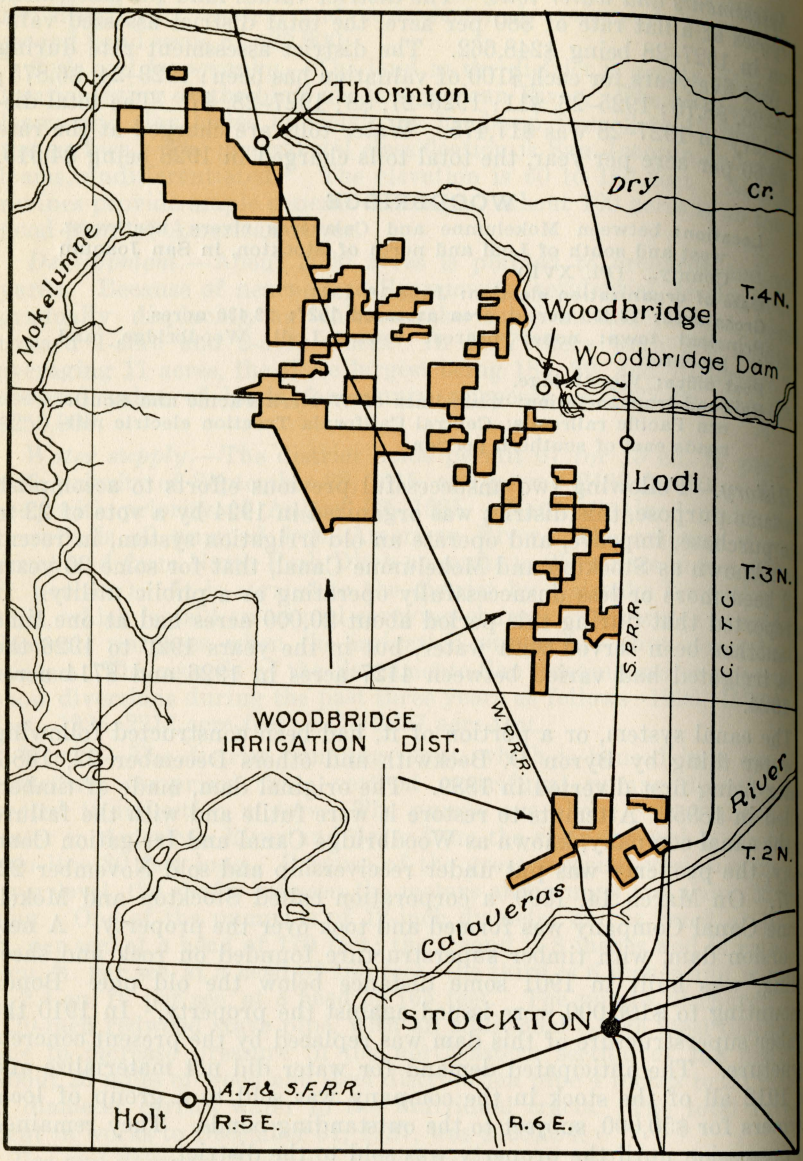
Location: between Mokelumne and Calaveras rivers, northwest, west and south of Lodi and north of Stockton, in San Joaquin County.. (Pl. XVI.)
Date of organization election: June 16, 1924.
Gross area: 13,430 acres; **area assessed 1927:** 13,430 acres.
Principal town: none; nearest towns: Lodi, Woodbridge, and Stockton.
Post office: Woodbridge.
Railroad transportation: main lines of Western Pacific and Southern Pacific railroads; Central California Traction electric railroads east of southern portion.

History.—Following two unsuccessful previous efforts to accomplish the same purpose, this district was organized in 1924 by a vote of 23 to 6 to purchase, improve, and operate an old irrigation system, in recent years known as Stockton and Mokelumne Canal, that for some 30 years had been more or less unsuccessfully operating as a public utility. It is reported that during this period about 20,000 acres had at one time or another been served with water, but in the years 1920 to 1926 the area irrigated had varied between 4127 acres in 1926 and 8714 acres in 1924.

The canal system, or a portion of it, had been constructed following a water filing by Byron D. Beckwith and others December 22, 1886, water being first diverted in 1889. The original dam, made of timber, failed in 1895. Attempts to restore it were futile and with the failure of the canal company, known as Woodbridge Canal and Irrigation Company, the property was put under receivership and sold November 22, 1897. On March 14, 1899, a corporation called Stockton and Mokelumne Canal Company was formed and took over the property. A new diversion dam, with timber superstructure founded on rock and sheet piling, was built in 1901 some distance below the old one. Bonds amounting to $106,000 were issued against the property. In 1910 the timber superstructure of this dam was replaced by the present concrete structure. The anticipated demand for water did not materialize and in 1912 all of the stock in the company was sold to a group of local farmers for $50,000, subject to the outstanding bonds. They remained in possession until the property was sold to the district.

After two attempts at district organization had failed, the present district was formed in 1924. Activities on Mokelumne River by East Bay Municipal Utility District and others, and failure of the district and the company to agree on a price, caused delay, and in April, 1926, the company filed with the Railroad Commission application 12,764 asking either to be relieved of its public utility status or to be granted an increase in rates.

PLATE XVI



Location and boundary map of Woodbridge Irrigation District, San Joaquin County.

By the following year conditions for consummation of the sale to the district were more favorable and by agreement made June 13, 1927, the company bound itself to sell and the district to purchase the system for $250,000, subject to approval by the Railroad Commission, and approval by electors of the district of a bond issue of at least that amount. Approval was given by the Railroad Commission in decision 19,242, dated January 11, 1928, subject to certain conditions which were later met and bonds in the amount of $325,000 were authorized by the electors February 4, 1928. The price finally paid by the district for the system

was $246,404, the stockholders assuming half of the discount on the first $290,000 of district bonds sold. Transfer of the property was effected in April, 1928.

Soils and topography.—The district is composed of a number of non-contiguous parcels and lies generally below the 40-foot contour. It extends in the northwestern section to levels naturally reached by tide water, where about 1000 acres has been included within Reclamation District 348. As computed from the soil survey, 40 per cent of the land is Hanford fine sandy loam, 28 per cent Fresno loam, 16 per cent Sacramento clay, 10 per cent Stockton clay adobe, 4 per cent Stockton clay loam, and 2 per cent Columbia silt.* The slope is toward the west at about 5 feet per mile. The surface is generally smooth and easily irrigated. Ground water levels, which are reported not to be rising, range from 5 to 10 feet below the surface in the northern area, 8 to 12 feet in the central area, and 15 to 20 feet in the southern area. Private pumping plants have served to prevent drainage troubles. About 500 acres is affected by alkali.

Development.—Practically all land in the district has been cultivated for many years. When appraised by the bond certification commission, as of 1927, 395 acres was in deciduous fruits and nuts, 2809 acres in grapes, 1290 acres in alfalfa, 6854 acres in grain and annuals, and 1767 acres in pasture. Land and plantings were given a value of $2,161,340. The assessed value of land for county purposes was reported by the engineer of the district as being $998,750. Four large ownerships contain 1500, 1200, 700 and 600 acres, respectively. There are 123 holdings averaging about 100 acres. Practically all owners are residents. There are no towns in the district. The population is about 200.

Water supply.—The water rights of Woodbridge District have not been completely defined. The original filing relied on was made December 22, 1886, and was for 150,000 inches. Records of past diversions and acreages irrigated are fragmentary for the earlier years and incomplete for the later years. The most reliable record of diversions is that for 1926, when about 30,000 acre-feet was taken out, but that was a year of light run-off.

The district gives the capacity of the main canal as 300 cu. ft. per sec. In the past, however, the discharge of Mokelumne River has not been regulated and the summer flow has at times been low, although those who have been operating the district for the past few years state that they have always been able to supply demands. At present East Bay Municipal Utility District is constructing Pardee Dam, which will impound about 200,000 acre-feet, and Pacific Gas and Electric Company is constructing Salt Springs Dam, which will impound 128,000 acre-feet. Both of these developments will change the flow of the river at the intake of Mokelumne Canal at Woodbridge. The district has made a preliminary filing with the Division of Water Rights for 300 cu. ft. per sec. of the water to be released for power generation from storage. The predecessors of Woodbridge District had obtained from certain riparian owners below Woodbridge relinquishment of their riparian rights, and the district succeeded to these.

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Sacramento Valley, California; also, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California.

Considering all aspects of the water-right situation on Mokelumne River, the bond certification commission found that the water right of the district is secure, although it seems clear that the final establishment of that right must be a matter of definition and adjustment between the various appropriators and riparian owners.

Works.—The concrete dam below the head of Main Canal at Woodbridge raises the water to an elevation of 41 feet, U. S. G. S. datum. Flashboards placed on the inclined upstream face of the structure back up the water over two miles, creating a lake, from the south bank of which water is diverted into the main canal by a headgate about 0.25 mile above the dam. The main canal extends westerly about 0.75 mile and then divides into three branches, one extending southeasterly about 12 miles to Calaveras River near Stockton, one due west 5 miles to tide water, and one northwesterly 13 miles to the vicinity of Thornton. These canals, totaling about 70 miles in length, were all purchased from Stockton and Mokelumne Canal Company. With the expenditure of about $16,000 the system can be made to serve the entire district, the work of doing this having already been started. The main laterals of the canal system could, in fact, serve about 35,000 acres, but the owners of much of this area are now relying on pumping from wells.

The properties taken over from the old canal company were appraised by the district at $223,714, exclusive of water rights, and the district estimated that desired repairs and extensions, including lateral extensions to get water to the entire district, would cost $75,000. Most of the structures taken over, with the exception of the dam and headgate at Woodbridge, are of timber, but these are to be gradually replaced by concrete structures.

Use and delivery of water.—The district began operating the canal system in April, 1928, and during 1928 has generally followed the former methods of water distribution, although betterments already made have permitted improvements in the service. Stockton and Mokelumne Canal Company, being a public utility, was required to deliver water on demand at rates approved by the Railroad Commission. During the years 1921 to 1926 the rates charged per acre per annum were as follows: alfalfa, $4; vines, trees, gardens, and beets, $3; grain and corn, $2.50; pasture, $1. The district established the same rates for 1928 for land in the district, with an increase of $0.50 per acre for outside lands.

Bonds.—An issue of $325,000 in bonds has been voted and $290,000 sold. These will mature from 1930 to 1954 in installments varying from $5,000 to $20,000. Other bonds against lands in the district total about $64,000, of which $41,000 is the estimated total of elementary and high school bonds.

Assessments and water tolls.—Lands are valued for purpose of district assessment at about 50 per cent of cash value. This gives valuations varying, generally by differences of $10 per acre, from $25 to $150 per acre. About 46 per cent of the total is given a value for district purposes of $100 to $150 per acre, about 36 per cent of $50 to $100, and about 18 per cent of $25 to $50. The total district assessed valuation for 1927–28 was $1,186,123. During 1925–26 and 1927–28 the district assessment rate per $100 of valuation was $0.70 and $0.80, respectively; in 1928–29 it is $2, of which $1.70 is for bond interest. No assessment was levied in 1926. The total amount of the levy for 1927–28 was $9,488. After 1929 the district will have to raise by assessment an average of about $24,000 annually to meet bond maturities and interest.

EAST CONTRA COSTA

Location: west side of San Joaquin Valley, in eastern Contra Costa County. (Pl. XVII.)
Date of organization election: August 16, 1926.
Gross area: 20,200 acres; **area assessed 1927:** 19,999 acres.
Principal towns: Brentwood and Knightsen.
Post office: Brentwood.
Railroad transportation: main lines Southern Pacific and Santa Fe railroads.

History.—This is a consolidation of Brentwood Irrigation District, containing 7904 acres, formed in 1923, Knightsen Irrigation District of 10,001 acres, formed in 1920, and Lone Tree Irrigation District of 2095 acres, formed in 1920.

About 1912 and 1913 the Balfour, Guthrie Company laid out an irrigation system capable of irrigating 22,000 acres near Brentwood and constructed sufficient of it to cover some 8000 acres. A subsidiary mutual water company, known as East Contra Costa Irrigation Company, was formed and on May 7, 1914, an agreement entered into under which the irrigation company would pay to Balfour, Guthrie Company $429,475.55 for the system as constructed to December 31, 1913. Balfour, Guthrie Company was to subscribe for not more than 9000 shares of the 20,000 shares of the stock of the water company at $30 per share. By January 15, 1919, 7075 of these shares had been purchased, Balfour, Guthrie Company meantime carrying the operating deficit and the cost of the extension of the laterals, and taking credit on the books of the irrigation company for these expenditures. Balfour, Guthrie Company sold land, to which was attached one share in the irrigation company for each acre sold.

In the meantime, irrigation development had been undertaken or contemplated for the areas surrounding the Balfour, Guthrie holding. The lands to the south first organized a cooperative irrigation company, which, for the purposes of condemnation of rights of way, was later changed to a public utility. Lands on the east in 1920 organized Knightsen Irrigation District and at first proposed to develop an independent water supply. The lands to the north in the same year organized Lone Tree Irrigation District.

It was obvious that the original Balfour, Guthrie system could also be made to serve the lands in Knightsen and Lone Tree districts, and a general understanding to that end was finally reached. After Knightsen and Lone Tree districts purchased one share of stock for each acre of land within their boundaries, amounting to 10,001 and 2095 acres, respectively, the area west of Brentwood, comprising 7904 acres, in 1923 was organized as Brentwood Irrigation District. Then, following several years of negotiations with reference to the adjustment of indebtedness, the three districts were consolidated into East Contra Costa Irrigation District under a special act approved June 1, 1921, and amended in 1925, relating to consolidation and cooperation of irrigation districts.*

Although uncertain when organized as to which of three possible sources of water would be developed, Knightsen Irrigation District had, on August 29, 1921, acquired 10,001 shares of East Contra Costa Irri-

* Statutes of 1921, 1018, and Statutes of 1925, 802.

gation Company at $35 per share, paying for these in bonds. It then sold the remaining $300,000 of a bond issue of $650,000 and built a distribution system.

Lone Tree Irrigation District arranged to purchase 2095 shares in East Contra Costa Irrigation Company at $35 per share and pay for them in bonds of the district at par. With the balance of a bond issue of $160,000 voted February 1, 1922, it also constructed a distribution system. Bonds of Lone Tree Irrigation District to the amount of $23,000 remaining unsold were ordered cancelled at an election of May 19, 1925. After Lone Tree and Knightsen districts completed the purchases of stock, Balfour, Guthrie Company closed its account with East Contra Costa Irrigation Company by writing off charges amounting to $526,168.74, including $254,390.48 in interest which had accrued under the agreement entered into May 7, 1914, which had remained in force.

Finally, to complete the consolidation, Brentwood Irrigation District purchased the remaining stock in East Contra Costa Irrigation Company, most of which was owned by Balfour, Guthrie Company, at $65 per share, a bond issue of $514,000 having been voted December 18, 1923, and turned over to Balfour, Guthrie Company March 10, 1924, at par. A consolidation election September 3, 1926, was carried by a vote of 253 to 31, the negative votes all having been cast in Knightsen District.

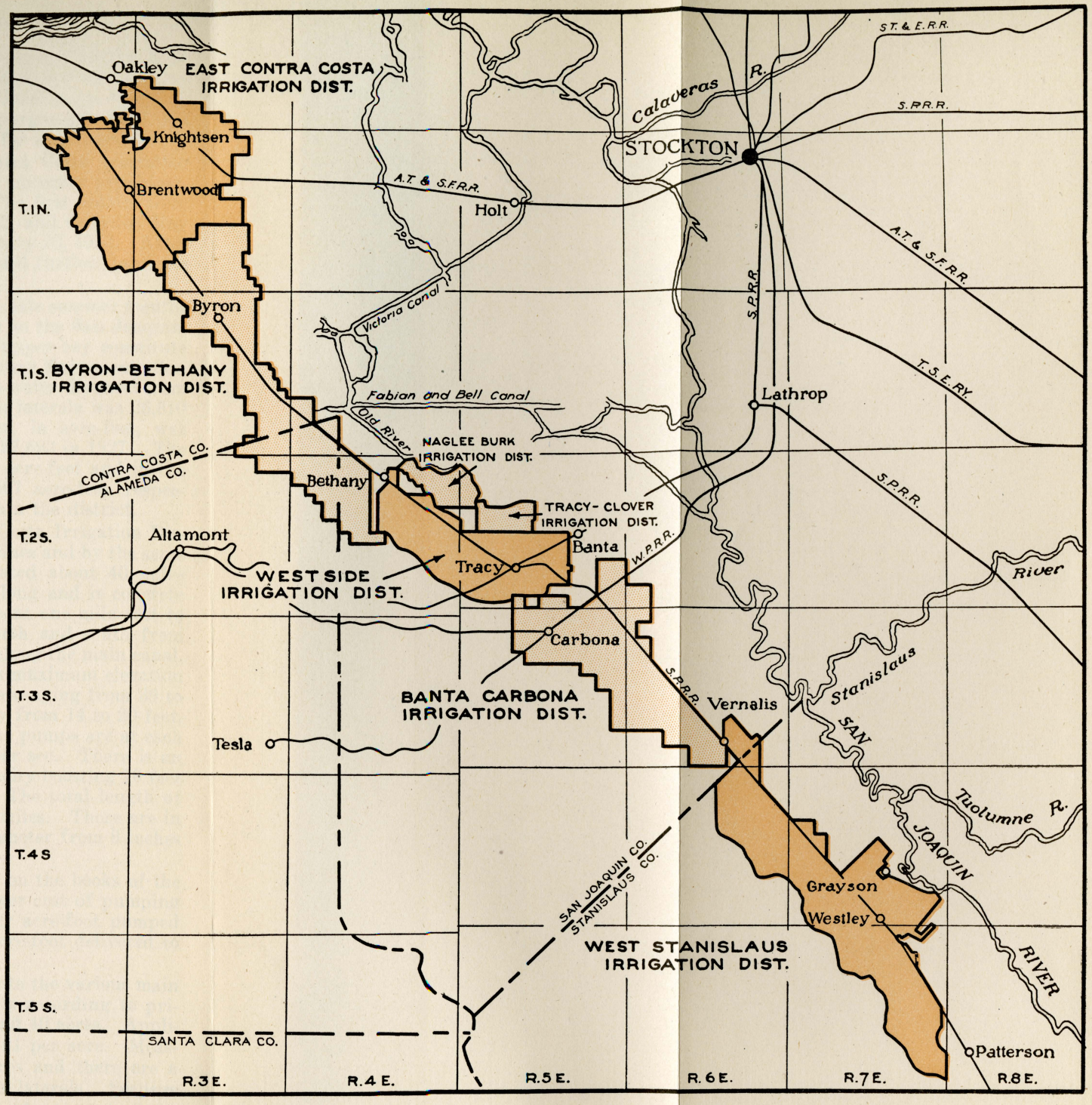
The financial basis of consolidation as of September 1, 1926, showed the following assets: Brentwood Irrigation District, $526,167.84; Knightsen Irrigation District, $693,554.40; Lone Tree Irrigation District, $136,649.31; East Contra Costa Irrigation Company, $688,380.41; eliminations, chiefly capital stock, $665,717.20; total, $1,379,034.76. Against these assets were oustanding bonds in the amount of $1,301,000, notes payable amounting to $6,095, bond interest accrued amounting to $1,232, reserve for depreciation amounting to $1,523.58, and a surplus of $69,184.18.

Soils and topography.—As classified in the soil survey, the soils are predominatingly Yolo clay loams, with scattered areas of Oakley sands in the Knightsen area, also areas of Yolo and Diablo adobes.* The soils are free of hardpan and generally deep and fertile. The elevation is from 0 to 150 feet and the land is flat to rolling. Ground water is 30 to 40 feet from the surface in the higher lands and in 1927 was within 5 feet of the surface southeast of Knightsen.

Development.—All land in East Contra Costa Irrigation District was under cultivation before the three original districts were formed. The land in Brentwood and Lone Tree districts was mainly in dry-farmed grain, that in Knightsen District largely in orchards, especially almonds. When the consolidation was effected in 1926, the area irrigated in the three districts was 15,094 acres, of which 5648 acres was in alfalfa, 2722 acres in truck crops, and 6127 acres in deciduous fruits and nuts. In 1927 the total irrigated area reported was 13,834 acres. Some of the orchard land was not irrigated.

There are 326 owners of farm property, the holdings averaging 62 acres. Eliminating 3 large holdings of 3226, 935 and 470 acres, the average holding is about 48 acres. The population of Brentwood is 400

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California.



Location and boundary map of irrigation districts on west side of lower San Joaquin Valley.

and that of Knightsen 100, with an additional population of 700 outside of these two towns. The main highway passes through the district, Oakley being about 50 miles distant by Tunnel Road from Oakland. The total valuation of land for city and county purposes in 1927 was estimated to be $2,000,000, of which $500,000 was for improvements.

Water supply.—The water rights of East Contra Costa Irrigation District are based on appropriations under the old statutory provisions, the amount claimed being 200 cu. ft. per sec. The first notices were posted for Balfour, Guthrie Company May 9, 1912, and recorded May 15, 1912. Later duplicate notices were posted January 23, 1913. After East Contra Costa Irrigation Company was organized further duplicate filings, three in number, were posted May 15, 1914.

Thus far the supply from Old River, which in the late summer months has largely been return water from irrigated areas on the San Joaquin, has been sufficient. Salinity intrusions from the upper bay constitute a potential hazard along with other lands in the lower Sacramento-San Joaquin delta. Continuous records are kept of the water diverted from the river. In 1927 the amount pumped into main laterals was 26,810 acre-feet. The amount diverted from Old River, in acre-feet, was 21,709 in 1924, 17,613 in 1925, 25,848 in 1926, and 27,693 in 1927. The amount delivered to the land in 1927 was 14,982 acre-feet and in the three previous years was 14,007, 10,814 and 15,567 acre-feet, respectively. There are no private pumping plants within the district.

Works.—The irrigation system of East Contra Costa Irrigation District was designed and constructed along the same lines and by the same engineers as the Patterson irrigation system, located about 40 miles to the south. The main canal is about 5.5 miles long and is concrete lined, the intake being a dredger cut extending about one mile east to Indian Slough, the various laterals extending north and south from the main canal. There are seven pumping plants along the main canal, lifting water from sea level in successive stages to a maximum elevation of 145 feet. These pumping plants have capacities ranging from 39 to 117 cu. ft. per sec., and the lifts of the first six vary from 14 to 20 feet, that of the highest plant being 45 feet. One to four pumps are at each plant, with unit capacities from 13 to 39 cu. ft. per sec. There is an additional pumping plant of 13 cu. ft. per sec. capacity boosting 10 feet from lateral No. 4 into the Knightsen pipe line. The total length of unlined canals is 145 miles and of lined canals, 26 miles. There are in addition 4 miles of lateral pipe lines ranging in diameter from 8 inches to 30 inches.

The total capital investment in works as carried on the books of the district January 1, 1928, was $1,285,031. The power cost of pumping in 1927 was $43,257, or an average power cost per acre-foot pumped from the river of $1.56, and an average cost per acre-foot delivered to the land of $2.88.

Use and delivery of water.—Water is delivered into the various main canals on a rotation basis, and service on laterals is according to priority of applications, delivery units being 10, 20, and 40 acres. Applications for water are accompanied by a deposit of $1 per acre. Measurements are made by weirs and submerged orifices and there are a number of venturi meters measuring deliveries to laterals. Seepage losses in the canals are heavy, amounting to about 44 per cent of the

amount delivered into the main laterals in 1927, and ranging from 9.7 to 52.5 per cent in the different main laterals. The lining of additional canals or substitution of pipes to lessen seepage is under way. The district has computed from the pumping records the quantity of water used per acre in 1927 for each crop. A tabulation of their results, showing an average application of 1.08 acre-feet per acre, is given in the summary below:

Crops	*Acre-feet*	*Acres irrigated*	*Average acre-foot per acre*
Alfalfa	6,123.7	4,125	1.48
Trees	4,155.3	4,652	.89
Vegetables	3,269.2	3,224	1.01
Trees and vegetables	708.9	870	.81
Vines	400.1	589	.67
Trees and vines	294.3	349	.84
Grain	31.2	25	1.24
	14,982.7	13,834	1.08

The water toll of $4 per acre-foot encourages economy of application.

Bonds.—Bonds outstanding after retirement of January 1, 1928, total $1,288,000, of which $637,000 are against lands in the original Knightsen District, $514,000 against lands in the original Brentwood District, and $137,000 against lands in the original Lone Tree District. The total of all bonds authorized by the three districts is $1,324,000. The first series of Knightsen District bonds, amounting to $13,000, have been retired, in addition to the $23,000 of Lone Tree bonds canceled in 1925. Other bonded indebtedness against lands in the district is estimated to total $118,250, divided as follows: elementary school bonds, $40,550; union high school bonds, $5,600; county bonds, $42,100; bonds of Water District No. 1, $20,000.

Assessments and water tolls.—For assessment purposes the three original irrigation districts are treated separately, although in 1927–28 the assessed valuations were the same, the valuation in each being $190 per acre on good farm land and $160 to $175 on land with rough topography. The total assessed valuation in 1927–28 was $3,615,344. The assessment rate per $100 of valuation in 1926–27 varied from $3.73 in the Brentwood area to $5.23 in the Lone Tree area. In 1927–28 the rate was uniform throughout, being $2.60 for bond interest and retirement and $1.40 for general fund, a total of $4. The total levy in 1927–28 was $145,508. Water tolls within the district in 1927 were $4 per acre-foot, all water used being charged for at that rate. Total water tolls collected in 1927 amounted to $59,934.

BYRON-BETHANY

Location: west side of San Joaquin Valley, between San Joaquin River and the hills on the west, in Contra Costa, San Joaquin, and Alameda counties. (Pl. XVII.)
Date of organization election: December 22, 1919.
Gross area: 17,200 acres; **area assessed 1927:** 17,200 acres.
Principal town: Byron.
Post office: Byron.
Railroad transportation: main line of Southern Pacific railroad.

History.—Surveys were started to outline an irrigation project for the land in the neighborhood of Tracy, Byron, and Bethany about 1913, but were not completed. About 1914 a local committee considered the promotion of a project to cover a large area and divert water near the

site of the old river landing known as San Joaquin City. By the following year, the landowners around Byron and Bethany had decided to work independently of the areas around Tracy and to the south, and proceeded to organize a cooperative irrigation company. Prior to the organization of this company a local surveyor had estimated the cost of the system at $5 per acre, but when reviewed by the county surveyor his estimate was increased to $5.88 per acre. Stock in the water company was sold at $10 per acre and money was borrowed from various banks.

Construction was started and a pumping plant erected and part of the canal built by the beginning of the irrigation season of 1917. The proposed source of water was a dredged cut leading to a slough near the junction of San Joaquin, Contra Costa, and Alameda counties. No right of access to the slough had, however, been obtained, and the owners refused to grant one. This was during the war period, and an effort was made through the State Council of Defense to have this right of way granted, but without success. Thereupon the company obtained from the Railroad Commission a certificate of public convenience and necessity, and with this it was able to proceed by condemnation to acquire the needed right of way, their action having been brought in June, 1918. By this time the company had expanded or incurred debts amounting to $115,630 and were confronted with additional estimated expenditures of $194,330. Shares in the company had been sold to the number of 6288 at $10 per share. By September 1, 1919, the expenditures had totalled $203,707.62, or at a rate per acre about five times the estimate on which the cooperative company had organized several years earlier. The company then had notes payable to the amount of $57,000, and accounts payable, less current assets, to the amount of $12,051. Water had been made available to about 8000 acres, or only approximately half of the area in which the company was interested.

With the conditions previously outlined facing them, the landowners finally reached the conclusion that the only feasible method of procedure was through an irrigation district, and this they proceeded to organize by a vote of 173 to 14. An engineer was employed to make a thorough study and cost estimate, and after revision by the assistant state engineer this called for a total expenditure of $632,370. This included $265,000 for the assets of Byron-Bethany Irrigation Company, which had been appraised at $357,067, and $358,095 for new works. The original estimate made by the district engineer calling for $550,000 was approved by the Irrigation Bond Commission and bonds to that amount were voted. Later an additional $100,000 bond issue had to be sold and a further amount of about $130,000 for construction raised from district taxes. Finally, on August 2, 1927, a special assessment of about $37,000, to be used chiefly for concrete canal lining and replacement of some canals with concrete pipe, was passed by a narrow margin of 73 to 70.

The district took over the works of the Byron-Bethany Company on March 5, 1921, at a total price, including interest and reimbursement of expenditures since January 1, 1920, of $302,392. Since that date the district has been on an operating basis.

Soils and topography.—The prevailing soil classifications are Yolo clay loam and adobe and Antioch clay loam and clay.* North of Byron

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California.

elevations vary from a few feet to 75 feet above sea level. In this portion the surface is generally smooth, with sufficient slope to aid irrigation. The southwest is more rough, with over 2000 acres above the district canals. From 2000 to 3000 acres along the rim of the old flood plain of San Joaquin River shows alkali. East of the concrete highway north of Byron the water table is within a few feet of the surface, but west of the highway it is 10 to 25 feet below the surface, and 10 to 40 feet below the surface south of Byron. Drainage wells are being used north of Byron to reduce the ground water level. Thus far the adobe soil south of Byron has not produced sufficiently to make irrigation attractive.

Development.—There are now about 250 farm holdings, averaging 46 acres. Three large holdings have 736, 745, and 810 acres. The population of Byron is about 300 and of the remainder of the district about 700. A concrete highway passing through the district connects with San Francisco and Oakland by way of either Martinez, Walnut Creek, or Livermore.

Water supply.—The water rights of the district are based on a notice of appropriation filed in the name of Byron-Bethany Irrigation Association on May 18, 1914, for 40,000 miner's inches, and on subsequent use. Construction was started in 1915 and some water was used in 1917. Diversion is from San Joaquin River at the junction of Indian Slough and Old River. The entire supply is pumped. Records kept by the Sacramento-San Joaquin water supervisor show diversions in acre-feet during the past four years as follows: 1924, 21,749; 1925, 14,187; 1926, 20,576; 1927, 16,237. The largest diversion thus far has been that of 1924.

Salinity from upper San Francisco Bay has been looked upon as a potential hazard in the general region of diversion by the district, but thus far there has been no apparent damage from this source to lands in this district.

Works.—The irrigation system of Byron-Bethany Irrigation District is somewhat similar to the systems of East Contra Costa, Westside, Banta-Carbona, and West Stanislaus districts, which, with Byron-Bethany Irrigation District, irrigate the west-side area from Patterson north through Brentwood. It consists of successive pump lifts from San Joaquin River, with distribution canals reaching north and south. Because Byron-Bethany District is more rolling than the others to the north and south, the pumping lifts are scattered along the north and south main canals and laterals, rather than along a main canal running westerly through the center of the district.

There are five pumping plants with capacities ranging from 125 down to 10 cu. ft. per sec. A dredged cut about one mile long conveys water from Indian Slough to pumping plant No. 1, which discharges through 1100 feet of 60-inch concrete pipe into the main distributing canal, the lift being 45 feet. The water flows for about one-half mile through a lined canal to the point where Byron Canal turns north and Bethany Canal turns south, the areas under these two canals being nearly equal. Most of the land supplied through Byron Canal is irrigated without further lift. At pump 4, north of Byron, however, 25 cu. ft. per sec. is lifted an additional 55 feet into a highline canal, which runs near the northern boundary of the district; also, booster pump 5 lifts 10 cu. ft. per sec. against a head of 75 feet to supply a

small area above pumping station 4. After leaving Byron Canal, Bethany Canal flows south about one mile to pumping station 2, which, with a capacity of 75 cu. ft. per sec., lifts water 30 feet into the canal which supplies the southeastern areas. A branch from this latter canal leading to pumping station 3 serves the higher southern land. Pumping station 3 boosts water by means of two 14-inch pumps to the 160-foot level and by means of a 22-inch pump to the 126-foot level. Very little land is irrigated under the higher lift. The maximum lift in the district is 175 feet.

Altogether the district operates 4.5 miles of canals, of which 3.5 miles are lined; 0.5 mile of main pipe line 30 inches to 40 inches in diameter, and 0.5 mile of 30-inch concrete lateral pipe. Many of the original canal structures were of wood, but concrete replacements are being made as funds are available. In addition to the irrigation works the district operates for drainage purposes three well turbines with rated capacities of 800 g.p.m. each, but the drainage water pumped is not used for irrigation. To further assist in controlling ground water, about one-half mile of canal is being replaced with concrete pipe to decrease seepage. While additional expenditures must be made for drainage in the near future, it is believed by the district that the water table can be controlled with comparative ease by means of well pumps and the lining of certain canals in which seepage is excessive.

The total amount invested in works to December 31, 1927, was $741,569.46, from which $97,231.79 has been written off for depreciation, leaving a net present worth of $644,337.67. Besides the system of Byron-Bethany Irrigation Company, the district purchased for $24,500 the town water supply system of Byron.

Use and delivery of water.—The district undertakes to deliver water to each 160-acre tract, and deliveries are either measured over weirs, through orifices, or are estimated by the ditchtenders. Records of deliveries have not been tabulated, but the quantities delivered have been estimated from water tolls charged as follows for the past four years: 1924, 15,300 acre-feet; 1925, 9570 acre-feet; 1926, 11,120 acre-feet; 1927, 9470 acre-feet. For purposes of operation the district is divided into Byron and Bethany divisions, each of which is in charge of a water master reporting to the general manager. The rules provide that water shall be delivered to irrigators only through measuring devices approved and installed by the district. Water users are required to file applications for water not less than 48 hours prior to the time it is desired, these applications to be made on blanks furnished by the district, and to be accompanied by an advance payment of 50 cents per acre. Deliveries are made in rotation from each lateral, beginning at the diversion point, except as agreed otherwise by the users. The district undertakes to make water available during the irrigation season every 15 days, provided a sufficient number of irrigators apply for water to justify the run.

Bonds.—The district has authorized bond issues of $550,000 and $100,000. On January 1, 1928, $25,000 had been retired. Other bonds against the district total $30,100, divided as follows: elementary school, $2,600; high school, $3,000; Contra Costa County, $20,000; San Joaquin County, $2,000; Alameda County, $2,500.

Assessments and water tolls.—Income is derived from both district assessments and water tolls. About 4000 acres of the best land north of Byron is assessed for district purposes at $200 per acre and the good land south of Byron at $130 per acre. Lands of somewhat poorer grade are assessed at $75 to $100 per acre and alkali 'rim' lands at $10 to $50 per acre. Lands above the canals, totaling 2766 acres, are assessed at $1 per acre. The total district valuation for 1927–28 was $1,720,644 and the amount of the levy for that year was $70,546. The assessment rate per $100 valuation for the past five years has ranged from $3.20 to $4.40. Water tolls are charged at the rate of $3.50 per acre-foot, the amount of the tolls collected in 1927 having been $33,145.

WEST SIDE

Location: west side of San Joaquin Valley surrounding Tracy, in San Joaquin County. (Pl. XVII.)
Date of organization election: October 25, 1915.
Gross area: 11,828 acres; **area assessed 1927:** 11,828 acres.
Principal town: Tracy.
Post office: Tracy.
Railroad transportation: Southern Pacific railroad, with main line of Western Pacific railroad nearby.

History.—The first recent movement to supply irrigation water for the lands around Tracy was made about 1913 when surveys were started at the instance of local merchants and landowners. These surveys were not completed, but about 1914 a committee of landowners in the area extending generally from Banta on the south to Byron on the north tentatively proposed construction of a canal from San Joaquin River, to head near the old abandoned townsite of San Joaquin City. Later the landowners around Tracy began working independently, with the result that West Side District was formed.

Soils and topography.—West Side Irrigation District extends from Bethany, a station on the main valley line of the Southern Pacific railroad, to about 2 miles east of Tracy, a distance of about 8 miles, and lies below elevation 107 and above the 17-foot contour, U. S. G. S. datum. The soils are classed as Yolo loams, clay loams, and adobes.* The surface is generally even, but slopes toward the north at a rate of 15 to 35 feet per mile. North of Tracy, in sections 19, 20, 21 and 22, the water table in April, 1928, was 2 to 4 feet below the surface, but in the southern section, roughly along the 75-foot contour, it stands about 15 feet below the surface.

Development.—The Tracy area has always been a strong producer of grains, although subject from time to time to deficient rainfall. All of the land in the district was in crop when the district was formed, with the exception of minor scattered areas and rights of way. The crop census for 1927 showed 8513 acres in alfalfa, 469 acres in trees and vines, 141 acres in truck crops, 1085 acres in grain, 1163 in pasture and grain hay, 219 acres in industrial use, and 158 acres in residential tracts. Out of the 11,761 acres assessed in 1927, 10,415 acres was irrigated. There are 174 farms averaging 65 acres, this including one holding of 1500 acres, one of 723 acres, one of 547 acres, and one of 197 acres. The estimated assessed value of land in the district for county purposes for 1927 was $900,000.

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California.

The estimated population in the district is 842. The town of Tracy is a railroad division and junction point, two lines leading to the San Francisco Bay region, two down San Joaquin Valley, and one easterly and northerly into Sacramento Valley. The main line of the Western Pacific passes close to the district on the east and south. Main-line state highways pass through the district, the distance by highway to San Francisco being about 60 miles. The principal business and residential sections of Tracy are excluded, but new residential and industrial centers are being extended into the district. The area within the Tracy townsite included within the district is 163 acres.

Water supply.—West Side Irrigation District pumps water from Old River, a branch of the San Joaquin, reaching Old River through a dredged intake canal approximately one mile long. Water rights are based on permit 270, for 220 cu. ft. per sec., issued by the Division of Water Rights May 3, 1917, with priority of April 7, 1916. The quantity pumped is not measured by the district, but was found by the Sacramento-San Joaquin water supervisor to have been 30,300 acre-feet in 1924, 28,292 acre-feet in 1925, 33,002 acre-feet in 1926, and 25,748 acre-feet in 1927. The water in San Joaquin River is largely return flow from diversions farther upstream and water reaching the San Joaquin delta from Sacramento River through Georgiana Slough and other inter-delta channels.

Works.—The main West Side pumping station is located at the south end of an intake canal, which extends north about one mile to San Joaquin River from the west end of the district. This canal is 25 feet wide on the bottom and the water is about 6 feet deep at low tide during the summer. Two separate discharge pipes are used to convey water to the upper and lower main canals which feed the lateral canal system. Four 15-inch centrifugal pumps, each driven by a 350 hp. electric motor, lift water to the upper main canal through 750 feet of concrete and 9350 feet of wood stave pipe, 48 inches in diameter. Each pump has a rated capacity of 10,000 g.p.m. and operates against a 126-foot head. With the exception of 8 acres, the entire district lies below the upper main canal, which flows along the south boundary for about 7 miles. There are 14.41 miles of laterals which carry water to 6170 acres from the upper main.

Three 15-inch pumps supply the lower main canal, which heads on the 55-foot contour and carries water to the lower 5625 acres in the district. These pumps operate against a 60-foot head, each delivering 10,000 g.p.m. Three 200 hp. electric motors drive the pumps. The discharge line contains 765 feet of concrete and 3900 feet of wood stave pipe, 44 inches in diameter. The lower main canal is 9 miles long and supplies 10.71 miles of lateral canal with water. The lateral canal system places water on the high point of each quarter section. There are no private pumping plants.

The district constructed about 13,000 feet of drainage canal along the north boundary in 1925 and 1926, extending this about one mile toward the east in 1927. The drains discharge into the drainage system of Naglee Burk Irrigation District, from which the drainage water is pumped into San Joaquin River. The drainage installed now affects about 1800 acres. In the fall of 1928 an additional bond issue of $50,000 for canal lining and drainage was requested.

The total investment in works, which has been entirely covered by bond issues, was $553,752 as of January 1, 1928.

Use and delivery of water.—Water is delivered to the high point of each 160 acres, and is measured to irrigators over weirs, through orifices and by current meters. Up to 1927 water was served on demand on a flat charge per acre. Heavy applications caused the water table to rise under the land adjoining Naglee Burk Irrigation District to the north. In order to restrict the use of water, the district assessment rate was decreased in 1927 from $9 to $6 on each $100 valuation, with an allowance of one acre-foot per acre, and a toll was levied on excess water at the rate of $2.50 per acre-foot. For the season of 1928 the assessment rate was still further decreased to $4.50 and all water charged for at the rate of $2.50 per acre-foot, with a result deemed very satisfactory by the directors of the district.

Bonds. Three bond issues are outstanding, the first, for $295,000, the second, for $100,000, and the third, for $150,000. The entire amount of these issues is outstanding.

The district has never collected sufficient money to carry operating expenses and had general fund warrants outstanding as of December 31, 1927, amounting to $49,702.26, these carrying interest at 7 per cent. Interest has been paid on outstanding warrants each year since 1922, the minimum of such payments in any one year having been $590.44, in 1922, and the maximum $3,332.04, in 1927. In addition to the irrigation bonds outstanding against lands in the district, there are the following estimated amounts of school, county, and municipal bonds: Tracy Elementary School, $86,800; West Side Union High School, $6,750; General County, $11,000; Tracy Municipal, $17,000; total, $120,550.

Assessments and water tolls.—As previously indicated, all money was raised by district assessments prior to 1927. Farm land is assessed normally at $100 per acre, with residential and industrial property around Tracy at $150 per acre, and 8 acres above the canal at $1. The total assessed valuation for district purposes has ranged from $906,252, in 1920–21, to $1,195,876, in 1927–28. The assessment rates for each $100 of valuation for the past five years have ranged from $9 down to $4.50, as already indicated in "Use and delivery of water." The assessments levied by the district during the past five years have varied from $53,812, in 1927–28, to $105,773, in 1923–24. Water tolls, at $2.50 for each acre-foot after the first, brought in $23,242 in 1927.

TRACY-CLOVER

Location: about 1 mile north of Tracy, in San Joaquin County. (Pl. XVII.)
Date of organization election: May 9, 1922.
Gross area: 1084 acres; **area assessed 1927:** 1033 acres.
Principal town: none; nearest town: Tracy.
Post office: Tracy.
Railroad transportation: Southern Pacific railroad at Tracy.

History.—The area now in Tracy-Clover District was subdivided into 5-acre and 10-acre parcels about 1913. The subdividers obtained a right to use Barge Canal, an intake from Old River, and installed a pumping plant in 1914. For the next seven or eight years the project was operated by the promoters, but when the area was practically all

settled the irrigation district was organized to take over and operate the irrigation system. An engineer employed by the district appraised the property, less depreciation, at $56,885, and the district took an option to purchase for $45,000. A bond issue of $52,170 was approved by the Bond Certification Commission and voted by the district February 27, 1923. The system was purchased for $40,596.85 and other expenses aggregating about $3,000 were incurred during the year.

Soils and topography.—Soil is classified mainly as Yolo clay loams.* The elevation is about 25 feet, with a slope northward toward Old River. Ground water is 4 to 6 feet below the surface. About 100 acres of 'rim' lands is alkaline. About 2 miles of drainage canals have been excavated to connect with the drainage outlet of Naglee Burk District, which joins Tracy-Clover District on the east.

Development.—As previously stated, the area in the district was practically settled when the district was formed. A 1926 crop report showed 740 acres irrigated, of which 596 acres was in alfalfa. The assessment roll for 1927–28 showed 67 holdings, averaging about 16 acres. The largest holding contains 125 acres and the two next largest 75 and 48 acres. The population is about 60. The county assessment of lands in the district for 1927–28 was about $75,000.

Water supply.—The land in the district was formerly part of Rancho el Pescadero, which had riparian rights on Old River. The district bases its right on riparian ownership and continued use since 1914. The pumping plant acquired by the district has a rated capacity of 18 cu. ft. per sec. According to the records of the Sacramento-San Joaquin water supervisor, the following diversions were made during the past three years: 1925, 1380 acre-feet; 1926, 1534 acre-feet; 1927, 1684 acre-feet.

Works.—The district pump is a 16-inch centrifugal, which is operated by a 125 h.p. electric motor against a head of 25 feet. The pump discharges into a 30-inch redwood pipe line extending south about 1 mile along the east line of the district and supplies two main laterals extending westerly through the district, the lower lateral having a length of about 1.9 miles and the upper of 1.2 miles. Distribution is accomplished through about 6.2 miles of smaller laterals reaching to each 10-acre tract.

A drain connecting with the Naglee Burk outlet is shallow and carries very little water. However, the district has not been greatly damaged by high ground water, the excavation of Grant Line Canal by Westside Irrigation District, which joins Tracy-Clover District on the south, having benefited the southern portion of the latter. The total investment in works to December 31, 1927, was $47,120.27.

Use and delivery of water.—So far as information is available, this is covered under "Works."

Bonds.—The bonds voted total $52,170 and the entire issue is outstanding. Other bonds against lands in the district, total about $6,000, of which $5,000 are school bonds and $1,000 are general county bonds.

Assessments and water tolls.—Land is valued for purposes of district assessment at a flat rate of $100 per acre, the total district assessed

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California.

valuation for 1927–28 being $103,380. During each of the past two years the assessment rate per $100 valuation has been $8.50; in each of the three previous years it was $7.50. The total district levy for 1927–28 was $8,787. No water tolls are charged. Thus far the district assessment rate has not been quite large enough to cover all expenses, and the district has usually carried over from $1,000 to $2,000 in registered warrants at the end of each year.

NAGLEE BURK

Location: northwest of Tracy and east of Bethany, in San Joaquin County. (Pl. XVII.)
Date of organization election: November 23, 1920.
Gross area: 2871 acres; **area assessed 1927:** 2871 acres.
Principal town: none; principal adjacent towns: Bethany and Tracy.
Post office: Tracy.
Railroad transportation: Southern Pacific railroad.

History.—This district comprises part of the old Naglee grant of Rancho el Pescadero. Land was subdivided in 1911 by real estate operators who installed a pump and began delivering water in 1912. They spent about $52,000 on the system and then transferred the title to Naglee Burk Irrigation Association, one share of stock being attached to each acre of land sold. The association spent about $57,000 in extending the system, paying for the work with 7 per cent and 8 per cent warrants. This association also gave warrants to the promoters for the money invested by them in the irrigation system.

Finding it necessary to fund the warrants over a period of years, it was decided to form an irrigation district and issue bonds to take up the indebtedness and finance further work. Although the petition for organization was signed by 72 landowners, representing 2269 acres of land, the settlers were mostly non-citizens, and therefore unable to vote at the organization election, so that only 13 votes were cast, all being favorable. An option was arranged by which the district would take over the system by a payment of $10 and the assumption by the district of $111,600 in outstanding warrants, plus interest on those warrants. A bond issue of $200,000 was voted and certified, and on November 25, 1921, the district acquired title to the system. Payments by the district up to March 4, 1922, included $111,368 paid for the Naglee Burk system, $10,023 interest on association notes, $7,870 to cover improvements by the association subsequent to the option, and miscellaneous items bringing the total to $142,222.

The original estimate included $64,000 for canal lining to reduce seepage, but rapid rise in ground water caused the district to delay the canal lining and construct a surface drainage system. Up to December 31, 1927, about $43,000 was spent on drainage work.

From the beginning, drainage has been a major problem in the district. Excessive application of water caused a rise in the water table and a decrease in the productivity of much of the land. Many complaints regarding drainage were made to the board of the district, and before the water table was lowered, many of the farmers, particularly the renters, moved away and certain owners failed to pay their taxes. Most of the drains constructed were rather shallow. In 1925 the area of high ground water extended about 0.5 mile into Westside District,

and to meet this situation the two districts entered into an agreement by which Westside District excavated a drainage channel along Grant Line road in 1926 and connected this with the Naglee Burk District outlet canal. Under this agreement Westside District was given a perpetual right to use the Naglee Burk outlet and agreed to pay $300 annually for 5 years for the cost of pumping drainage water into Old River. The effect of the drainage work done by the two districts was immediate, and led the district to conclude it had solved its drainage problem. Lateral drains are still, however, rather shallow, and continuation of drainage work is necessary to maintain control of the ground water. About 2.5 miles of main canal have been lined with concrete.

In addition to, and largely the result of drainage difficulties, the district has been confronted with financial problems. Tax delinquencies and failure of the directors to levy sufficient assessments for bond redemption and the retirement of outstanding warrants, caused a shortage of funds when the first bonds matured July 1, 1926. Money was borrowed to meet the bond principal, and April, 1927, a refunding issue of $192,000 was voted. In the meantime, all but $10,000 of the original $200,000 bond issue had been sold. Anticipating the refunding of their first issue, no provision was made in the tax levy for 1926–27 for retirement of $6,000 in bonds due July 1, 1927; likewise, no provision was made in the 1927–28 levy for bond retirement on July 1, 1928. The outstanding warrants on December 31, 1927, amounted to $11,487. Uncollected taxes as of the same date amounted to $19,969, including penalties and interest. The district took tax deeds to about 165 acres, but did not exercise their right to take tax deeds to all property which had been sold three times for assessments.

At this writing (November, 1928) an agreement as to refunding the first issue has not been completed. The refunding bonds have maturities of 1933 to 1967, whereas the original issue had maturities of 1926 to 1940. The holders of the original bonds have expressed willingness to exchange them for refunding bonds, but agreement has not been reached as to maturities which will be accepted in the exchange. The district reports that during 1928 it has paid all running expenses, including all bond interest due, and warrants carried over from the previous year have been cut about $3,000.

Soils and topography.—The district is part of the old flood plain of San Joaquin River, with elevation from 0 to 25 feet. Soils are classified as about 10 per cent Yolo clay loams, 45 per cent Yolo adobe, and 45 per cent Sacramento clay loam.* The drainage situation has already been described. About 400 acres show alkali concentrations.

Development.—In 1928, according to records of the Sacramento-San Joaquin water supervisor, 1700 acres of the district was in alfalfa, 216 acres in Sudan grass and beans, 107 acres in rice, and 34 acres in irrigated pasture. The unirrigated land of the district is mostly in old alfalfa used for pasture. The assessment roll for 1927–28 showed 57 separate holdings averaging about 43 acres. Four holdings totaling

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California.

366 acres have been taken over by banks, and there were four individual holdings aggregating 466 acres. The estimated county assessed valuation is about $150,000.

Water supply.—Water is obtained by pumping from Old River, which bounds the district on the north. The first filing was made September 13, 1912, and called for 19,000 inches under a 4-inch head. A second filing for 250 cu. ft. per sec. was made by an individual September 6, 1921, but this presumably is not effective because made subsequent to the passage of the Water Commission act. However, the district has established a right to water through use since 1912. The records of the Sacramento-San Joaquin water supervisor show diversions of 6960 acre-feet in 1924, 5249 acre-feet in 1925, 5369 acre-feet in 1926, and 5582 acre-feet in 1927. The district, on the other hand, claims an approximate diversion for these years of 7000, 5000, 5500, and 6000 acre-feet, respectively, and 7000 acre-feet in 1928.

Works.—The main pumping plant of the district on Old River is a 20-inch centrifugal, delivering 31 cu. ft. per sec. against a 16-foot head. It is operated by a 100 h.p. electric motor and discharges into the main canal, which follows the east boundary of the district for about 2.5 miles to the upper booster plant. The latter is a 16-inch centrifugal with a capacity of 15 cu. ft. per sec. pumping against a head of 19.5 feet. It is operated by a 60 h.p. electric motor and discharges into a 24-inch wood stave pipe about one mile long which delivers water to the southeast corner of the district. A lateral runs from that point westerly for about five miles, and there are about 30 miles of laterals which carry water to each 40-acre tract of the district. The total investment in works to December 31, 1927, was $185,635.06.

Use and delivery of water.—The district has not printed any rules and regulations, but delivers water according to mutual understandings. No records are available regarding the amount of water used other than those already given regarding the amounts pumped from the river. Almost all of the land has been irrigated at some time and most of the unirrigated land has been checked.

Bonds.—As previously indicated, the district voted an original bond issue of $200,000 and a refunding issue of $192,000. Bonds of the old issue outstanding January 1, 1928, amounted to $186,000. Six thousand dollars of the first issue was used to redeem bonds due July 1, 1927. A portion of the district is in Reclamation District 1007, which has no outstanding bonds. The estimate of school bonds against lands of the district is $8,100, and general county bonds, $2,000.

Assessments and water tolls.—The usual valuation of land for district purposes is $100 per acre, a small area being assessed at about $60 per acre. The total district assessed value in 1927–28 amounted to $284,524. The district assessment rate for each $100 of valuation for the past five years has been as follows: 1923–24, $7.75; 1924–25, $8.00; 1925–26, $9.00; 1926–27, $8.70; 1927–28, $9.00. The total levy for 1927–28 amounted to $25,622. No water tolls are charged.

BANTA-CARBONA

Location: west side of San Joaquin Valley, a few miles south of Tracy, in San Joaquin County. (Pl. XVII.)
Date of organization election: February 24, 1921.
Gross area: 14,379 acres; **area assessed 1927:** 14,379 acres.
Principal town: none.
Post office: Tracy.
Railroad transportation: west-side line of Southern Pacific railroad and main line of Western Pacific railroad.

History.—Organization of this district was the logical sequence from the irrigation district development to the north around Tracy, Bethany, Byron, Brentwood, and Knightsen. The land was in large holdings and dry-farmed to grain. The first petition for the formation of the district was circulated in August, 1920, but because of doubt as to its sufficiency, a second petition was circulated and presented to the board of supervisors, October 4, 1920, signed by 65 landowners, representing 13,115 out of 18,850 acres included. The required report from the state engineer failed to recommend formation of the district because of possible water shortage and doubt as to the economic feasibility of the enterprise. Suggestions were made by the state engineer concerning the elimination of land above the 125-foot contour. The report of the state engineer was not construed as adverse, and after fixing the boundaries, the supervisors called an election for February 24, 1921, when organization was approved by a vote of 73 to 22. An engineer was immediately employed to lay out a system and make cost estimates, and negotiations were carried on relating to a right of way for an intake from San Joaquin River.

A revised engineering report calling for a $690,000 bond issue was submitted and was approved by the Bond Certification Commission, but this was defeated June 21, 1922, by a vote of 59 to 53. The largest landowner, who had in the first instance been favorable to the organization, led in the opposition. A recall election was lost by one vote and a decision of the superior court sustaining the canvas of the votes was appealed. By excluding the town of Banta and the residence of the largest landowner in the district, opposition was throttled. These exclusions reduced the area in the district to 14,135 acres.

New proceedings for a bond issue were started, and one of $705,000 was approved by the Bond Certification Commission and authorized on July 1, 1924, by a vote of 60 to 28. The plan approved by the commission was for a two-level canal system supplying water below the 150-foot contour. On September 22, 1924, the directors adopted new plans for a four-level system, with the main lateral canals supplying lands below the 80, 100, 120, and 160-foot contours; they also approved the construction of an electric distribution system for supplying energy to the pumping plants.

On August, 1925, the engineer of the district and the consulting engineer recommended a second bond issue of $125,000 to complete the system, and to carry water to the high point on each quarter-section. These engineers raised the estimated cost to $803,895, about $50,000 of which covered items not included in the original estimate. The second bond issue was authorized by unanimous vote November 3, 1925. The system was supposedly completed by the contractors in the fall of 1925, but during the following winter the discharge pipes from the lift

pumps settled when priming of the ditches started in February, and almost all of the concrete pipe culverts failed. However, repairs were made, and 9500 acres was irrigated in 1926.

In July, 1926, the former consulting engineer of the district was employed to prepare new plans and estimates for completing the irrigation system in a satisfactory manner. His report, filed August 11, 1926, recommended an additional bond issue of $334,000, of which $148,100 was for completion of the system then built, $120,955 was for enlargements, canal linings, lateral extensions, etc., and $65,000 was for a canal to land which it was proposed to include in the district, thereby increasing the gross area to 20,500 acres. This bond issue was approved by a vote of 38 to 1 November 16, 1926. The works contemplated by this additional bond issue were not completed and the additional lands had not been brought into the district when the district was visited in April, 1928.

Soils and topography.—Soils are classified as Yolo adobes, loams, and clay loams.* They are deep and fertile, with no hardpan. The surface is generally smooth and easily prepared for irrigation. The district lies mainly between the 50 and 170-foot contours. Ground water stands 20 to 100 feet below the surface, and no drainage has as yet been required.

Development.—This district has had an unusual experience in bringing its land under irrigation, 9500 acres of the net irrigable area of 13,548 acres being irrigated in the first year, and 10,924 acres in 1927, the second year. In the latter year 5707 acres was in alfalfa and 4321 in field crops, mostly beans. It was the success met with in growing beans that largely brought about the rapid development. The average holding is about 97 acres, but there are still a number of large holdings, including four of 358, 776, 1056, and 1830 acres, respectively. The population in the district is about 500, with 140 ownerships. The estimated assessed value of land for county purposes in 1927 was about $750,000.

Water supply.—Water is obtained from San Joaquin River under an appropriation for 200 cu. ft. per sec., posted August 11, 1911, and purchased from River View Land and Water Company October 8, 1924. The State Division of Water Rights has issued permit 1752, with priority of July 23, 1920, for a diversion of 179.69 cu. ft. per sec., and the district has applied for a permit to take an additional 40 cu. ft. per sec. It has also received permit 2850, with priority of March 15, 1927, for 5 cu. ft. per sec. from Corral Hollow Creek. The amount of water diverted is not measured by the district, but has been calculated by multiplying hours of operation by capacities of pumps. This shows 29,450 acre-feet in 1926, and 34,738 acre-feet, including 2478 acre-feet delivered to Kasson, in 1927. The records of the Sacramento-San Joaquin water supervisor show diversions of 41,841 acre-feet in 1926 and of 37,300 acre-feet in 1927.

Works.—The district gained access to San Joaquin River by purchasing the works and properties of the River View Land and Water Company for $20,000, assuming the obligation to deliver water to certain land outside the district. An intake canal 6500 feet in length was dredged to elevation minus 6 feet from the river to pumping plant 1.

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California.

the first of six plants which raise the water in successive lifts along the main canal which runs through the central portion of the district in a southwesterly direction. All pumps are driven by direct-connected electric motors and have capacities varying from 20 to 60 cu. ft. per sec. The total capacity of each successive station commencing with the first is 220, 200, 160, 160, and 60 cu. ft. per sec., respectively. One pump in plant 1, with a capacity of 20 cu. ft. per sec. is used to supply land outside of the district. The combined connected load of all electric motors amounts to 3175 h.p. The lift canal between stations 1 and 5 is a full-cut excavation, concreted above the water line; between stations 5 and 6, the water is pumped through 4150 feet of 48-inch welded steel pipe. Laterals lead from the main canal and pipe line at the 72, 100, 122, and 171-foot contours. The gross areas which can be served from the main laterals are 5400, 5200, 5020, and 7630 acres, respectively, totaling 23,250 acres, of which 2850, 3190, 4060, and 4278 acres, totaling 14,378 acres are now within the district, with distribution laterals constructed to them.

The main contour laterals were originally constructed with excessive capacity with a view to providing storage, so that water could be pumped into them after midnight at lower power rates and released for irrigation in the day time. This scheme, however, has not proven practical because of the increased seepage losses, and these enlarged sections are being reduced by backfilling wherever concrete lining is being placed. The district operates 4.5 miles of lined lift canal, 4.5 miles of lined laterals, and 76 miles of unlined canals. Most of the structures on the distribution laterals have been constructed of redwood. The total expenditures on works to January 1, 1928, was $1,029,472.92, all of which has been obtained from bond issues.

Use and delivery of water.—A rotation system is used in serving water to the main lateral canals. On the laterals irrigators receive water according to priority of application, except as emergency service is given to crops endangered by drouth. Each application for water must be accompanied by a deposit. The minimum delivery head is supposed to be 2 cu. ft. per sec., and deliveries are made to the high point on each 160 acres. As computed from the water tolls, the amount of water delivered to irrigators in 1927 was 15,877 acre-feet.

When the district acquired the River View Land and Water Company system, it assumed service obligations to about 2000 acres, and this is being continued by the district. The exact extent of these service rights has not been definitely established.

Bonds.—Bonds voted by the district total $1,164,000, of which $1,058,240 were outstanding December 31, 1927. Other bonds against lands in the district are estimated to amount to $18,800, and include elementary school bonds of $3,800, high school bonds of $5,000, and general county bonds of $10,000.

Assessments and water tolls.—Both district taxes and water tolls are collected. From 1924–25 to 1926–27 land was assessed for district purposes at a flat rate of $100 per acre. At present most of the land is assessed at $150 per acre, with some assessed at $130 and $140 per acre, according to location and soil. Seventeen acres above the canal is assessed at $1 per acre and railroad rights of way are assessed at $50 per acre. The total assessed district valuation for 1927–28 was

$2,063,684, and the total levy for that year was $103,185. The district assessment rate per $100 of valuation was $4.50 in 1924–25, $5.50 in 1925–26 and 1926–27, and $5 in 1927–28. In 1926 a water toll of $2.50 per acre-foot was charged for water served in excess of one acre-foot per acre, but during 1927 and 1928 the toll was $2.75 per acre-foot regardless of quantity used. The revenue from water tolls in 1927 was $40,154.

WEST STANISLAUS

Location: on west side of San Joaquin River north of Patterson, mainly in Stanislaus County. (Pl. XVII.)
Date of organization election: November 19, 1920.
Gross area: 21,400 acres; **area assessed 1927:** 21,400 acres.
Principal railroad station: Westley.
Post office: Westley.
Railroad transportation: west-side main line of Southern Pacific railroad.

History.—Although this district was organized in 1920, construction of its works was not started until the summer of 1928.

There has long existed a desire to irrigate the fine body of lands on the west side of San Joaquin Valley north of the area served by San Joaquin and Kings River Canal. An irrigation district, known as Westside Irrigation District, was created by a special act of the legislature in 1876, and a canal was surveyed leading from Mendota to Antioch. Nothing, of course, was accomplished under this special act, but irrigation development has gradually extended until nearly the entire area between Brentwood and Mendota within reach of gravity diversion, or within economic pump lifts, from San Joaquin River, with the exception of the area in the present West Stanislaus Irrigation District, has been brought under irrigation systems.

In 1918 a petition was circulated proposing to form a district, to be known as California Irrigation District, covering about 400,000 acres west of San Joaquin River in the counties of Fresno, Merced, and Stanislaus, including the lands under San Joaquin and Kings River Canal, but the enterprise had little support. When the present district was proposed in May, 1920, the area included was 35,681 acres, extending entirely across Stanislaus County and some 4 miles into Merced County, the northern and southern portions of the proposed district being separated by Patterson Colony. An adverse report was rendered by the state engineer on the basis of a lack of demonstrated water supply. However, the organization of the district was later carried by a vote of 115 to 4. Preliminary investigations were made in 1920 and 1921, but the enterprise remained more or less dormant until 1926, when the area south of Patterson withdrew, most of it entering San Joaquin River Water Storage District. Measurements of the San Joaquin during the dry year 1924 and succeeding years demonstrated the sufficiency of a water supply from the San Joaquin near the mouth of Tuolumne River. An engineer's report was submitted December 1, 1926, outlining a system of works and proposing a bond issue of $1,216,376. This was approved by the district by a vote of 52 to 1, and also by the Irrigation District Bond Commission. Subsequently an agreement was made with certain landowners permitting a change in the intake canal location and a reduction in the required number of pumping plants from 9 to 6. A revised estimate was approved by the Bond Certification Commission and contracts have been let during the

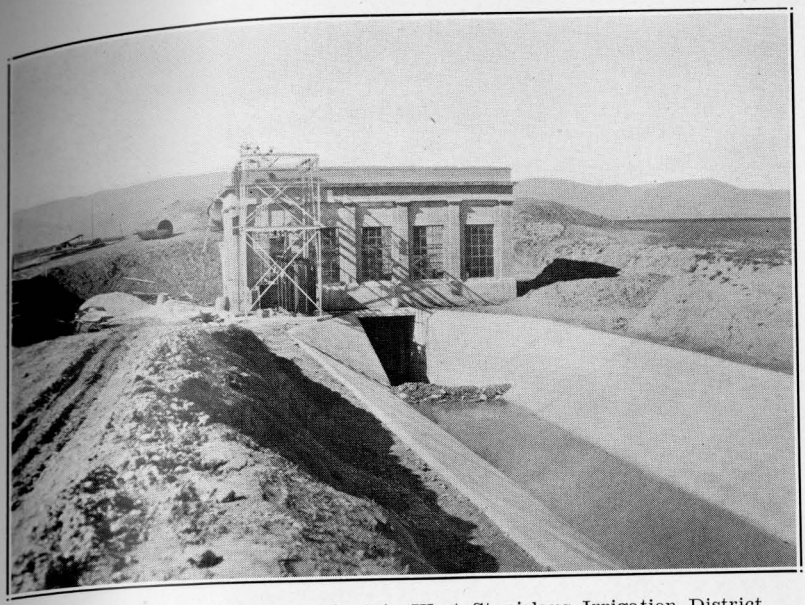


FIG. 1. A principal pumping plant in West Stanislaus Irrigation District.

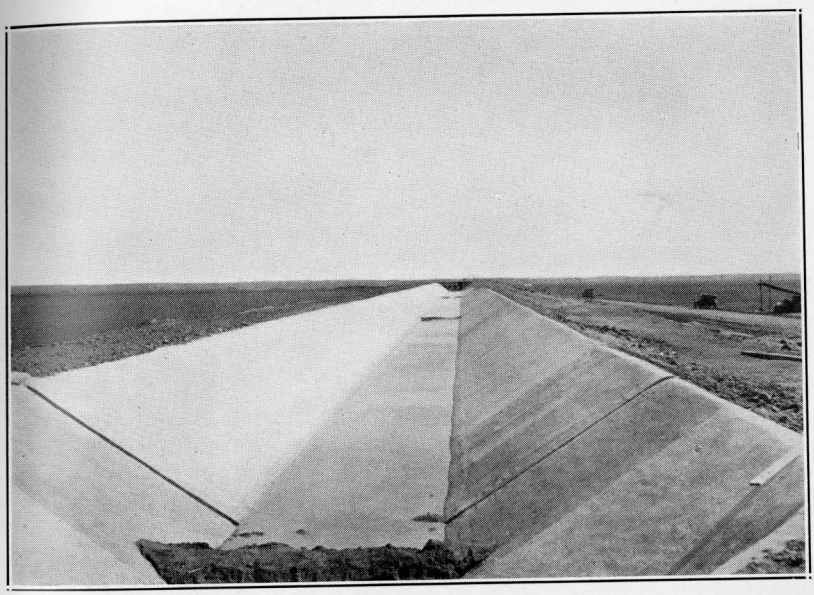


FIG. 2. Concrete-lined main canal, West Stanislaus Irrigation District.

summer of 1928 for the main canal and structures, the major parts of the laterals and structures, and for the main lift pumps, including motors and electrical equipment.

Soils and topography.—The soils as classified are mainly of the Yolo series and include loams, clay loams, and adobes.* There is also a small area of Alamo clay loam and clay reaching to the lower levels. Soils are deep with no hardpan, and no evidences of alkali. Elevations range from 25 to 170 feet, with a general slope of about 20 feet per mile toward San Joaquin River from the west. With this heavy slope any drainage found necessary can be easily cared for in the higher lands, and it is assumed that a dangerous rise of ground water in the lower lands can be prevented by pumping from drainage wells in those lands. The surface of the land is even and can be easily irrigated. Domestic water is available underground at depths of 50 to 60 feet.

Development.—There is very little irrigated land within the district, most of the area being dry-farmed to grain in relatively large holdings. There are 79 separate ownerships, giving an average of about 266 acres. There are six large holdings containing 3508, 1824, 1438, 1281, 821, and 751 acres, respectively. The total population is about 315, of which 15 are in the nonincorporated village of Westley. The estimated assessed valuation of land within the district for county purposes for 1927 was $553,282. The west-side highway down San Joaquin Valley passes through the district.

Water supply.—Water is to be diverted from San Joaquin River about one mile north of the mouth of Tuolumne River. The Division of Water Rights has issued a permit dated March 29, 1927, for 262.15 cu. ft. per sec., with priority of August 27, 1920. The necessary ultimate demand of the district, estimated at 265 cu. ft. per sec., is expected to be available even during years of low flow. The supply in the river at the point of diversion is largely return flow from irrigation from San Joaquin River and its east-side tributaries, and it is expected that normal development will maintain or increase this return flow. The water supply granted in the permit from the Division of Water Rights is at the rate of approximately 1 cu. ft. per sec. to each 80 acres within the district. The entire supply is to be pumped.

Works.—As is the case with the Patterson project and the west-side irrigation districts north of West Stanislaus District, the water supply is to be pumped from the river in successive stages and distributed in laterals running generally north and south from the main supply canal. The intake canal is to be dredged from a horseshoe bend on the San Joaquin where the elevation of the water surface in the river ranges from 23 feet to 41 feet above sea level. Six pumping installations are required, the first three having capacities of 270 cu. ft. per sec. each, the next three having capacities of 225, 135, and 90 cu. ft. per sec., respectively. The individual units at each pumping station are to have capacities of 42 cu. ft. per sec. The discharge elevations for pumping stations 1 to 6, in feet above sea level, are 58.5, 80.3, 102.8, 124.7, 147.3, and 169.7, respectively. With the water in the intake at 23 feet elevation, the lifts above stations 2 to 6 will be 57.3, 79.8, 101.7, 124.2, and 146.7 feet, respectively. The intake canal is dredged for about 2 miles from the river, and from the end of this

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California.

canal water is carried through 2.75 miles of lined canal in successive elevations. The main north and south laterals are to aggregate about 56 miles in length, and from these about 19 miles of sub-laterals will distribute water to each ownership. Pumping stations are to be housed in reinforced concrete buildings, pumping equipment controlled automatically, and laterals controlled by radial gates. The total estimated cost of the system according to the revised budget is $1,216,376.

Use and delivery of water.—It is proposed to deliver water to the average amount of 2 acre-feet per acre per annum. The average annual cost of operation per acre has been estimated by the district engineer as follows: bond interest and redemption, $4.32; salaries, $1.25; power, $3.04; depreciation, $1.08; total, $9.69. These estimated costs assume 22,000 acres irrigated, this being about 1100 acres more than the present net irrigable area.

Bonds.—Bonds in the amount of $1,216,376 have been voted and approved. Bonds in the amount of $550,000 were sold February 3, 1928.

Assessments and water tolls.—County valuations are used for district assessments, the total valuation for 1927–28 being $553,282. This includes town lots in Westley to the total value of $2,670. An assessment of $0.50 per each $100 of valuation was levied in 1921–22 and one of $1 in 1926–27; no assessment was levied in 1927–28. The amount raised by assessment in 1921 was $4,810, in 1926, $4,305, and in 1928, $14,394.

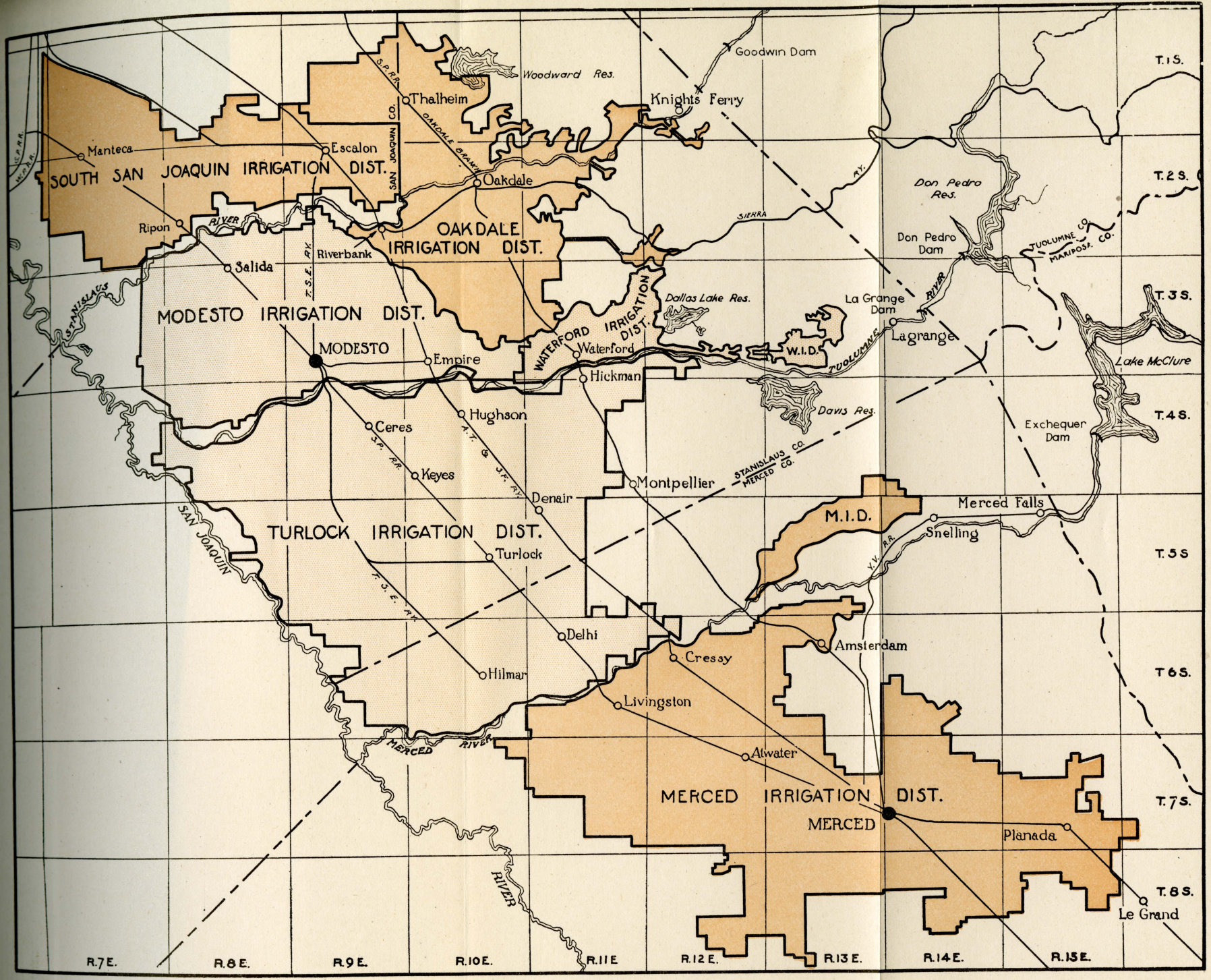
SOUTH SAN JOAQUIN

Location: north of Stanislaus River, in southern San Joaquin County. (Pl. XIX.)
Date of organization election: May 11, 1909.
Gross area: 71,112 acres; **area assessed 1927:** 66,871 acres.
Principal towns: Manteca, Ripon, Escalon.
Post office: Manteca.
Railroad transportation: main San Joaquin Valley line of Southern Pacific and Santa Fe railroads and Tidewater Southern Electric railway.

History.—The history of this district from its organization to 1915 has been covered in Bulletin No. 2 of the State Department of Engineering.* Briefly, an old established system, known as the Tulloch system, had been supplying water to several thousand acres, but was said to have capacity to serve no more than 3000 acres. An effort to extend the Tulloch system by the sale of water rights at $20 per acre was not received favorably, but this effort was largely responsible for creating the interest in irrigation development that brought about the organization of South San Joaquin District. A bond issue amounting to $1,875,000 was authorized shortly after the district was created. Then, jointly with Oakdale Irrigation District, which had been organized soon after South San Joaquin District, the old Tulloch system was purchased for a total of $650,000 and construction of the district irrigation system was started.

The bonds of this and Oakdale districts went on the market as the first new irrigation district issues under the irrigation district act as it was revised in 1897, not counting the refunding issues put out a few years previously by the reorganized Modesto and Turlock irrigation

* State Dept. of Eng., Bul. 2, 66–71.



Location and boundary map of irrigation districts on Stanislaus, Tuolumne, and Merced rivers.

districts. The early bad history of irrigation securities was still reflected in the investment market and South San Joaquin District and its neighbor on the east were confronted with a critical situation. By requiring contractors to purchase bonds covering their work, South San Joaquin District was able to begin construction; but, because of the heavy bond discount resulting from this arrangement, the works contemplated under the first bond issue could not be completed within the funds available from it. The main portion of the second issue, which amounted to $1,170,000, was desired for the construction of a distribution system to take water to the high point on each 40 acres within the district, this unusually complete distribution system being designed to hasten land settlement. A third issue for $790,000, voted at the same time as the second issue, was to be used to build a foothill reservoir and other storage. Partly due to legislation improving the status of irrigation district bonds, the second and third issues sold more favorably than the first, but still sufficient funds were not in hand for completing the works. Accordingly, a special assessment of $140,000 was levied in 1914, and by the early summer of that year the delivery system had been finished and water was made available to the land owners. Some drainage provided for in the second bond issue was held over for later construction, as was also the foothill reservoir covered by the third issue. Practically all of the land within the district had been in crop before the district was organized, but all except a small portion of this was in dry-farmed grain. By 1915 approximately 22,000 acres had been irrigated. Since then the district has built the Woodward foothill reservoir, for which the third bond issue had been carried in 1913, has entirely reconstructed a long structure known as Hilt Sag Flume, has built an extensive drainage system, replaced many wooden canal structures with concrete, lined many miles of canals, and, jointly with Oakdale Irrigation District, has constructed Melones Reservoir on Stanislaus River. To carry forward this, and other work, three additional issues of bonds were necessary, $500,000 being voted in 1919, $550,000 in 1923, and $1,100,000 in 1925. The sixth issue was used to cover the portion of the cost of building Melones Dam for which South San Joaquin District was responsible. Both interest and principal of this sixth issue, excepting a relatively small portion paid by the district assessments before the dam was completed, are to be covered, as later indicated, by payments received from the use of water from Melones Reservoir for power generation. During the 12-year period ending in 1927 development has gone forward much more satisfactorily than during the first few years after construction, and the irrigated area has increased from 22,000 to 53,000 acres.

When the rights of way for Melones Reservoir were acquired it was necessary to purchase the properties of Melones Mining Company, which included a small power plant. South San Joaquin and Oakdale districts own the plant jointly and divide the revenue share and share alike. Pacific Gas and Electric Company operates and maintains the plant, and pays 2 mills per kwh. for the energy generated. The company is not required to expend over $5,400 per annum for operation and maintenance under the lease contract dated December 21, 1926,

which expires December 31, 1934. In 1927, the first complete year of operation, under the contract now in force, the combined revenue to both districts amounted to $8,340.

Soils and topography.—Soils of the district are mainly light in character and classified largely as Oakley and Fresno sands, undifferentiated.* The surface varies from flat to rolling. The entire western area is subject to high water table and to relieve this, 70 miles of drainage canals have been constructed, 42 drainage pumps installed, canals are being lined, and an effort is being made to restrict the use of water. Over about 1000 acres the district assessed valuation has been reduced from $100 or more to $20 per acre because of this high ground water.

Development.—Reduction in the size of farm holdings through settlement and more intensive cultivation has characterized development in the district in recent years. While there is still one holding of 1000 acres, as well as others of 800, 480, and 300 acres, the average farm holding is now only 32 acres, with 1979 owners of farm land and 887 owners of city property. The three towns of Manteca, Ripon and Escalon have populations of 1600, 1000 and 1000, respectively, and the farm population is estimated at 6400, or a total within the district of approximately 10,000. The estimated assessed valuation in the district for county purposes in 1927 was $7,500,000, of which one-third was for improvements.

Water supply.—The water supply of South San Joaquin Irrigation District comes from Stanislaus River by direct-flow diversion and by storage. Rights to direct flow are based on appropriation and use under the old statute, including purchase of the rights of the old Tulloch system. Filings made on behalf of the district prior to its organization included one for 70,000 inches measured under 4-inch pressure, dated September 12, 1907, and one for 50,000 inches, dated July 15, 1908. A filing by the district for 60,000 inches is dated September 3, 1909, and a second filing by the district for 150,000 inches is dated December 20, 1909. By deed dated April 28, 1910, the district acquired a one-half interest in the principal rights of the old San Joaquin Canal and Irrigation Company and Consolidated Stanislaus Water and Power Company. The latter rights date back in part to 1853, but more particularly to 1885. They constitute what was acquired by South San Joaquin and Oakdale districts by purchase of the Tulloch system. According to the investigations of the Bond Certification Commission in connection with South San Joaquin Irrigation District bond issue No. 1, the total amount available under the older rights does not cover in excess of 9 per cent of the right of the two districts to the surface flow from Stanislaus River.

The total amount claimed by the two districts under the Tulloch rights, together with the filings for or on behalf of the districts, is 1730 cu. ft. per. sec. An adjudication of Stanislaus River water rights by the Division of Water Rights dated September 21, 1922, allots to Oakdale and South San Joaquin districts, jointly, the following: 5 cu. ft. per sec. with priority of 1853, 127 cu. ft. per sec. with priority of 1885, 66.20 cu. ft. per sec. with priority of 1902, 847.80 cu. ft. per sec.

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California.

with priority of 1909, and an additional priority of 770.60 cu. ft. per sec. with priority of 1909, provided the water should be diverted and put to beneficial use prior to December 31, 1926. These amounts total 1730 cu. ft. per sec., to be divided equally between South San Joaquin and Oakdale Irrigation districts. The following permits have been issued to the two districts by the Division of Water Rights: 242 (license 37), priority October 16, 1926, for 20 cu. ft. per sec. for agriculture April 1 to December 1; 2104, priority September 20, 1918, for 96,195 acre-feet for agriculture January 1 to December 31; 2105, priority July 29, 1921, for 2000 cu. ft. per sec. diversion and 150,000 acre-feet storage for power January 1 to December 31 at Melones Reservoir; and 2106, priority October 19, 1922, for storage of 25,704 acre-feet for agriculture January 1 to December 31. Storage in Woodward Reservoir is covered by permit 2524, for 36,000 acre-feet, with priority of August 29, 1921.

An analysis by the consulting engineer of the district of the flow of Stanislaus River, particularly in relation to the needs of South San Joaquin and Oakdale districts, has shown that during the 18-year period 1904 to 1921, the ultimate requirement of the two districts was available in only 4 years, but in only one year would the deficiency have been as high as 20 per cent. During 6 years the maximum deficiency would have been under 3.4 per cent, during 3 years between 7.8 and 8.9 per cent, and during 4 years between 10.3 and 14.2 per cent. Since the ultimate diversion duty should be less than 4 acre-feet per acre, it is evident that this district has an excellent and dependable water supply lasting throughout the season. Reduction in transmission losses and increased economy in application of water should in due time eliminate the relatively small deficiencies indicated. The amounts diverted by South San Joaquin District from 1915 to 1926, during which years there was no storage control by the districts, varied from 105,000 acre-feet, in 1915, to 223,000, in 1921 and 1922. The diversion in 1927 was 271,480 acre-feet, which included stored water from Melones Reservoir. The ultimate annual requirement of the district is estimated to be 256,000 acre-feet.

In discussing the water supply of this district, reference should be made to the agreement under which Melones Dam was constructed by South San Joaquin and Oakdale irrigation districts. This agreement is between the two districts, Pacific Gas and Electric Company, and Sierra and San Francisco Power Company, and is dated January 15, 1925. The maximum capacity of Melones Reservoir is fixed at 112,500 acre-feet, with 103,500 acre-feet available for withdrawal each year, to be shared equally between the two districts. The districts were jointly to bear the cost of Melones Dam and Reservoir, and the power companies were to build the power plant below the dam. From March 1 to October 31 of each year the control of the water stored is in the hands of the districts, with the maximum and minimum withdrawals to be 1700 and 1000 cu. ft. per sec., respectively. From November 1 to March 1 operation of the reservoir is placed under the direction of the power companies, who must allow sufficient water to pass Melones Reservoir to fill Woodward Reservoir, plus any additional water needed by the districts for irrigation or domestic use. For the use of water passing through Melones Reservoir, the power companies pay to the two dis-

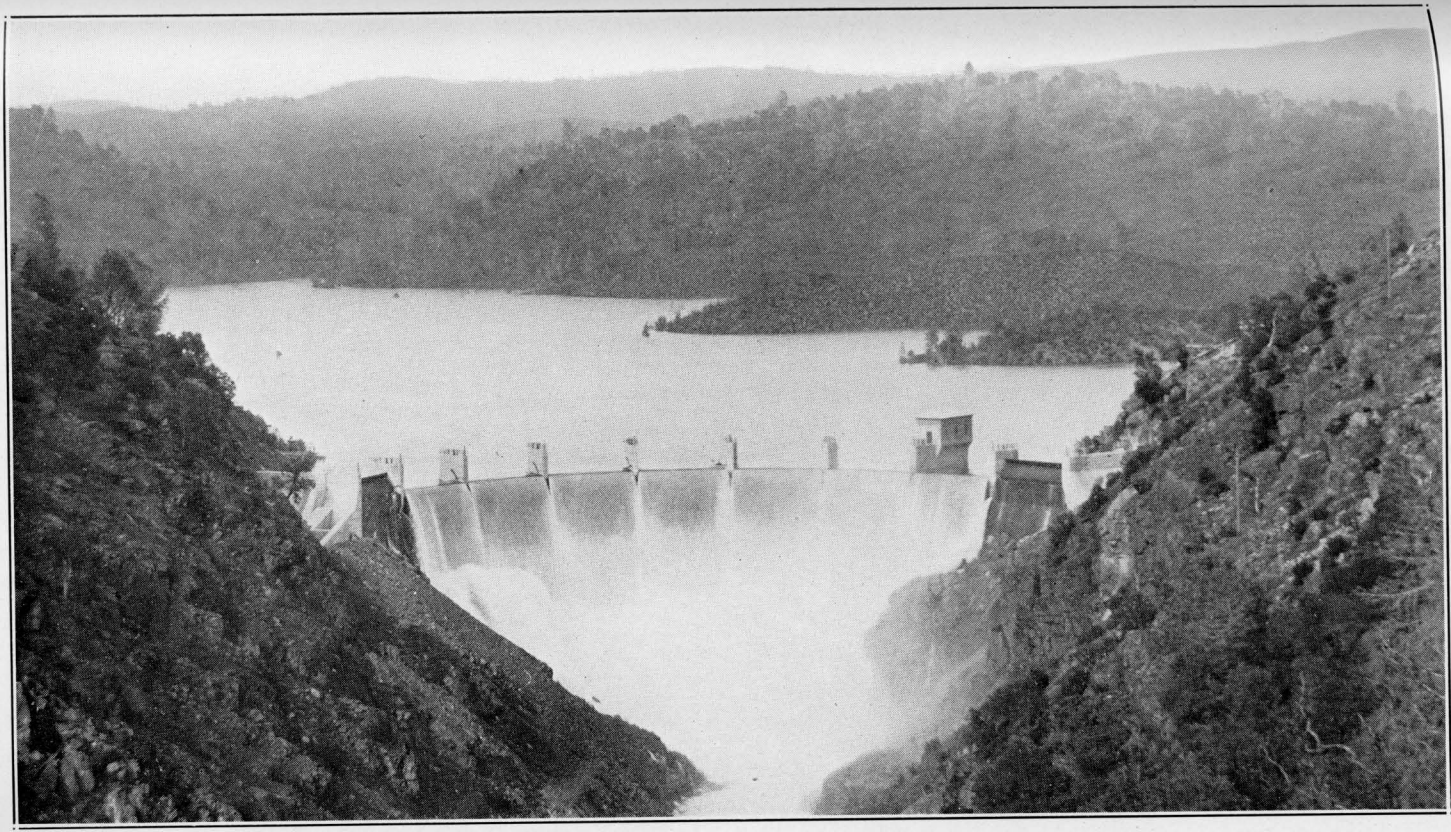
tricts jointly the sum of $5,175,000 in semiannual installments of $64,687.50, these payments to be used by the districts to cover interest and principal of the bonds used in the construction of Melones Dam. When the bonds have been fully paid, this income is to be available to the districts for other purposes. Other provisions of the contract cover storage rights of the power companies above Melones Reservoir, release of the water so stored to the districts, maintenance and upkeep of the reservoir, and other related matters.

Melones Dam was not completed as soon as contemplated, so that payments to the districts by the power companies were somewhat delayed. The works are now completed and in operation, and the benefits provided are being received by the respective parties. Sierra and San Francisco Power Company, one of the parties to the agreement, has since been purchased by Pacific Gas and Electric Company, and this company succeeds to the rights under the agreement of Sierra and San Francisco Power Company.

Works.—Melones Dam and Reservoir, owned jointly, as already indicated, with Oakdale Irrigation District, is, of course, the outstanding feature of the district works. Melones Dam is 210 feet high above the stream bed, and is arched with a crest length of 590 feet. It contains 92,913 cubic yards of concrete. The center section, 450 feet in length, has a constant radius of 238 feet on the upstream face, while the wings are of gravity type, with a combined length of 140 feet. Both arched and gravity sections have vertical upstream faces and inclined downstream faces curved at the bottom to deflect the water flow over the spillway lip. The spillway extends across the top of the dam, and is divided by piers into nine sections, each containing a balanced hinged gate. An outlet tunnel equipped with large needle valves enters the reservoir beneath the south abutment. This tunnel is extended downstream below the irrigation outlet valves to supply the power plant constructed by Pacific Gas and Electric Company. When water in the reservoir reaches an elevation of 735 feet, it floods 1980 acres.

Perhaps the next most important element in the works of the district is Goodwin Dam, which is also owned jointly with Oakdale District. It is about 4 miles upstream from Knights Ferry. This is a double-arch concrete overpour diversion weir in Stanislaus River, the two arches being jointly anchored in midstream to a heavy concrete abutment resting on a rock ledge which extends across the stream. The main arch has a radius of 135 feet and is 78 feet high and 12 feet thick at the base, while the smaller arch is only about 40 feet in height. The two districts have regulating diversion gates on opposite sides of the structure.

Leading from the north side of the stream, South San Joaquin District has 62 miles of lined and 288 miles of unlined canals reaching to all parts of the district. Woodward Reservoir, lying in the foothills above the district, is fed from the main canal and has a capacity of 36,000 acre-feet. There are 70 miles of drainage canals, located mainly in the western half of the district, as are also the 42 drainage pumps. The latter are deep-well turbines with capacities of 700 to 1600 g.p.m., driven by 7.5 to 20 h.p. electric motors. Unlike most other sections with high ground water, there are very few private pumping plants within the district.



Melones Dam and Reservoir, South San Joaquin and Oakdale irrigation districts.

The jointly owned power plant, formerly known as the Melones Mining Company plant, contains one 1,000 kv-a. generator, operated by a hydraulic turbine. A wooden flume about 4.5 miles long, with a capacity of 220 cu. ft. per sec., carries water to the penstock.

The initial irrigation canal structures within the district were of wood, but about 60 per cent of these have been replaced with concrete. The total amount invested in works, as of January 1, 1928, was $6,403,374, and the depreciated value of the properties was $6,167,569.

Use and delivery of water.—As previously indicated, the distribution system of the district is carried to each 40-acre unit. Water deliveries are roughly measured, but delivery records are not totaled, since water is not charged for at a quantity rate. The 1927 crop census summary shows a total of only 9347 acres within the district not irrigated, of which 5334 acres was bare land and 1479 acres pasture and other crops. A total of 4763 acres is reported as double-cropped in 1927. Water is generally delivered to irrigators in heads of 15 cu. ft. per sec. flowing not to exceed 30 minutes to each acre requiring flooding. For gardens, trees, and vines, water is, as far as possible, kept continuously available and delivered on demand. The usual delivery head for trees is 5 cu. ft. per sec. running 1.5 hours per acre. Delivery receipts are signed by each irrigator at the time of each irrigation.

Bonds.—The total bond issues to date are $5,985,000. Issue No. 6, for $1,100,000, is secured by the Melones power contract. Bonds retired to January 1, 1928, inclusive, amounted to $15,000. General or special obligations against lands in the district, other than district bonds, are estimated to total about $499,000, divided as follows: elementary school bonds, $147,000; high school bonds, $206,000; general county bonds, $80,000; Manteca municipal and street bonds, $66,000.

Assessments and water tolls.—The district follows an unusual zoning system in assessing lands for district purposes, with the three towns of Manteca, Ripon, and Escalon as the zone centers. A square is drawn around each town one-fourth mile from the town limits, and land within this square outside of the town limits is assessed at $125 per acre. In a second zone, extending an additional one-fourth mile on all four sides, the assessment is $5 less, or $120 per acre. In each succeeding quarter-mile zone the valuation is still further reduced by $5 per acre until the zoning reaches 2 miles from town on all four sides. Beyond the zones the valuation is $100 per acre for good farm land. Land damaged by high water table is reduced in valuation to $20 per acre. The total assessment for district purposes in 1927–28 was $6,810,935. The amount of the district levy in 1927–28 was $439,293. During the past five years the district assessment rate for each $100 of valuation has gradually increased from $6.10 to $6.45.

OAKDALE

Location: on both sides of Stanislaus River on the eastern side of San Joaquin Valley, mainly in Stanislaus County. (Pl. XIX.)
Date of organization election: October 23, 1909.
Gross area: 74,240 acres; **area assessed 1927:** 74,240 acres.
Principal towns: Oakdale and Riverbank.
Postoffice: Oakdale.
Railroad transportation: Oakdale branch Southern Pacific railroad, main line of Santa Fe railway at western edge of district, with branch to Oakdale, and Sierra railroad.

History.—This district was formed along with South San Joaquin Irrigation District to obtain water from Stanislaus River for the large area adjacent to it in Stanislaus and San Joaquin counties, which, at the time of the formation of these districts, had only been irrigated in very small part. For the early history of the district, reference is made to bulletin 2 of the State Department of Engineering.* Since Oakdale and South San Joaquin irrigation districts have been jointly concerned in water rights, construction of Melones and Goodwin dams, and ownership of the upper part of the canal of South San Joaquin Irrigation District, reference is also made to the account of South San Joaquin Irrigation District above. The organization of Oakdale Irrigation District was largely stimulated by the organization of South San Joaquin District. The Tulloch irrigation system, which was jointly purchased by the two districts, was irrigating a small area around Oakdale, and it was thought necessary to follow the lead of those organizing South San Joaquin District if the possibility of obtaining water from the Stanislaus were not to be lost. Sentiment was almost unanimous, only 27 votes out of a total of 376 being cast against organization.

Immediately after organization, the district prepared plans and joined with South San Joaquin District in purchase of the Tulloch system. The first bond issue, $1,600,000, was approved by the electors February 26, 1910. However, owing to the same adverse situation with reference to irrigation district securities which faced South San Joaquin Irrigation District, Oakdale District was unable for nearly two years to dispose of its bonds, and then only by the same costly method of requiring contractors to find purchasers for them that was followed in South San Joaquin District. The resulting discount and other causes exhausted the first bond issue without completing the system, and second and third issues of $400,000 each were authorized in December, 1912, and October, 1914. By 1914 the irrigated area had reached 11,217 acres, including lands receiving water under the old Tulloch contracts. A special assessment of $135,000 was voted October 1, 1920, to provide funds for canal improvements, and a fourth issue of bonds in the amount of $175,000 was voted November 16, 1923, and largely used to construct a concrete siphon, line canals, and provide some surface drainage for the bench lands. Expenditure of the money derived from the fourth bond issue extended through 1927.

Early plans of Oakdale and South San Joaquin irrigation districts did not include storage works. Investigations and negotiations were later conducted and a bond election held in 1924 to provide, jointly with South San Joaquin District, for construction of Melones Dam, but this

* State Dept. of Eng., Bul. 2, 71–74.

failed. Subsequently on May 18, 1925, after a tentative contract had been entered into with Sierra and San Francisco Power Company and Pacific Gas and Electric Company contingent on the voting of bonds both in Oakdale and South San Joaquin irrigation districts, Oakdale District authorized the necessary funds, along with the approval of the contract, by a vote of 988 to 38. The directors of Oakdale and South San Joaquin districts formed a joint board for directing the Melones project and all expenditures were made from a joint account. The contract for Melones Dam called for completion by March 15, 1926, but the work was not finished until December 15 of that year. Unanticipated engineering and overhead expenses accruing on the dam construction during the summer of 1926, and lack of expected income under the contract with the power companies during that period, made it necessary for Oakdale District to levy a special assessment of $100,000 on October 7, 1927. The final cost estimate, made after Melones Dam was accepted, totaled $1,657,000, which was $82,544 in excess of the engineer's original estimate for the dam and railroad construction, less salvage values.

Soils and topography.—The soils of the larger part of the district are classed as Madera and San Joaquin sandy loams undifferentiated, these lying south of Oakdale and Stanislaus River.* Northerly and easterly from Oakdale across the Stanislaus the principal classification is Madera loams. The bottom lands along the river west of Oakdale are Hanford loams, and on the bluffs above the river on both the north and south banks are Oakdale sandy loams. There are many other classifications in small areas.

Over much of the district the lands are gently rolling. Ground water stands 30 to 40 feet from the surface under the uplands, and seepage emerges at the base of the bluffs bounding the low lands along the river. Surface drainage of the uplands has been provided by cleaning and grading about 19 miles of natural swales and gullies. About 5 miles of drain canal have been dug near the base of the river bluffs. Of the total area of the district, 9834 acres lie within San Joaquin County west of Valley Home.

Development.—There are approximately 948 water users within the district, the holdings averaging about 78 acres. There are still a number of large holdings, the five largest containing 1960, 1833, 1657, 1344, and 800 acres. The three towns of Oakdale, Riverbank, and Valley Home, which have respective populations of 2425, 1200, and 75, are included within the district. The estimated population outside of the cities and towns is 2800. The largest acreage is in alfalfa, with deciduous fruits and nuts, field crops, vines, cotton, and grain or grain hay following in the order named. The estimated assessed valuation in the district for city and county purposes for 1927 was estimated at $4,666,000, of which about one-third covered improvements.

Water supply.—An outline of the water supply situation is given under South San Joaquin Irrigation District. The district shares equally with South San Joaquin District the right to divert 1730 cu. ft. per sec. from Stanislaus River, and to store 112,500 acre-feet in Melones Reservoir. The total ultimate demand in the district has been estimated by the consulting engineer of the district at 252,000 acre-feet, and the

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California.

water supply study by the same engineer, covering the period 1904 to 1921, shows that there would have been no deficiency in 4 years, but deficiencies of 20.4 per cent in 1 year, 10.3 to 14.2 per cent in 4 years, 7.8 to 8.9 per cent in 3 years, and not over 3.4 per cent in 6 years. The amounts diverted from 1919 to 1926, which included no storage in Melones Reservoir, varied from 66,694 acre-feet in 1926 to 127,515 acre-feet in 1921. In 1927 the diversion, including water stored in Melones Reservoir, was 134,927 acre-feet. The average gross diversion since 1919 has ranged from 3.24 to 6.7 acre-feet per acre per year.

Works.—References have already been made under South San Joaquin Irrigation District to the Melones and Goodwin dams and the small power plant acquired from Melones Mining Company which are owned jointly with South San Joaquin Irrigation District. The district operates 18 miles of lined and 292 miles of unlined canals, and 40 miles of main pipe line, varying from 6 inches to 36 inches in diameter. Oakdale District has a 19 per cent interest in the upper four miles of the north side canal of South San Joaquin Irrigation District, and through this carries water to the lands north of Stanislaus River. In reaching the north-side lands Oakdale District in part makes use of the channel of Little John Creek. The north-side laterals aggregate in excess of 120 miles in length. Water for the south side of Stanislaus River is supplied by the main south-side canal, which diverts water at Goodwin Dam. In reaching the south-side lands the water flows about 4 miles through a rocky canyon section, passing through six short tunnels. After leaving the bench above the river and crossing branches of Wildcat Creek, it passes through a tunnel 6900 feet in length, from which it emerges into a branch of Dry Creek, to be later diverted at a small diversion weir known as Cashman Dam. The south-side laterals aggregate in excess of 150 miles in length. In recent years the district has built the 40 miles of pipe line referred to above to carry water over the many swales below the main laterals. In all, 23 miles of drainage canal have been excavated. The total investment in works to December 31, 1927, was $4,012,000, of which $3,462,000 was obtained from bond issues. This total investment does not include expenditures from the general fund for construction purposes.

Use and delivery of water.—Water is not generally measured to the irrigators. A total of 64,000 acres is under the skeleton gravity irrigation system. Water is usually delivered to the high point on approximately each 160 acres, but the district does not guarantee to deliver to any specified area. However, it assists the landowners in building lateral pipe lines and canals to connect with the system. For this purpose it maintains a pipe yard and sells concrete pipe to the farmers at cost of construction. The average gross diversion in 1927, the first year in which stored water was available, was 5.83 acre-feet per acre.

Bonds.—The total bonds voted amount to $3,675,000, of which $3,560,000 were outstanding January 1, 1928. Issue No. 1, for $1,600,000, and issue No. 2, for $400,000, were used in early construction and sold through contractors. The fifth issue, for $1,100,000, is secured by the contract with Pacific Gas and Electric Company covering power generation below Melones Dam. Bonds other than those of Oakdale District lying against lands within the district are estimated to total $300,600, of which $293,400 have been issued in Stanislaus County and $7,200 in San Joaquin County.

Assessments and water tolls.—Good bottom land within the district is assessed for district purposes at $135 per acre and good high land at $60 per acre. High bench land between Riverbank and Oakdale is valued at $80 to $110 per acre. The Southern Pacific and Santa Fe rights of way are assessed at $500 per mile and the entire right of way of Sierra Railway at $1,000. The total assessed valuation for 1927–28 was $4,346,260, of which $365,930 was for city and town property. The total amount of the assessment in 1927–28 was $282,506. The assessment rates per $100 of valuation for the past five years have ranged between $5.70 and $6.50. No water tolls are charged within the district. A small revenue is obtained from water sold to the old town of Knights Ferry and a few adjacent irrigators.

WATERFORD

Location: north of Tuolumne River, east of Modesto Irrigation District, and southeast of Oakdale Irrigation District, in Stanislaus County. (Pl. XIX.)
Date of organization election: September 6, 1913.
Gross area: 14,100 acres; **area assessed 1927:** 13,424 acres.
Principal town: Waterford.
Post office: Waterford.
Railroad transportation: Oakdale branch of Southern Pacific railroad and main line of Santa Fe railway at Empire.

History.—*This is one of the few active irrigation districts in California that have been promoted chiefly by large landowners. The individual who was most active in its formation controlled some 6000 acres. He had been a member of the board of directors of Modesto Irrigation District during the early years of the use of water there, and his experience there showed him the advantage of changing over from dry farming to irrigation farming. The lands included are susceptible of irrigation from Modesto Canal, and when Modesto District was formed proposals were made to include these lands in that district, but this was not done.

Obviously, the chief difficulty in connection with making a successful project of Waterford District was acquirement of a water supply. Prior rights of Modesto and Turlock irrigation districts and of San Francisco in connection with its municipal supply apparently left only flood waters of Tuolumne River available to the new enterprise.

A filing of 13,000 inches measured under a 4-inch pressure was made on behalf of the contemplated district February 27, 1913, and conveyed to the district after organization. Later, on November 13, 1913, the district made an additional filing of 16,000 inches. Both of these were prior to the effective date of the Water Commission Act of 1913, and they both covered only flood waters, or at least waters available at La Grange Dam in excess of diversions by Modesto and Turlock irrigation districts. A very valuable addition was made to the water rights of the district when, on January 14, 1919, it entered into an agreement with Sierra and San Francisco Power Company to purchase from that company for $170,000 a perpetual right to divert a minimum of 60 and a maximum of 66 cu. ft. per sec. belonging to the old La Grange mining ditch, this being the first right on the river. This right is subject to certain rights for La Grange and vicinity, not to exceed 6

* See also State Dept. of Eng., Bul. 2, 74–75.

cu. ft. per sec. for a 6 months' period. Certain matters connected with the amount of the reservation for La Grange and vicinity, as well as other minor features of the contract with Sierra and San Francisco Power Company, are involved inpending litigation with Modesto and Turlock irrigation districts.

Next to acquiring a water right, the chief problem of Waterford District was to bring the flood waters appropriated to the lands to be irrigated. An arrangement by which Modesto Irrigation District should transport this water was the obvious solution, and arrangement to that end was made through friendly suit against Modesto Irrigation District under Chapter 429, Statutes of 1915. This act amended section 1240 of the Code of Civil Procedure to permit one irrigation district to condemn property of another irrigation district when not inconsistent with its use by the latter. Acting pursuant to law, it was planned that the Railroad Commission should fix the price to be paid in this condemnation, but before the suit came to trial the two districts reached an agreement, and for a consideration of $254,000 Modesto Irrigation District agreed to enlarge and line the upper portion of its canal, and to convey to Waterford District a perpetual carrying right in such canal. The two districts share operation and maintenance costs in proportion to the amounts of water carried. Subsequent to entering into this agreement, that is, August 31, 1916, Waterford Irrigation District supplied itself with funds by voting bonds in amount of $465,000, and used the proceeds to pay Modesto District and to build a system of laterals.

Some water was diverted in 1918, but the first complete year of operation was in 1919, when about 15,400 acre-feet was used on 1023 acres. It was subsequent to this that, as previously indicated, the district purchased the old La Grange ditch right from Sierra and San Francisco Power Company. At the time of the construction of Don Pedro Dam, Modesto and Turlock districts succeeded to the rights of Sierra and San Francisco Power Company under its agreement with Waterford Irrigation District.

Waterford Irrigation District, after building its lateral system, has gone forward with its development, and in 1927 some 45 per cent of the net irrigable area was under irrigation.

Soils and topography.—Waterford District lies mainly in the lower rolling foothills. Immediately about Waterford the soils are Fresno sandy loams, similar to adjacent lands in Modesto Irrigation District. The main soils in the district, however, are classified as Altamont loams and clay loams and Altamont sandy loam.* The district is practically separated into eastern and western parts by Warner-Dallas Reservoir of Modesto District. The eastern part extends from the upper main canal of Modesto District to the bluffs above Tuolumne River. Here the land is rolling, but it becomes flatter adjacent to Modesto District west of Waterford. The elevation at Waterford is 170 feet. Because of ample natural drainage, artificial drainage is not required. The land in the district most suitable for irrigation is already under irrigation.

Development.—In 1927 there were 325 individual farm holdings, but there was still one large holding of 2687 acres. In the flatter lands alfalfa is the principal crop, but more than one-third of the entire

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California.

area is in fruit-tree plantings, mainly deciduous. Being more favorably situated as to frost than the valley land, a wide range of truck and horticultural products are grown. For instance, the 1927 crop report shows eight varieties of grapes, six different deciduous fruits, three varieties of figs, walnuts, almonds, persimmons, nursery stock, and ten different field and truck crops. The entire area can be reached with the present irrigation system.

The total population of the district is about 800, of whom about 220 are in the town of Waterford. A paved highway connects Waterford with Empire and Modesto. The land in the district is assessed for city and county purposes at approximately $750,000.

Water supply.—The nature of the water rights of the district was mainly set forth under "History." The engineer of the district estimates that the annual requirements are about 45,000 acre-feet. Since 1919 the amounts diverted for the district have ranged from 15,443 acre-feet, in that year, to 29,438 acre-feet, in 1927. The Division of Water Rights has recently allowed an application of Waterford Irrigation District for water stored on the Tuolumne River system by San Francisco, on the theory that such water is foreign water and subject to appropriation. Modesto and Turlock districts have refused to recognize this allowance and a suit has recently been filed in an attempt to establish this right.

Works.—Waterford District diverts from Modesto Canal, first, near lower Dominici Gulch about 15 miles east of Waterford, and again, above the Davis drop, about one mile east of the main outlet of Warner-Dallas Reservoir. The district operates 40.25 miles of unlined and 1.5 miles of lined canals; also 1.50 miles of concrete pipe line 12 inches to 42 inches in diameter.

Including the amount paid to Modesto Irrigation District for enlargement of Modesto Canal and for carriage rights, and the amount paid for the La Grange mining ditch water right, Waterford District had expended to December 31, 1927, $696,651.57 on capital investment. Of this, all but $50,017, raised by general district assessment, was obtained from bond issues.

Use and delivery of water.—Water is served on a rotation basis, the land receiving an irrigation about every 20 days. Measurements of deliveries to individuals are not made, but a record is kept of the amount diverted from the canal, and this has been referred to. The gross duty of water in acre-feet per acre for the past three years has been as follows: 1925, 5.77; 1926, 5.14; 1927, 6.05. Since the district has no storage, the amounts available in dry years may not exceed, during part of the season, the 60 cu. ft. per sec. obtained under the La Grange mining ditch right, and in such cases use will be materially restricted. Heretofore, there has been no incentive to conserve water, but if the area irrigated is to be increased, the present use on the land will need to be materially decreased. In this connection it should be remembered that Waterford District has been delivering water less than 10 years.

Waterford District does not undertake to deliver water beyond its main skeleton system, leaving it to the landowners to make necessary connections.

Bonds.—Two bond issues have been put out, totaling $670,000. Bonds amounting to $4,375 have matured and have been paid to January 1, 1928, leaving $665,625 outstanding. Other bonds outstanding against lands in the district total about $49,000, as follows: elementary and high school bonds, $30,000; general county bonds, $19,000.

Assessments and water tolls.—All income in the district is derived from district assessments. Land is assessed for district purposes at its cash value. A strip one-half mile around Waterford is assessed at $200 per acre, but the usual rate within the district is $120 per acre, with a low limit of $5 per acre. Land within the townsite of Waterford was assessed in 1927–28 for $59,671. The total assessed valuation for district purposes in 1927–28 was $1,069,751, the amount levied for 1927–28 being $66,695. During the past five years the annual assessment rate per $100 of valuation has ranged between $4.95 and $5.30.

MODESTO

Location: between Tuolumne and Stanislaus rivers, west of San Joaquin River, in Stanislaus County. (Pl. XIX.)
Date of organization election: July 23, 1887.
Gross area: 81,183 acres; **area assessed 1927:** 79,000 acres.
Principal city: Modesto.
Post office: Modesto.
Railroad transportation: main lines of Southern Pacific and Santa Fe railroads, Oakdale branch of Southern Pacific railroad, Modesto-Empire Traction railroad connecting Modesto with the Santa Fe at Empire, and Tidewater Southern Electric railway.

History.—*Modesto Irrigation District and Turlock District, its neighbor on the south, were the first districts organized under the original Wright act of 1887, and in fact the Wright act was prepared by and named for a resident of Modesto who was urged on in his efforts largely by the desire to break up the large grain farms in the areas around Modesto and Turlock through construction of irrigation works. It was realized that dry-land grain farming was ceasing to be profitable and that the only way to bring about community development was through irrigation. It was also realized that unless large landowners could be induced or be made to bear their portion of the cost of irrigation works, it would be impossible to proceed on an adequate scale with irrigation development.

A general outline of an irrigation act had been prepared by the first state engineer of California. In fact, a general irrigation act had been passed by the legislature of 1872, but was inoperative. Special irrigation acts were passed in 1874 and 1876, but they accomplished nothing. Finally, a special act creating Modesto Irrigation District, covering the area now generally embraced in Modesto and Turlock districts, was passed in 1878. This latter act pledged the credit of the state and Stanislaus County for the payment of bonds up to $500,000, and contemplated that these bonds should be repaid by increased taxes expected to follow an expected rise in land values. As in the case of previous special acts, nothing substantial resulted. With the passage of the Wright act in 1887, however, Modesto District and its neighbor on the south were organized and became active immediately.

* See also U. S. Dept. of Agr. Office of Experiment Stations Bul. 158, 93–139, and State Dept. of Eng., Bul. 2, 15–19 and 75–79.

Modesto District authorized bonds in the amount of $800,000 and a system of works was outlined. Stanislaus River was the first proposed source of supply, but this was later changed to Tuolumne River. Modesto and Turlock districts joined in building La Grange Dam for diverting water from Tuolumne River about 1 mile above the old mining town of La Grange, this dam being completed in December, 1893. By the time the first bond issue had been expended the district headworks, necessary flumes in the upper 9000 feet of the main canal, and all earth work down to the district boundary near Waterford, a distance of approximately 20 miles, had been completed.

A second issue of bonds amounting to $350,000 was authorized July 30, 1895, but no bids were received. By this time, the opposition to the district, which had been active from the beginning, came into control. When the district was formed in 1887 the affirmative votes numbered 700 and the negative 156, but 526 of the affirmative votes were cast in the town of Modesto, which was included in the district, indicating that from the start a majority of the voters outside of the city of Modesto were against the movement. From the early days of the district the opposition had engaged in litigation against the district. They sought first to have the original bond issue set aside, carrying their case to the state and United States supreme courts, but organization of the district and, with certain exceptions, its acts were confirmed. The controversies continued until 1901, by which time the opposition had been mainly overcome, and petitions representing 54,436 acres and an assessed real property valuation of $1,388,795 were presented to the directors, asking for refunding the indebtedness of the district, which by this time amounted to $1,056,511, including bonds, defaulted interest, and outstanding warrants. The cost of completing the system was estimated to be $284,000.

In January, 1902, after reaching an agreement with the bondholders and other creditors, refunding bonds amounting to $1,056,511 were carried by a vote of 433 to 24. By the following July contracts for completing the work were let, and on October 6, 1903, work under the last contract was accepted and the district, after 16 years of trouble, was ready to receive and deliver water. With this stage reached Modesto District became a sound and going enterprise.

The history of Modesto Irrigation District, from the first completion of its works in 1903 to the present, involves many matters of great interest for which space is not available in this report. There have been periods of calm and periods of bitterness, and it has been necessary to carry through to sucessful issue controversies of vital importance in the life of the enterprise. These have involved nearly every phase of irrigation district policy, but regardless of them, the district has gone steadily forward. Old, temporary wooden structures have been replaced with permanent structures and the system has been enlarged to a diversion capacity of 2000 cu. ft. per sec. from a few hundred cu. ft. per sec. in 1903. Laterals have been extended, a foothill reservoir has been provided, and, jointly with Turlock Irrigation District, Don Pedro Dam and power plant have been constructed; drainage has been provided, both gravity and pumping, and a hydro-electric power transmission system with necessary substations and stand-by plants has

been built. In the meantime, the area irrigated has increased to 65,541 acres in 1928, or about 85 per cent of the net irrigable area, not counting some 3000 acres double-cropped.

Soils and topography.—The soils of Modesto District are in the main classified as Fresno sandy loam.* There are, however, considerable areas of Madera and San Joaquin loams, undifferentiated, in the eastern portion of the district, Madera loams running easterly and westerly through the central portion of the district, and some Fresno loams toward the west.

Alkali is indicated in some of the Madera loams north of Modesto and in portions of the Fresno loams and Fresno sandy loams in the western portion of the district. It is apparently only in spotty areas in the western portion of the district, however, that alkali is sufficient to affect crop production. The surface of the land is mainly even, with a gentle slope toward the west. In 1927 ground water stood less than 8 feet from the surface over 25,020 acres and less than 4 feet over 4540 acres. The water table, however, is believed to be under control, although some additional drainage pumps will be needed.

Development.—In the twenty-five years during which irrigation water has been available to this district, economic conditions of agriculture and prices of farm land have undergone a great change. In 1904 the most valuable land in the district could be purchased for $75 an acre, and the usual price was from $40 to $60 an acre. Modesto had a population of about 2500, and Salida and Empire were flag stations on the railroads. The district now estimates the actual value of farm lands, including improvements, at $18,500,000, and city and town property, including improvements, at $22,000,000. Modesto now has a population estimated at 17,800 and covers an area of 1800 acres. Salida and Empire together have an estimated population of 400, and the number outside of these towns and the city of Modesto is about 6800.

There are approximately 5000 separate ownerships in the district, of which 2000 are outside of the towns, making an average of about 38 acres to the holding for the net irrigable area of 76,240 acres. There are still two large holdings of 878 and 270 acres. Approximately 25 per cent of the farmed land is in alfalfa, and from one-seventh to one-sixth each in field crops, deciduous fruits, and vines.

Good highways, largely paved, extend throughout the district, and both Modesto and the towns, as well as the farms, show excellent types of buildings. The estimated assessed valuation for county purposes in 1927 was $20,400,000.

Water supply.—The water rights of Modesto District in Tuolumne River are based on (1) purchase of old rights dating back to 1854 from M. A. Wheaton, (2) a filing of 250,000 inches on June 21, 1890, (3) a filing on October 1, 1908, for 50,000 inches "in addition to the 850 second-feet heretofore appropriated and utilized," (4) agreements with Turlock Irrigation District as to the division of the water available at La Grange Dam, (5) a declaration in the Hetch Hetchy grant of 1913 that Turlock and Modesto irrigation districts are entitled to take 2350 cu. ft. per sec. at La Grange Dam, and (6) permits 1164–5–6 issued by the State Division of Water Rights to cover storage at Don Pedro Reservoir.

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California, and Soil Survey of the Modesto Area, California.

Tuolumne River has a mean annual discharge at La Grange of about 2,000,000 acre-feet. There are, of course, periods of low flow, one of these occurring in 1924 when the discharge was about 574,000 acre-feet. Diversions since 1916–17 have ranged from 214,020 acre-feet, in the low-flow year of 1924, to 327,886 acre-feet, in 1923. In only four of the last eleven years has the total diversion been less than 250,000 acre-feet, and in three years it has exceeded 300,000 acre-feet. Since the installation of drainage wells a considerable quantity of water has been obtained from that source, the amounts during the past four years ranging from 12,449 acre-feet, in 1925, to 29,268 acre-feet, in 1927. The water supply can be considered as ample for the entire district, except that very low years will require some curtailment in deliveries, which are normally ample or more than ample. Of the 291,300 acre-feet gross storage capacity in Don Pedro Reservoir, 31.54 per cent is available to Modesto Irrigation District. Modesto District also has Warner-Dallas foothill reservoir with a storage capacity of 30,000 acre-feet. Further, under the Hetch Hetchy grant, Modesto Irrigation District, along with Turlock District, has the right to purchase water from the Hetch Hetchy system of San Francisco in years of drought, and in the dry year of 1924, 100,000 acre-feet was released for use by the two districts.

Works.—Don Pedro Reservoir and power plant and La Grange Dam, both owned jointly by Modesto and Turlock districts, are the important features of the upper works. When constructed in 1893, La Grange Dam was recognized as one of the highest, if not the highest, overpour dams in existence. It is built of masonry and rises 127 feet above river bed. It cost a little over one-half million dollars. Don Pedro Dam is some 6 miles above La Grange Dam and rises 271 feet above streambed. It has a crest length of 1020 feet. The dam was calculated as a gravity section, although curved in plan with a constant radius. A total of 281,800 cu. yds. of concrete was placed in the dam, spillway, and powerhouse. The total cost of these structures, of which 31.54 per cent was paid by Modesto District, was $4,864,824.34. The power plant below Don Pedro Dam has a generating capacity of 30,000 k.w., of which 15,000 k.w. has been installed in 1928.

Modesto Canal diverts water from the north end of La Grange Dam through a canal having a capacity of 2000 cu. ft. per sec. extending for 22.69 miles along the river bluffs and over rough table land through Dallas-Warner Reservoir, approximately 13 miles from the dam, to the eastern boundary of the district, thence along the northeastern and northern boundary of the district 21.96 miles to Stanislaus River. The various main laterals within the district divert at intervals of from 2 to 4 miles and flow westerly. In all, the district operates 20 miles of lined and 140 miles of unlined main canals. About 450 miles of smaller laterals, some of which cover several sections, are owned by individual farmers.

Drainage canals and pumping plants constitute an important part of the works of the district. The first drainage canal was built in 1907 at a cost of $16,000 and served the western part of the district. Beginning again in 1918, the district has annually made important investments in gravity drains and repairs, totaling at the end of 1927, $268,668. In 1923 the district began installing drainage pumps, of which 39 were operating in 1927 and 11 more were to be put into service

in 1928. The drainage wells are equipped with well turbines. During the past eleven years drainage operations have decreased, the area having ground water less than 6 feet below the surface, from 29,300 acres to 25,020 acres, and has reduced the area having ground water less than 4 feet below the surface from 10,600 acres to 4540 acres. These are the net reductions as of 1927, the area fluctuating up and down within the period.

The total capital investment in irrigation works to December 31, 1927, including the Modesto District share of Don Pedro Reservoir, but including no expenditures for power houses or other electrical equipment, was $5,193,029.

Hydro-electric development.—After long and somewhat heated discussion, Modesto District, at an election held June 1, 1922, decided by vote of 1468 to 605 not to dispose of its share of Don Pedro power wholesale, but rather to distribute it within the district. The first electric meter was connected on November 15, 1923, and by December 31, 1927, a connected load of 18,882 k.w. was being served through 7022 active meters. The district has encouraged the use of power on the farms by making line extensions under a liberal policy, and its rates have encouraged the installation of electric stoves and heating systems. The total capital investment in the electrical system to December 31, 1927, was $1,709,371, of which the largest items have been as follows: power house, $452,304; transmission, $66,236; distribution, $799,966; substation, $105,505; and steam plant, $120,965. The bonds issued on account of the electric system outstanding December 31, 1927, amounted to $1,055,000. The cash income from power sales in 1927 was $433,871, and the total expense for the year including $63,450 for interest, but not including depreciation, was $171,027. The amount of power available at Don Pedro power house, after deducting deliveries on account of a contract with Sierra and San Francisco Power Company under which the old La Grange power system was taken over, was 24,777,756 k.w.h. Energy metered by the district during the year was 18,483,690 k.w.h., showing a distribution and transmission loss during the year of 25.4 per cent.

The electrical department does not pay interest on any portion of the capital invested in Don Pedro dam and reservoir. It does pay interest on the bonds voted for the power house, for transmission, and for the distribution system. Almost all of the cash income has been invested in the system, and this accounts for the excess capital investment over bonds outstanding. No depreciation has been included because past depreciation deductions by the district have not followed a consistent plan.

Use and delivery of water.—Water has always been used plentifully in Modesto Irrigation District, but late summer and fall shortage existed prior to provision of storage. Anticipating deficiency in the summer and fall, irrigators were accustomed to apply water as long as available. Construction of Dallas-Warner Reservoir with the capacity of 30,000 acre-feet was a step toward making up the shortage, but it was not until water was made available from Don Pedro Reservoir that irrigators were assured a full-season supply in all but very lean years. Even in the recent low-water year of 1924, and including water pumped from drainage wells, gross diversions per acre were 3.79 acre-feet, with 59,899 acres irrigated. This was the smallest diver-

sion per acre since 1919, when it was 3.96 acre-feet, with 55,475 acres irrigated. The present use is set forth in the following tabulation covering the seasons 1922–23 to 1926–27:

Year Oct.-Sept.	*La Grange diversion, acre-feet*	*Water pumped, acre-feet*	*Total water available, acre-feet*	*Area irrigated, acres*	*Gross duty, acre-feet per acre*
1922–23	327,886	-----	327,886	61,770	5.32
1923–24	214,020	13,443	227,463	59,899	3.79
1924–25	281,976	12,449	294,425	63,898	4.61
1925–26	285,900	21,369	307,269	64,457	4.75
1926–27	303,668	29,268	332,936	64,882	5.14

The total amounts of water delivered to irrigators are not recorded, although the amounts supplied to individual irrigators are measured with sufficient accuracy to meet the needs of water distribution. These measurements of deliveries are made over weirs and through delivery gates used as submerged orifices. In the last record available there were listed 377 weirs of which 240 were concrete, and 980 delivery gates of which most were concrete, with cast-iron or wood slides. During the past eight years over $180,000 has been spent for weirs and gates of a permanent nature. Of the 64,882 acres irrigated in the season of 1927, 3018 acres was double-cropped. The area dry-farmed and in pasture in that year was 8934 acres. In handling water delivery, 16 delivery divisions are set up with a ditchtender for each.

Bonds.—Beginning with the refunding issue of May 1, 1902, Modesto has voted a total of $5,219,511 in bonds, but of these, $48,000 have been destroyed and $236,000 remain unsold. A total of $383,353.30 have been retired, leaving outstanding January 1, 1928, $4,454,157.70. Fourteen issues have been put out, beginning with the refunding issue of 1902, the favorable votes generally being very large, the smallest ratio having been better than 2 to 1. Issues Nos. 1 and 2 were refunding bonds and were dated May 1, 1902, and January 5, 1904. Issues 3 and 4, dated July 1, 1909, and January 1, 1911, were turned over to contractors through a third party. The remaining issues were sold for cash. Bonds to the amount of $25,000 were purchased by the state for the School Teachers' Retirement Fund.

General county and school bonds against lands in the district total approximately $2,600,000, as follows: elementary school, $464,800; high school, $272,000; city of Modesto and street bonds, $876,750; general county, $450,000.

Assessments and water tolls.—Farm land in Modesto Irrigation District is assessed for district purposes at from 33 to 40 per cent of its cash value, a zoning system being used with centers at Modesto, Salida, and Empire. The valuations decrease from $150 per acre at the rate of about $3 per acre for each half mile from the zone centers until a base price of $70 per acre on good farm land is reached. City property in Modesto is assessed at 25 per cent of its cash value, using a zone system with the center at Tenth and I streets. The highest valuation in Modesto is $8,000 on a lot 25 by 140 feet. Residence lots are assessed at from $300 to $500 for each 50-foot lot. About 26 per cent of the total district assessments are received from city property. The total assessed valuation in 1927–28 for district purposes was $7,436,880, and the amount levied for that year was $446,212. For the past five years the district assessment rate per $100 of valuation has been $6, with the exception of 1924–25, when it was $6.40. No water tolls are imposed.

TURLOCK

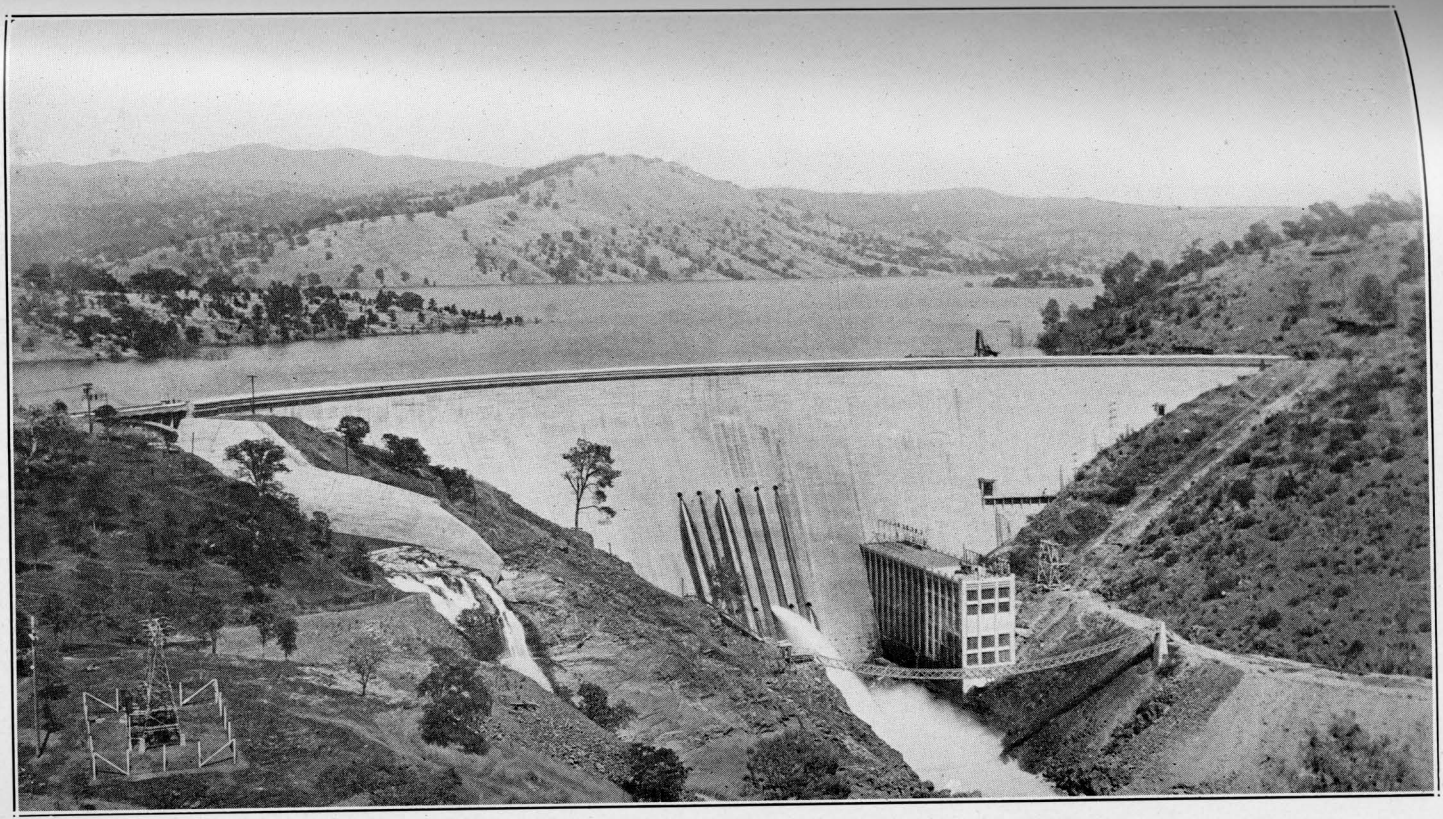
Location: west side of San Joaquin Valley between Tuolumne and Merced rivers, in Stanislaus and Merced counties. (Pl. XIX.)
Date of organization election: June 6, 1887.
Gross area: 181,498 acres; **area assessed 1927:** 177,082 acres.
Principal city: Turlock.
Post office: Turlock.
Railroad transportation: main lines of Southern Pacific and Santa Fe railroads and Tidewater Southern Electric railway.

History.—Turlock Irrigation District has been so closely identified with Modesto Irrigation District that for matters relating to its history reference is made to the preceding statement regarding Modesto Irrigation District.* The two districts are together in the matter of water rights and water supply, with Turlock holding a 68.46 per cent interest therein. They are also together in the same proportion in ownership of Don Pedro Dam, Reservoir, and Powerhouse, and La Grange Dam. Their problems of canal construction, water distribution, finance, and management are similar, although each has worked them out in its own way. Turlock District was the first of the two to organize, preceding Modesto District by about two months. They passed through parallel periods in controversy and litigation, but met the problems of reorganization somewhat differently.

The principal part of the construction of Turlock system below La Grange Dam was done during the period 1897 to 1901, and water for 3757 acres was supplied in the latter year, which was the first year of operation. Turlock was then but a village, lying entirely on the west side of the Southern Pacific railroad. Its streets were of sand and its business was done chiefly in a few general merchandise stores. Ceres was even smaller, and what are now important local towns were then sidings or railroad stations. The farmers of Turlock District seemed to have greater difficulty during the first few years than those of Modesto District in adjusting themselves to the new conditions irrigation water had created. Internal friction was exceedingly bitter at times, and the inexperienced directors were slow in grasping the need for putting district affairs on a business basis. During the last fifteen years district affairs have moved both smoothly and efficiently, and a continuous, constructive policy has been maintained. Probably no cooperative irrigation enterprise has been handled better and achieved a more commendable success than has this one.

Soils and topography.—The major soils of Turlock Irrigation District are classified as Fresno sandy loam and Oakley sands, with Madera and San Joaquin sandy loams undifferentiated in the north central portion.† A considerable area is of rolling topography, with frequent low pockets south and west of Turlock. Alkali is indicated west of Turlock and in the lower areas near San Joaquin River. Hardpan is found over much of the district, but is not continuous or of sufficient depth to be greatly detrimental. Drainage has been found necessary and has been provided to an extent that enables the district to state that they no longer have a drainage problem. The average ground water depth in the spring has been reduced from 3.2 feet below the surface, in 1916, to 6.36 feet, in 1927, and in the summer from 4.06 feet below the surface, in 1917, to 5.68 feet, in 1927.

* See also U. S. Dept. of Agr., Office of Experiment Stations Bul. 158, 93–139, and State Dept. of Eng., Bul. 2, 15–19, 75–84.
† U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California.



Don Pedro Dam, Reservoir, and Power House, Turlock and Modesto irrigation districts.

Development.—Nearly 75 per cent of the net irrigable area of Turlock District is now irrigated. The city of Turlock has reached a population of 6000, Ceres 1500, the smaller towns 800, and the area outside of cities and towns 12,000, or about 20,000 for the entire district. While generally looked upon as an important center for raisin grapes, peaches, and melons, dairying ranks as one of the more important industries, 29 per cent of the irrigated land being in alfalfa. Nearly 30,000 acres of beans were grown in 1927, and there was more than 20,000 acres in grain. District assessment payers now number 7354, and there are about 2500 separate farms. There are only three holdings that may be classed as large, one of 4518 acres, one of 3727, and one of 705 acres. Farm lands are estimated to have reached a total value of $30,000,000, not counting farm buildings with an estimated value of $7,000,000. The main state highway passes through the center of the district, with improved roads connecting it with all important areas.

Water supply.—The water supply of the district has been mentioned in referring to that of Modesto Irrigation District. Briefly, it consists of 68.46 per cent of the water obtained from Tuolumne River through purchase of the old Wheaton rights and through later appropriations for both direct diversion and storage. The main early water filing of Turlock District was 225,000 miners inches, posted January 5, 1889, and the main filing for storage, 200,000 miners inches, posted August 31, 1911. Later storage and diversion rights are covered by permits 1164, 1165, 1166, and 1699 issued by the State Division of Water Rights.

With the exception of earlier rights to about 60 cu. ft. per sec. held by Waterford Irrigation District, La Grange Gold Mining Company, and the old mining town of La Grange, Modesto and Turlock districts are generally conceded to have the first right to take the natural flow of Tuolumne River up to the amount that they can apply beneficially. In a year of shortage they can rely to some extent on purchasing water from the Hetch Hetchy system of San Francisco, as set forth in the Hetch Hetchy grant by congress. In order to insure further against shortage, the two districts have applied to the Federal Power Commission and the State Division of Water Rights for permits to store about 80,000 acre-feet of the water of south and middle forks of Tuolumne River, but this project is still in its preliminary stages. The district considers that, on the average, about 786,000 acre-feet annually will ultimately be available to the district.

Since 1915 the total annual diversions at La Grange Dam have ranged from 304,564 acre-feet, in 1919, to 498,986, in 1923. After deducting losses between La Grange Dam and the district, the amounts available during this period have ranged from 258,855 acre-feet, in 1919, to 420,438 acre-feet, in 1923, not counting water added to the canals since 1922 by the drainage pumps. The amount obtained from the latter source increased from 13,650 acre-feet in 1923 to 71,205 acre-feet in 1927.

Besides owning 68.46 per cent of 291,300 acre-feet gross storage in Don Pedro Reservoir, Turlock District has built the Owen foothill reservoir with a capacity of 48,740 acre-feet, this being on the line of the main canal between La Grange Dam and the district.

Works.—In describing the works of Modesto Irrigation District, brief descriptions were given of Don Pedro Dam, Powerhouse and Reservoir and La Grange Dam, owned jointly with Turlock Irrigation District,

and mention has just been made of Owen Reservoir. The other major works of Turlock District consist of 80 miles of lined and 170 miles of unlined main canals, 80 drainage wells and pumps, and some 750 miles of unlined and 50 miles of lined farmers' laterals. The main canal has been enlarged to a diverting capacity of 2200 cu. ft. per sec. The main supply canal below Owen Reservoir has a capacity of 1700 cu. ft. per sec., and carries that quantity to the district line a few miles east of Hickman. At that point the high-line canal takes out about 250 cu. ft. per sec. and covers the eastern and southeastern portion of the district. Below Hickman the main canal feeds successfully Ceres and Turlock main canals, which, with their various laterals, supply the main portion of the district. Practically all of the canal structures are now of concrete, and all new service outlets are equipped with iron slide gates. Drainage wells and pumping equipment in the district are described in Univ. of Calif., Agr. Exp. Sta. Bul. 382. These are located throughout the heart of the district.

The total investment by Turlock Irrigation District in irrigation and drainage works to December 31, 1927, was $6,372,399.85, which included a reserve for depreciation and contingencies. The above does not include capital investment charged to power.

Hydro-electric development.—The total power installation at Don Pedro Power House is 30,000 k.w., one-half of this capacity having been put into service May 1, 1928. The share of Turlock District in this power is 68.46 per cent. An additional power plant has been installed by Turlock District alone below La Grange Dam having a generating capacity of 4000 k.w. This plant was placed in operation on December 12, 1924.

On June 21, 1922, the people of Turlock District voted to distribute power generated at Don Pedro Power House, and on October 23, 1923, by a vote of 1087 to 28, approved a bond issue of $500,000 for power distribution. On March 11, 1924, they entered into a contract with San Joaquin Light and Power Corporation under which the district agreed not to sell power outside of certain boundaries, and the power corporation agreed to take the entire surplus of Turlock District from the Don Pedro power plant, provided that the rate of delivery should be not less than 6500 k.w. from June 1 to December 31 of each year, or more than 2500 k.w. from January 1 to May 31. The power company also agreed to take future surplus output at Don Pedro. In years in which the run-off of Tuolumne River is less than 1,900,000 acre-feet from January 1 to July 31, Turlock District is not obligated to deliver to the power corporation in excess of 65 per cent of their share of Don Pedro power. The price paid by the power corporation to the district under this contract is 4.5 mills per k.w.h. for energy delivered at the Livingston substation, at not less than eight-tenths load factor. The above contract remains in force for 15 years and may be renewed by the district for an additional like period.

The total investment of Turlock District charged to power as of December 31, 1927, was $3,780,944.41, of which $2,437,956.09 was for generating capital, $310,967.32 for transmission, and $1,008,647.56 for distribution. The total for generating capital includes one-half of the shares of Turlock District in the cost of Don Pedro dam and reservoir, the amount so included being $1,471,996.47. The outstanding bonds charged on the district books against the electric system amount to

$1,381,000. In 1927 the total cash income from power sales, not including power delivered to Pacific Gas and Electric Company on account of purchase of the old La Grange power system, amounted to $515,161.49, and the operating expense, including interest totaling $162,650.35, but no depreciation, amounted to $258,179.02. In 1927 the total Turlock power generated reached 76,789,300 kw-h., of which 22,423,000 kw-h. was distributed inside the district. Active meters in service December 31, 1927, numbered 5035.

Use and delivery of water.—The water distribution system of Turlock District is a skeleton covering the entire area. Farmers are required to make their own connections to lateral canals. Associations of farmers and individuals build and maintain the laterals which tie in to the district canals. Under the act of the legislature approved May 25, 1927, several improvement districts are being organized within Turlock District for the concrete lining of distribution laterals, this improvement having been made on about 10 miles of laterals to date. If the act under which this work is being done is not declared unconstitutional, it is proposed to improve several hundred miles of laterals at the rate of about 50 miles per year.

Measurements of deliveries are made over weirs or through submerged orifices, or in some cases are merely estimated. Ditchtenders take a receipt for each delivery and from these receipts the total deliveries for the year are calculated. Deliveries reached a total of 310,257 acre-feet in 1927, the maximum to date having been 313,364 acre-feet, in 1926.

The gross duty of the system since 1915, in acre-feet per acre, has varied from 3.00 in 1919 to 4.63 in 1923. The net duty during this period has ranged between 1.11 acre-feet per acre in 1919 and 2.50 acre-feet per acre in 1926, the former figure not including water delivered as 'garden heads' on a continuous flow basis. The differences between net and gross duty indicate losses ranging from 36.2 to 63 per cent. In this connection it is interesting to note that of the total miles of canals operated by the district, 32 per cent are lined, but of the 800 miles of farmers' laterals, only 6 per cent are lined. It might be well to recall also that the soils of the district are predominatingly sandy. Finally, it might be noted that the percentage of loss has been decreasing in recent years, dropping to between 36.2 and 43.6 during the past four seasons from a range of 50.8 to 63.0 during the preceding nine seasons. The district reports that this decrease has been brought about through increase in the irrigated area, lining of main lateral canals, and use of water pumped from drainage wells.

Water is usually served in rotation, with variations to meet crop demands. The district is divided into twenty-six operating divisions, within each of which a ditchtender controls deliveries. The ditchtenders are responsible to the water superintendent, who in turn reports to the chief engineer.

Bonds.—Beginning with the refunding issue of December 10, 1901, nine bond issues have been put out, totaling $7,869,900, of which $7,313,900 were outstanding January 1, 1928, after retirement to that date of $555,100. The funding issue of 1901 was for $1,156,000 and carried maturities from 1922 to 1941. The next three issues were put out in 1905, 1910, and 1911, and together their maturities extend from 1926 to 1942. They were all sold to contractors. Issues 4, 5, and 6

are dated July 1, 1920, and have combined maturities from 1936 to 1960. Issues 7 and 8 are dated January 1, 1924, and have combined maturities from 1927 to 1946.

General, school, and special assessment bonds against lands in Turlock District total about $1,400,000, of which $268,000 are for Merced County and the remainder for Stanislaus County. Bonds issued in Stanislaus County are divided as follows: high school, $178,000; city of Turlock and Turlock street bonds, $293,875; and general county bonds, $375,350; those issued in Merced County are: school bonds, $37,400; road bonds, $162,000; general county bonds, $68,600.

Assessments and water tolls.—Turlock Irrigation District assesses land for district purposes at about 40 per cent of its cash value. About half of the district is assessed at $100 to $125 per acre. Poor agricultural land is reduced to $20 to $40 per acre. The highest assessment on town lots in Turlock is $60 per front foot for business lots 150 feet deep. The total assessed valuation for district purposes in 1927–28 was $13,360,665, and the amount of the levy for 1927–28 was $601,229, of which $36,580, or about 6 per cent, was on town lots. No water tolls are charged. During the past five years the district assessment rate per $100 of valuation has been $4.50, with no increase in assessed valuation.

MERCED

Location: main portion of Merced County south of Merced River and east of San Joaquin River. (Pl. XIX.)
Date of organization election: December 8, 1919.
Gross area: 189,682 acres; **area assessed 1927:** 185,682 acres.
Principal city: Merced.
Post office: Merced.
Railroad transportation: main lines of Southern Pacific and Santa Fe railroads, Oakdale branch of Southern Pacific railroad, and Yosemite Valley railroad.

History.—Merced Irrigation District is the fifth largest district in California, and one of the most important. It was organized after a long period of investigation and discussion, the landowners realizing that agricultural development had about reached its limit with the water supply then available. The Crocker-Huffman Canal, operated by Crocker-Huffman Land and Water Company, had for some years been supplying water to the area of which Merced was the business and geographical center. This company in 1888 purchased the property of Merced Canal and Irrigation Company, which, in 1883, had taken over the old Farmers Canal, constructed in 1876. Farmers Canal was the first to divert water from Merced River for irrigation on the main valley floor and adjacent plains.

At the time Merced Irrigation District was formed, the Crocker-Huffman system had been extended to cover about 100,000 acres, of which 52,000 acres was under water-right contracts, with about 40,000 acres irrigated in years of plentiful supply. It was realized that with storage provided, a very much larger area could be irrigated. A storage site on Dry Creek, north of Merced River, had been purchased by the Crocker-Huffman interests, and sufficient surveys and water studies had been made to indicate that an enlarged project with storage at that site was feasible.

In 1917 and 1918, the Merced Farm Bureau assumed leadership in a movement to work out an irrigation project, and in June of that year, requested the State Department of Engineering, the Division of Irrigation Investigations of the U. S. Department of Agriculture, and the Division of Irrigation Investigations and Practice of the College of Agriculture to make a study and report. Such a report was submitted under date of October 12, 1918, and with the assistance of those who had prepared the report, the boundaries of a district were outlined.

Sentiment was not unanimous in favor of such a move, and strong opposition soon developed, this coming mainly from some of the large landowners and groups of owners of smaller holdings around Plainsburg and Atwater. Before the petition for the formation of Merced Irrigation District could be acted upon by the supervisors of Merced County, petitions for the formation of five smaller districts within the proposed boundaries of the larger district were presented to the supervisors and sent to the state engineer. These smaller proposed districts were the Nairn, Plainsburg, Atwater, Winton, and Bloss, the latter including the holding of one individual only. When the matter of organizing Merced Irrigation District was finally acted upon by the board of supervisors on October 9, 1919, they excluded the area within Plainsburg District and allowed it to organize independently, denied the petitions of the other four small districts, and approved the petition of Merced District. Opposition continued but organization of Merced District was carried in the following December, with 922 out of the 2889 votes cast being against the proposal. Many of those who voted against formation were the owners of small tracts, particularly in the areas centering in the Planada, Franklin, McSwain, and Atwater sections.

As soon as organized, Merced Irrigation District started the engineering investigation required to determine the best plan and probable cost. The studies resulted in abandonment of the proposed Dry Creek storage, substituting storage on Merced River near the old Exchequer mine, because of the possibilities of hydro-electric development at that point. The engineer's report was submitted in January, 1921, and called for a total expenditure with complete development of $15,850,000. The estimated capitalized value of the energy to be produced at the powerhouse was $6,932,000, figured at 0.5 cent per k.w.h., leaving an estimated average net irrigation cost against lands in the district of $46.93 per acre.

Under the plan recommended it was proposed to purchase the Crocker-Huffman system at an estimated price of $1,750,000, build Exchequer Dam at a cost of $4,448,000, with a 20,000 k.w. power plant costing $2,000,000; construct Exchequer Canal from Exchequer Dam through Millerton Divide to reach the southeastern portion of the district too high to be watered by gravity from an extension of Crocker-Huffman Canal, this feature being estimated at $1,225,670; and to improve and extend the distribution system throughout the district and complete the drainage system. Relocation of the Yosemite Valley Railroad to take it out of the proposed Exchequer Reservoir site was estimated to cost $3,000,000.

On review by the Irrigation District Bond Commission and further study by the district, Exchequer Canal was eliminated and pumping to the lands above an extension of Crocker-Huffman Canal substituted, and changes were made in the Yosemite Valley Railroad relocation, bringing the total estimated cost down to $12,000,000.

The district thereupon took up construction. The Crocker-Huffman system was purchased for $2,250,000, title passing to the district on January 18, 1922. A board of arbitration awarded the Yosemite Valley Railroad $463,000 to cover additional maintenance and operation costs to result from relocation of the railroad by the district. The works of the three small drainage districts within the district were taken over. Agreements were made with respect to water rights for land along Merced River, thus eliminating objection by the owners of that land to storage in Exchequer Reservoir. Agreements were also made with holders of water rights under the Crocker-Huffman system by which compensation was to be made to them by the district. A contract was made with San Joaquin Light and Power Corporation under which the power to be generated at the Exchequer powerhouse would be purchased by that company at 4.5 mills per k.w.h.

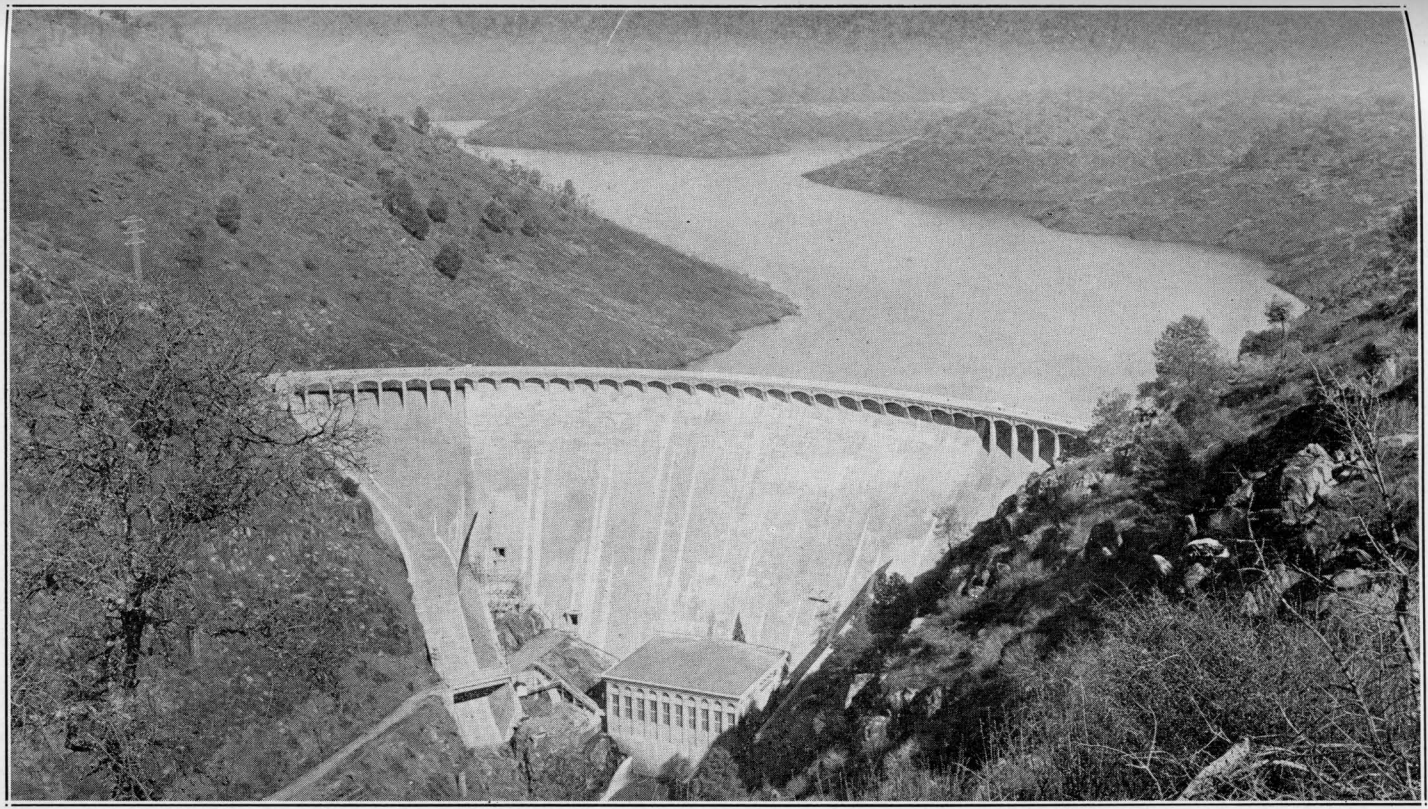
After receiving bids for the construction of Exchequer Dam, the district, on August 3, 1923, had decided to proceed under force account. Prior to this, bonds to the amount of $4,920,000, of the $12,000,000 voted had been sold, and construction of the distribution system within the district had gone rapidly forward. In December, 1923, after partially laying the foundation of Exchequer Dam, its design was changed on recommendation of the state engineer from a constant-angle arch to a gravity section, arched in plan.

By this time it was evident that additional bonds would be needed to complete construction of the various works and on March 31, 1924, $3,250,000 were authorized by a vote of 2662 to 272. An agreement for the sale of these and the $5,760,000 remaining of the $12,000,000 issue was made March 31, 1924. Immediately thereafter contracts were let for the construction of Exchequer Dam and for re-location of Yosemite Valley Railroad. Unstable ground encountered in the cuts and tunnels along the new railroad caused changes in slopes and made lining of the tunnels necessary. For this a third bond issue of $1,000,000 was found necessary and this was authorized March 31, 1926. This brought the bonded debt of the district to $16,250,000.

Exchequer Dam was completed early in 1926 and on April 20 the gates were closed to begin storage. On June 23, 1926, the reservoir and power house were officially dedicated, water being passed through the turbines when President Coolidge pressed a golden key in the White House. In 1927, the reservoir formed by Exchequer Dam was formally named Lake McClure in honor of the late state engineer, Wilbur Fisk McClure, and in recognition of his fine service to irrigation in California during his incumbency in the office of state engineer.

Soils and topography.—The soils of the district are mostly of the Fresno, Madera, and San Joaquin series.* Madera and Fresno sands cover the main portion of the area north of Merced and west of the Santa Fe Railroad. A strip of Madera clay runs north and south-

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Merced Area, California.



Exchequer Dam and Power House and Lake McClure at low water stage, Merced Irrigation District.

westerly from Merced. The southern portion of the district is almost entirely Merced silt loam, this extending northeast of Merced within a few miles of Lake Yosemite. Soils of the San Joaquin series lie generally north of Merced.

Alkali is indicated in spots south and west of Merced. The district states that the area sufficiently impregnated with alkali to affect crop production is probably about 5000 acres. In 1927, when the ground water stood at its peak for the year, about 80,000 acres south of Merced and west of the Santa Fe Railroad required drainage. Ground water stood from 3 to 5 feet below the surface over about 35,000 acres and less than 3 feet from the surface over about 10,000 acres. Plans for drainage are described hereafter.

Development.—At the time Merced Irrigation District was organized, irrigation was scattered over an area of more than 100,000 acres, but that area was not all receiving water. When a supply was available, Crocker-Huffman Canal irrigated up to about 40,000 acres. There were, however, a large number of private pumping plants. The district crop survey for 1927 shows 111,858 acres irrigated by gravity, including 5690 acres served by booster plants lifting from the gravity canals. The number of private pumping plants is now about 300 and they serve about 10,000 acres. There are approximately 2300 farms in the district, but there are also still a number of large holdings, including one of 20,540 acres and four of between 3000 and 4000 acres.

Six incorporated cities and towns lie within the district boundaries, with an aggregate population of nearly 10,000, of whom 7600 are in Merced. The estimated population outside of the cities and towns is 11,700.

In 1927 deciduous fruits and vines covered about 37,000 acres, about 26,000 acres was in alfalfa and field crops, about 8,000 acres was in rice, and over 13,000 acres in pasture. There is still much need for subdivision and settlement.

Water supply.—The water rights of the district are founded upon the old appropriation of Crocker-Huffman Land Water Company and its predecessors, and on permits 912, 913 and 914, granted by the State Division of Water Rights, September 27, 1921. Permits 912 and 913 authorize the diversion of 2400 cu. ft. per sec. for power development, with storage and re-storage up to a total of 850,000 acre-feet per year, with a greater quantity than this allowed if it can be used without interference with other users. Permit 914 is for irrigation and authorizes the storage of 300,000 acre-feet per annum and diversion into the canals of the district of a maximum of 1500 cu. ft. per sec., provided the total diversion under this permit and under the old Crocker-Huffman rights shall not exceed one cu. ft. per sec. for each 80 acres of land irrigated. The old Crocker-Huffman rights have not been adjudicated, but the district claims the right to diversion of 1600 cu. ft. per sec. under them. All of the above rights are subject to rights of certain landowners along Merced River, as set forth in the case of *A. E. Upton et al* vs. *Crocker-Huffman Land and Water Company*, and as modified by agreement with most of those benefited under it, and with the owners of the Cook and Dale ranch. As modified, the district is to maintain a flow in Merced River ranging from 100 to 250 cu. ft. per sec. below Crocker-Huffman Dam during the irrigation season, and 50 cu. ft. per

sec. during the remainder of the year; also it is to permit a maximum flow of 24 cu. ft. per sec. when needed, and a minimum flow of 3 cu. ft. per sec. to the owners of the Cook and Dale ranch. With these agreements made, all objection to storage and diversion by the district was waived and the suits previously filed were dismissed. A suit entitled *Collier* vs. *Merced Irrigation District,* in which lower riparian owners sought to enjoin storage and diversion by the district was recently decided in the superior court in its favor, and the plaintiff has appealed. Another suit against the district by lower riparian owners, entitled *Stevinson et al.* vs. *Merced Irrigation District,* is still pending.

The mean annual flow of Merced River is about 1,000,000 acre-feet. A water supply study made by the district covering the years 1901 to 1919, during which period the mean annual flow of the river was 1,152,000 acre-feet, indicated that a draft of 470,000 acre-feet per annum could be maintained from the natural flow and from a reservoir storing 250,000 acre-feet. The average annual excess was estimated at 682,000 acre-feet, with only one year having a deficiency of 29,000 acre-feet after deductions for all prior rights. The years of subnormal flow, 1921 to 1926, have reduced the mean discharge to about 1,000,000 acre-feet but the reservoir capacity is 289,000, instead of 250,000 acre-feet.

No measurements of total diversions are available, except for 1927. In that year 575,760 acre-feet was run through the turbines at Exchequer, 441,136 acre-feet was spilled and by-passed, and after yielding 547,170 acre-feet for irrigation in the district and to meet priority demands, 469,726 acre-feet was still available below Crocker-Huffman Dam. These figures are approximations.

Works.—Exchequer Dam, the major engineering feature of the works of the district, is built across a narrow gap in the canyon of Merced River about seven miles above Merced Falls. Above this point there is a watershed of about 1000 sq. mi. in the Sierra Nevada, including a large part of Yosemite National Park. The dam rises 326 feet above the stream bed and when completed, in 1926, was claimed to be the highest in the world. The structure is of gravity section arched in plan, with a constant radius of 674 feet on the upstream side. Two spillways, having a capacity of 75,000 cu. ft. per sec., are situated near the dam on the canyon walls, each being equipped with 7 large butterfly gates. Rock excavated for the foundation totaled 97,000 cu. yds. The dam and the power house together required 396,000 cu. yds. of concrete. The power house, adjoining the dam, contains two generating units rated at 15,625 k.v.a. each, and the turbines have a guaranteed capacity of 17,800 h.p. at full gate under the maximum head.

After passing through the power house or over the spillways, the water passes down Merced River to Crocker-Huffman Dam, a masonry structure a few miles below Merced Falls, which diverts water to the district canals. The main canal of the district has a capacity of about 1500 cu. ft. per sec. and extends about 17 miles, passing through two tunnels 1579 feet and 1943 feet in length, respectively, to Lake Yosemite, 5 miles east of Merced. This lake has a storage capacity of about 7000 acre-feet and marks the southern end of the old Crocker-Huffman Canal. Before reaching Lake Yosemite, the main canal supplies water to four laterals which cover the area north of Merced. Another canal

diverting from Lake Yosemite serves the area directly north and east of Merced. Almost all of the land east of Merced is irrigated from Le Grand Canal, which diverts from Lake Yosemite and follows the eastern boundary of the district about twelve miles to Planada and Le Grand.

Five booster plants supply about 6000 acres of high land near the eastern end of the district, lifting water from 14 to 23 feet. Booster plant No. 1 has four pumps with a combined capacity of 120 cu. ft. per sec.; booster plants 2 and 3 also each have two pumps, with combined capacities, respectively, of 17 and 15 cu. ft. per sec. Plants 4 and 5 have one pump each, with a capacity of 3.1 cu. ft. per sec.

The section of the district lying north of Merced River and containing about 9400 acres is supplied by a north-side canal diverting from Merced River at Merced Falls.

The total length of all canals owned by the district is 1020 miles, of which only about 10 miles were lined until 1927. In that year the district spent $128,535 on betterments to the canal system, and provided $217,510 in the 1928 budget for the same purpose. All but a few thousand acres of the district are supplied with lateral canals.

From the first, drainage has been a problem of Merced Irrigation District. Prior to irrigation from the old Crocker-Huffman system, the water plane around Atwater and east of the Southern Pacific Railroad was 30 to 40 feet below the surface. It rose rapidly with irrigation, particularly in the sandy land, causing ponds in low places and a high water table in many places except close to Merced River. The extension of irrigation pumping plants, especially between 1910 and 1918 alleviated the poor drainage condition, but did not solve the problem. In 1918 a drainage district of 2900 acres around Livingston built 11 miles of drainage canals. A second district in 1919 provided open drainage for 5800 acres around Atwater. A third, known as Fruitland Drainage District, lifted water by pumps from drains reaching 840 acres. The operations and works of these districts were taken over by Merced Irrigation District, and in 1922 and 1923, 37 drainage pumps were installed. These held down the water table until stored water was available from Exchequer Dam, but as soon as that water began to be used, a decided rise in ground water occurred. Since 1923, 34 additional drainage pumps have been installed and provision has been made in the 1929 budget for 10 more. The drainage wells are equipped with well turbines operated by 20 to 30 h.p. motors. They have an average capacity of 1400 g.p.m. and draw down from the surface from 20 to 40 feet. Of the 59 pumps installed, only two have proved ineffective for drainage and have been abandoned.

About 45,000 acre-feet of drainage water was pumped in 1927, but, as previously indicated, ground water was within 5 feet of the surface over about 35,000 acres and within 3 feet of the surface over about 10,000 acres in that year. Suits brought against the district seeking to compel the district to drain about 2400 acres, on the claim that the canals of the district were constructed in a negligent manner, have recently been decided in the superior court in favor of the district.

The total amount invested in works by the district to January 1, 1928, was $16,019,326.82, without deduction for depreciation. This includes investments for storage and power works and the cost of

relocating the Yosemite Railroad, as well as for irrigation and drainage purposes. All but $69,811.33, raised from district taxes, has been obtained from bond issues.

Power.—The powerhouse constructed by Merced Irrigation District is located on the toe of Exchequer Dam, and the penstocks which feed the turbines are cast into the dam. The generators have a combined peak capacity of 37,000 k.w. The first agreement with reference to the sale of power to San Joaquin Light and Power Corporation was dated June 24, 1921, but this was succeeded by a contract dated February 21, 1924, which runs for a period of 20 years, with option to the district to continue it for another 20 years. Under the contract now in force, power is delivered to San Joaquin Light and Power Corporation at the Exchequer plant. It is understood that deliveries of water to the power plant must be governed by irrigation requirements, and the district agrees to deliver energy on a daily load factor ranging from unity to eight-tenths, as demanded by the power company, the agreement also covering delivery at less than eight-tenths daily load factor. The price paid by the power company for energy delivered as above is 4½ mills per k.w.h. Under date of July 7, 1926, the power company agreed to take power at certain hours not covered by the original contract at a rate of 2 mills per k.w.h. The income from power in 1926, which was the year the power plant was put into operation, was $72,996. In 1927, the power generated totaled 126,603,350 k.w.h., yielding an income to the district, as billed, of $569,815. A dispute is pending between the district and the power company with reference to payment for power delivered in excess of 25,000 k.w. The district brought suit against San Joaquin Light and Power Corporation for payment for all power delivered at the Exchequer plant in excess of 25,000 k.w., and on September 14, 1928, after a trial by jury, judgment was entered in favor of the district that San Joaquin Light and Power Company should pay for all power generated and delivered at Exchequer from the hydro-electric plant installed there.

The total expenditures for power development to December 31, 1927, exclusive of the cost of Exchequer Dam and the reservoir above, have been $1,023,412. These include the cost of penstocks, amounting to $198,303, and of power house generators, transformers, etc., amounting to $825,109. These expenditures are included in the total expenditures for works, amounting to $16,019,326.82, previously referred to.

Adjustment of old water-right contracts.—In briefing the history of Merced Irrigation District, reference was made to agreements between the district and holders of water-right contracts under Crocker-Huffman Canal. Adjustment of these contracts between the district and the contract holders has been one of the difficult accomplishments of the district. These contracts had been made by Crocker-Huffman Land and Water Company and its predecessor, Merced Canal and Irrigation Company. The contracts of Merced Canal and Irrigation Company were to run to March 3, 1933, and those of Crocker-Huffman Land and Water Company to April 30, 1938. Under these various contracts, 400.18 acres of land was entitled to receive water free, 2405.37 acres was to pay $0.625 per acre per annum, 26,335.59 acres was to pay $1 per acre per annum, and 21,582.65 acres was to pay $2 per acre per annum. Negotiations occupied the attention of the district and the contract holders for several years. When the district purchased

the Crocker-Huffman system, it assumed obligations of the former companies under these contracts, and also succeeded to the benefits to accrue to those companies. It was generally the contention of the contract holders that they should continue to receive water at no more than the contract prices, and many of them urged that, in return for cancellation of the contracts, they would be entitled to about $900,000 from the district. The district, on the other hand, contended that the position of the contract holders under the district would be far superior to that under the old companies, since the district proposed to provide storage of water and better service, and would also deal with the drainage problem. It further contended that the lands on which contracts had been placed would be subject to district taxes, regardless of the contracts. It was clear to all parties that continuation of the contracts was undesirable because of complications that would arise with one class of users occupying a different position from the others with reference to water service and charges. After some litigation a compromise was effected and the following payments were finally agreed upon, with a committee of the contract holders, these to be made annually for 17 years, or up to and including July 1, 1941, for holders of contracts running to 1938, and for 12 years, or up to July 1, 1936, for contracts running to 1933; to holders of contracts for free water, $2.50 per acre; to holders of contracts for water at $0.625 per acre, $1.90 per acre; to holders of contracts for water at $1 per acre, $1.60 per acre; and to holders of contracts for water at $2 per acre, $0.80 per acre.

The amounts of these payments were arrived at by making a rough calculation of the probable amount of district taxes that would be paid by the contract holders for the cost of the same kind of service to which they had been entitled under the operations of the private corporation, and taking an average of the difference between these amounts and their contract rates. No attempt was made to vary the payments according to the assessed value of the land, for it was felt that this would result in a schedule too complicated for use.

Nearly all of the contract holders have accepted the agreement and have been receiving the payments agreed upon. In a few cases, landowners have made no request for a settlement, but no one has attempted to assert any rights under the contracts since the terms of settlement were approved by the committee of the contract holders.

Use and delivery of water.—The district undertakes to supply water to each 160 acres. Deliveries are roughly measured over checks and through submerged orifices. The total quantity delivered to users, however, is not computed. As the supply available to the district has been abundant since storage was started in Lake McClure, applications have been excessive. In former years, much land was poorly prepared for irrigation, with resulting waste. Recently, better methods of preparing land have been followed, but there is still room for improvement, and the district is enforcing rules to secure greater efficiency. Recently the district has levied an annual water toll for water delivered in excess of 4 acre-feet per acre in a season, and this is expected to diminish waste.

Deliveries are made on a rotation basis for alfalfa, orchards, vineyards, and general crops, and on a continuous flow basis for some other crops, mainly rice. No charge is made for the first 4 acre-feet of

water in either class. For deliveries above that quantity, rates are on an increasing scale as indicated below under "assessments and water tolls." At the beginning of each irrigation season, the superintendent obtains from each irrigator a written application for water, specifying the kinds of crops and the numbers of acres of each he expects to irrigate. Each irrigator is notified by his ditchtender 12 hours before water is delivered to him. Fifteen cu. ft. per sec. is considered a standard irrigating head, and the rules specify that when delivered on a rotation basis, this quantity shall be allowed not to exceed an average of 30 minutes per acre. All water delivered is receipted for by the irrigator. Users desiring water on a continuous flow basis are required to make application to the secretary not later than October 15 of each year.

Bonds.—The three issues of bonds put out by Merced Irrigation District have combined maturities extending from 1933 to 1966. They are dated January 1, 1922, May 1, 1924, and April 1, 1926. The larger part of the bonds were disposed of through a syndicate composed of twelve investment banking houses. The conditions covering the sale to this syndicate of $9,010,000 of the first issue included a requirement that $150,000 should be impounded until July, 1927, to insure interest payments, and that a like amount should be impounded until the completion of Exchequer Dam; also that during the construction period the districts should employ a comptroller satisfactory to the syndicate who would keep the syndicate informed of progress on contracts, etc. No irrigation district had previously put out such large issues of bonds, and this explains the necessity for the formation of the syndicate to take them. The feature of the district system that made the sale possible at the prices received was the hydro-electric power to be developed, for which sale contract had already been negotiated, and from which an average annual income in excess of $500,000 was anticipated.

In addition to the $16,250,000 bonds mentioned above, the district is obligated to pay the bonds in the three small drainage districts taken over. These bonds carry combined maturities from 1922 to 1939, and together totaled $127,450. A schedule of the payments to be made on account of bond interest and principal for Merced Irrigation District, and for the three small drainage districts taken over, shows required annual payments beginning at $110,564 July 1, 1922, reaching a peak of $1,281,700 July 1, 1951, and falling to $1,167,400 July 1, 1964, when all of these issues, with the exception of the third of Merced Irrigation District for $1,000,000, will be paid. The principal of the third issue falls due in 1965 and 1966. Including principal and interest, the total payments that will be required in those two years for the extinguishment of the last issue will be as follows: 1965, $541,250; 1966, $513,750.

Other bonds and obligations against lands in Merced Irrigation District as of June 30, 1928, are estimated to total $1,446,000, divided as follows: elementary school bonds, $65,000; high school bonds, $249,000; county road improvement district bonds, $300,000; general county bonds, $384,000; Merced municipal bonds and special assessments, $448,000.

Assessments and water tolls.—Until 1928, the district obtained all of its income, other than that derived from sale of power at Exchequer powerhouse, from district assessments. Average good farm land is

assessed for district purposes at $150 per acre, or at $200 per acre if adjacent to the city of Merced; land above the gravity system is assessed at $20 per acre, and swamp land at $10 per acre. In Merced the usual resident lot is assessed at $600, and the highest assessment on a business corner, 50 feet by 150 feet, is $15,000. In the towns of Livingston and Atwater, business lots are assessed at from $600 to $1,000 each. In general, all land is assessed for district purposes at about 75 per cent of its cash value. Railroad rights of way within the district are assessed at $1,200 per mile. The total district assessed valuation for 1927–28 was $20,636,465, and the amount of the annual levy was $1,238,187. The assessment rates per $100 of valuation for the past five years have ranged between $4.20 and $7.10, being $6.00 for 1927–28.

Water tolls imposed by Merced Irrigation District, effective in 1928, apply to quantities used in excess of 4 acre-feet per acre, and graduate upward with each successive acre-foot per acre used above that amount. For water delivered on a rotation basis, which applies to alfalfa, orchards, vineyards, and general crops, the rate for the first acre-foot in excess of 4 acre-feet per acre is $0.75; for the next acre-foot, $1; for the third, $1.25; for the fourth, $1.50; and for each acre-foot over 8 acre-feet per acre, $1.75. When water is delivered on a continuous flow basis, which is the method used mainly for rice, the charge for the first acre-foot in excess of 4 acre-feet per acre is $1; for the second, $1.50; for the third, $2; for the fourth, $2.50; and for each acre-foot in excess of 8 acre-feet per acre, $3.

MADERA

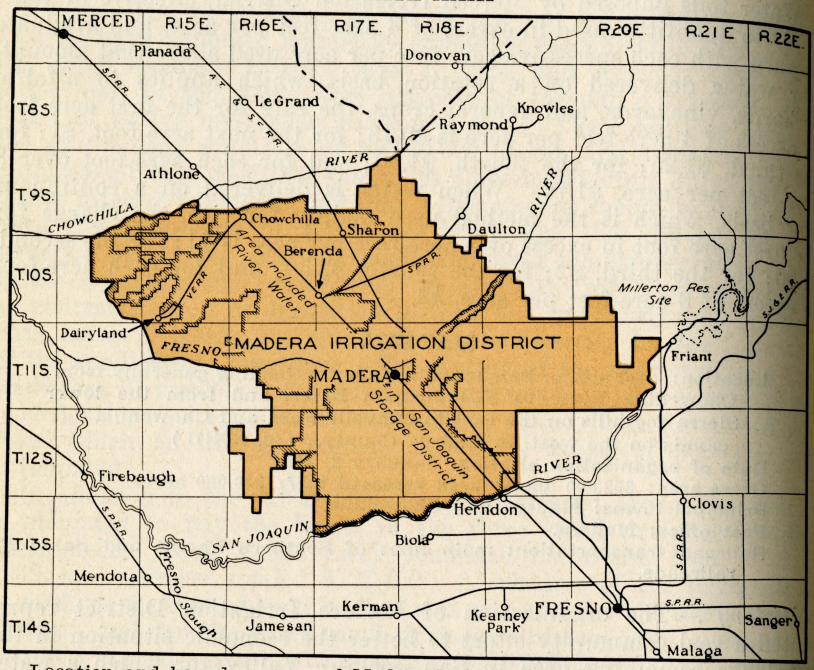
Location: east side of San Joaquin Valley, extending generally from Chowchilla River to San Joaquin River, and from the lower Sierra foothills on the east to Gravelly Ford and Chowchilla canals on the west, in Madera County. (Pl. XXIII.)
Date of organization election: January 2, 1920.
Gross area: 352,000 acres; **area assessed 1927:** 330,000 acres.
Principal towns: Madera and Chowchilla.
Post office: Madera.
Railroad transportation: main lines of Southern Pacific and Santa Fe railroads.

*History**.—The organization of Madera Irrigation District represented a real community effort to better the economic situation in the last large remaining area in San Joaquin Valley for which a water supply could be made available from nearby sources, but of which a relatively small area was being irrigated. This was not the first effort to accomplish this purpose. An irrigation district of 280,000 acres had been formed in 1888 under the original Wright act. Opposition to that district developed from large landowners lower down on the San Joaquin who objected to the proposed use of that river, and from some large landowners who were satisfied with the methods of farming they were then following. Losing in litigation, and finding that continuance meant facing long-extended further litigation, those in control deemed it best to disorganize. This was ordered by a vote of 166 to 14 late in 1893, and the district was dissolved April 18, 1896, after clearing up in full by assessment its small indebtedness. Surveys had been made and $850,000 in bonds had been voted, but none were sold.

* See also State Dept. of Eng., Bul. 2, 25–27.

Madera Canal and Irrigation Company, which was incorporated in 1888, and which the old irrigation district considered purchasing for $100,000, has never been an adequate enterprise for the large area in Madera County needing water. Its sole source of supply is Fresno River, supplemented by a maximum of 100 cu. ft. per sec. from North Fork of San Joaquin River, Big Creek, a tributary of Merced River, and Chilcoot Ditch, which diverts overflow from Chilcoot Lake. Fresno River watershed, heading in the low Sierra Nevada, yields water only during freshets occurring usually from December to April. The right of Madera Canal and Irrigation Company amounts only to 200 cu. ft. per sec., including its diversions from the other watersheds, and the quantity available is ordinarily much below that.

PLATE XXIII



Location and boundary map of Madera Irrigation District, Madera County.

Not only has its water supply been inadequate, but the funds available to Madera Canal and Irrigation Company have been insufficient to maintain and operate the system efficiently. Complaints were taken to the Railroad Commission, and that body, in Decision 1116, dated December 5, 1913, together with Decision 1397, dated April 3, 1914, directed the company to institute a better service. The company employed a competent engineer to carry out the orders of the commission, but owing to lack of funds for repairs and operation, and inadequacy of the water supply, satisfactory service was impossible.

It was the conditions described above which, about 1914 and 1915, again helped to create interest in a larger project. An irrigation bureau was formed, which, realizing that the key to a successful project lay in making use of the flood flow of San Joaquin River, directed its attention chiefly to a study of that supply, and the possibility of storage at Millerton site on the San Joaquin above Friant. A preliminary

engineering report was filed with the irrigation bureau June 21, 1917. This indicated the practicability of a project watering 250,000 acres by storage on the San Joaquin, the latter being estimated to cost $7,755,000 for storage of 300,000 acre-feet. A preliminary estimate for a project covering a gross area of 300,000 acres fixed the cost at $11,155,000, or $37.20 per acre. The report recommended that borings be made at the Millerton site. The irrigation bureau raised the money needed for these borings and a report filed May 28, 1918, showed satisfactory foundation conditions. This last report went further into plans for an irrigation district. It proposed to obtain 400,000 acre-feet annually by natural flow and storage on San Joaquin River, 60,000 acre-feet from natural flow of Fresno and Chowchilla rivers, and 150,000 acre-feet by pumping from underground within the district. The first development contemplated by the report was construction of Millerton Dam, together with the canal systems to part capacity, structures to full capacity, and the installation of enough pumps to supply 150,000 acre-feet from underground sources. Increased storage possibilities were found to exist at the Millerton site. Rise of the price of materials and labor since the first report caused the engineer to increase his estimate covering first development to between $45 and $50 an acre. With the reports of their engineer submitted, and the engineering feasibility of a large project established, the local irrigation bureau proposed the formation of an irrigation district. On November 3, 1919, they presented their petition to the board of supervisors of Madera County. As a move to keep certain areas from being included in Madera District, the owners of these lands proposed the formation of five smaller districts under the California Irrigation Act, approved May 16, 1919,* and there were certain applications for exclusions. On the other hand, owners of about 3000 acres along the foothills and of about 35,000 acres along Chowchilla River applied for inclusion. The act under which formation of the five smaller districts was proposed was declared unconstitutional** and the supervisors approved the petition for the formation of a district of 350,000 acres. At the organization election January 2, 1920, the district was formed by a vote of 1642 to 47, this vote indicating the popularity of the movement to develop a water supply. Engineering reports were made, in part by the engineers who had made the two preliminary reports, and a project was outlined and estimated to cost $28,000,000, of which $10,830,000 was for Millerton Dam, $3,570,000 for a power plant below the dam, $8,610,000 for canals and laterals, $1,000,000 for pumping plants, $100,000 for the purchase of the system of Madera Canal and Irrigation Company, $2,550,000 for discount on bonds and interest during construction, and $1,340,000 for engineering and contingencies.

Throughout the period of study of the proposed project, it was realized that storage on the San Joaquin at Millerton would not be possible without agreement with lower riparian owners. Some of the large landowners had opposed formation of the district and numerous court actions were brought against the district. It was proposed to fight this litigation and approval of a bond issue in the amount of the estimate of the engineers was requested of the Bond Certification Com-

* Statutes 1919, p. 672.
** *Mordecai* vs. *Board of Supervisors*, 183 Cal. 434.

mission, with a proviso that a portion of the bonds would be used to pay for this litigation. Approval was not given, but the district went to the electors on the proposition to authorize issuance of the entire $28,000,000, of which $500,000 would be available for litigation, but with the understanding that the remaining bonds should not be sold prior to the establishment of title to an adequate water supply. This proposition carried July 26, 1921, by the unusual vote of 3098 to 25. This vote reflected the attitude of the voters toward the interests that were seeking to prevent storage on the San Joaquin. Litigation continued after the vote, but in 1922 a truce was arranged between Madera Irrigation District, Miller & Lux, Inc., and the consumers under San Joaquin and Kings River Canal, on the west side of San Joaquin River, with a view to forming a water storage district under the act approved June 3, 1921.* It was agreed that litigation would be discontinued pending the formation of such a district to cover the lands in Madera Irrigation District lying roughly between Santa Fe Railroad and the alkali plains east of San Joaquin River, lands in Stevinson Colony, and lands on the west side of San Joaquin Valley receiving water from San Joaquin River. Since this agreement, Madera Irrigation District has devoted itself mainly to working with the other interests in determining the proper boundaries of San Joaquin River Water Storage District and the final details of the larger project. It was expected that when agreements should be reached and this larger water storage district should start to function, Madera Irrigation District would cease activity. Late in 1928, however, a decision was reached to disorganize San Joaquin River Water Storage District, and at this writing (December, 1928) the best means of doing this are being sought. This outcome apparently throws Madera District back on its own resources for the development of a project. The district already has the matter under consideration and has reemployed its former engineer for that purpose. If it goes forward with a project, it seems to be understood that the present boundaries are to be reduced to eliminate the large area of hardpan and other poorer land which was excluded from the water storage district.

Soils and topography.—Madera Irrigation District contains a large body of very fine land and some which grades from fair to poor. The soils are largely classified as Madera, Hanford, and San Joaquin sandy loams.** The plains lands to the east are rolling, but the surface of the main portion of the area is flat. Elevations range from 150 to 450 feet. In the rolling areas hardpan is generally present. Alkali is indicated in the western portion, 15 per cent of the lands in the district being reported as showing sufficient to affect crop production.

Development.—Madera Canal and Irrigation Company is still operating within the area and, as heretofore, is supplying water as available to about 10,000 acres. Half or more of the area served by Madera Canal obtains a supplemental supply from private pumping plants. About 25,000 acres is irrigated from private pumping plants in Chowchilla Basin, and about 25,000 acres from wells in Fresno River Basin. The estimated total number of private pumping plants is about 1500. Records show about 2000 separate land holdings. There are eight large holdings totalling 143,000 acres, of which the four largest are

* Statutes 1921, p. 1727.
** U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Lower San Joaquin Valley, California.

60,000, 25,000, 18,000 and 12,000 acres, respectively, the others ranging from 3000 to 10,000 acres. Madera, with a population of 5000, and Chowchilla, with a population of 500, are included within the district, and there are about 6500 in the district outside of the towns. The assessed valuation in the district for city and county purposes in 1927 was approximately $13,500,000.

Water Supply.—The district has applications before the Division of Water Rights for water from San Joaquin, Fresno and Chowchilla rivers. These call for diversions of 3000 cu. ft. per sec. and 500,000 acre-feet storage for irrigation. Extensions have been granted pending results of negotiations with San Joaquin River Water Storage District. Dates of the filings run from January 9, 1916, to March 13, 1922. The last filing calls for a direct flow of 9000 cu. ft. per sec. and 600,000 acre-feet of storage for power development. It is recognized that the rights applied for in these various applications are subject to claims of lower riparian owners and prior appropriators. Appropriative rights adverse to the Madera filings are relatively definite, but the riparian claims comprise the entire flow of San Joaquin River. Adjustment of these water rights has been part of the problem connected with the establishment of San Joaquin River Water Storage District. The district has filed a condemnation suit for lands in the reservoir site which is still pending. It has also engaged in engineering and legal activities in an endeavor to perfect its filings, but no water has been diverted by it from San Joaquin River.

Works.—No works have been purchased or built, but the district owns a gravel pit near Friant, for which it paid $40,000, and equipment valued at $10,665.

Bonds.—Of the $28,000,000 in bonds voted in 1921, only $200,000 have been issued. These are dated October 1, 1921, bear interest at 6 per cent, and carry maturities of 1927 and 1928. The bonds sold were all purchased by a local bank at Madera. Unmatured bonds to the amount of $80,000 were bought up by the district prior to 1927, and $62,000 were retired in that year. The remaining $58,000 were retired July 1, 1928, with the exception of $3,000 not yet presented for payment.

Madera is one of the few counties in the state that has no bonded debt for county highways. There are no reclamation, drainage, or levee districts within the irrigation district boundaries. The estimated outstanding elementary and high school bonds, as of July 1, 1927, amounted to $455,375, or at the rate of only $1.30 per acre.

Assessments.—Annual assessments were levied by the district from 1920–21 to 1923–24. Land was valued for purposes of district assessment at 80 per cent of its full cash value, the latter being determined by nearness to important centers and quality of the land. High valuations ranged from $200 to $225, the average valuation being about $80. After the formation of San Joaquin River Water Storage District, assessments were discontinued until 1927–28. In that year the high valuation was $180 per acre and the average about $60 per acre. The total district valuation was $20,500,670. Amounts levied annually from 1920–21 to 1923–24 ranged from about $55,000 to about $223,000. The total levy for 1927–28 was $61,502, the rate being $0.30 on each $100 of valuation. About 9 per cent of the assessment for 1927–28 was against lands in the towns.

FRESNO

Location: Surrounding Fresno, in Fresno County. (Pl. XXIV.)
Date of organization election: June 28, 1920.
Gross area: 241,300 acres; **area assessed 1927:** 240,728 acres.
Principal adjacent cities and towns outside boundaries: Fresno, Pinedale, Clovis, Malaga, and Kerman.
Post office: Fresno.
Railroad transportation: main and branch lines of Southern Pacific and Santa Fe railroads.

*History.**—Fresno Irrigation District is the most northern, as well as the largest, of the important group of irrigation districts which receive water from Kings River. It covers the highly developed section around Fresno in the northwesterly portion of the Kings River delta, reaching as far north as the south bank of San Joaquin River.

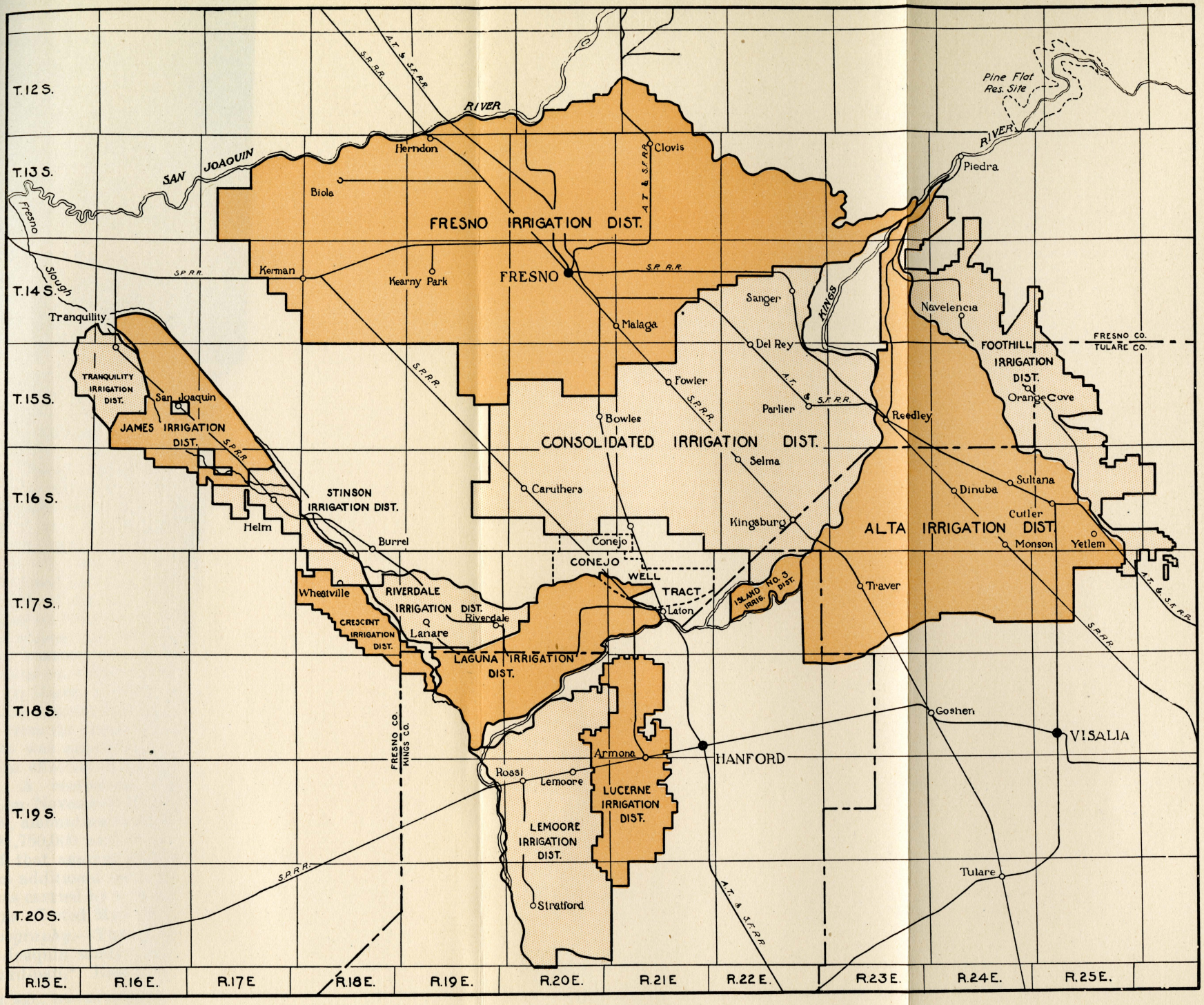
The first effort to turn out irrigation water for land within the boundaries of the present district was made in 1867. The original ditch, afterwards known as Centerville Ditch, was extended by Centerville Canal and Irrigation Company, formed in 1868. The next year a small ditch known as Sweem Ditch was started, this diverting water about 1.5 miles farther down the river, the intended use of the water being the operation of a flour mill.

The Sweem interests soon joined with Centerville Canal and Irrigation Company and the combined interests were acquired by M. J. Church, who, in 1870, undertook on a rather comprehensive scale to provide water for the large area to the west and northwest of the diversion points, including the area of which Fresno is now the center. He and his associates organized Fresno Canal and Irrigation Company on February 16, 1871, and transfer of the Centerville Canal and Irrigation Company properties was made to the new company in 1874. The new enterprise met financial reverses and was transferred in 1876 to the Bank of Nevada, which soon sold it back to the original projector for $28,000. In the meantime a considerable settlement had resulted from making water available. The first water rights were sold for $200 for each 160 acres of land, this later being increased to $800 and finally to $1,600. It is reported that by 1884, 64,000 acres was being served.

Fresno Canal and Irrigation Company, however, was not the only irrigation enterprise formed to supply water to these Fresno County lands. About two years after the Church system was started, operations were begun by Kings River and Fresno Canal Company. Their canal, known as Gould Canal, was the upper north-side diversion from Kings River. A branch, known as Enterprise Canal, skirted generally the westerly edge of the plains or lower foothills, reaching northwesterly toward San Joaquin River. Construction of this canal dates back to 1872, and in 1900 the area reported to be irrigated by its system was 15,000 acres.

Kings River and Fresno Canal Company and Fresno Canal and Irrigation Company became involved in extended litigation over water rights and on November 5, 1885, Gould Canal was ordered to cease diverting water from the river. As an outcome of this litigation, Gould Canal passed under the control of Fresno Canal and Irrigation Company. Litigation still continued, but now it was between Fresno

* See also U. S. Dept. of Agr., Office of Experiment Stations Bul. 100, 286-90, and State Dept. of Eng., Bul. 7, 14-23.



Location and boundary map of principal irrigation districts on Kings River.

Canal and Irrigation Company and owners of Laguna de Tache Rancho, an area of 68,000 acres riparian to lower Kings River. This litigation ended in the Fresno Canal group purchasing Laguna de Tache Rancho, together with its riparian and other water rights, on May 4, 1892. There was still further protracted litigation in which the Fresno group and the lower south-side Kings River irrigation interests were involved, but settlement was reached and the suits dismissed October 4, 1897. Other settlements were made as follows: with Alta Irrigation District by agreement November 1, 1902; with Centerville and Kingsburg Ditch Company December 15, 1900; with Crescent Canal Company April 18, 1899; and with Murphy Slough Association August 19, 1898.

In 1917 Fresno Canal and Irrigation Company was reincorporated as Fresno Canal and Land Corporation. When operations of this company were studied in 1918, water was being delivered for irrigation under water rights which allowed not to exceed 1 cu. ft. per sec. to each 160 acres. First-class water rights of this chararter were sold or to be sold up to 1000 cu. ft. per sec., or for 160,000 acres of land, and second-class rights covering flow in the canal in excess of 1000 cu. ft. per sec. had been sold to the extent of 175 cu. ft. per sec. With certain minor exceptions the annual charge against these first and second-class water rights was $0.62½ per acre. Water-right contracts were to run until February 16, 1921. As the time approached when these contracts would terminate, Fresno Canal and Land Corporation initiated proceedings before the State Railroad Commission to have new rates fixed. In these proceedings they claimed a valuation of $2,031,748 for canals, rights of way, etc., $3,403,168 for water rights, and $305,023 for engineering and legal expenses. They asked for an annual income of $679,460, or at the rate of about $3.40 per acre irrigated. This action of Fresno Canal and Land Corporation, together with proposals for the construction of storage on Kings River at the Pine Flat site, resulted in creating an interest in the formation of an irrigation district to take over and operate the Fresno canal properties. Seven hundred and eighty-eight landowners, representing nearly one-fourth of the total assessed valuation within the area, petitioned the supervisors of Fresno County on March 1, 1920, for the formation of Fresno Irrigation District. The exterior boundaries were limited to the areas which received service from the canals of Fresno Canal and Land Corporation. The organization was approved by the State Engineer, and the district organization effected at an election June 28, 1920, by a vote of 1438 to 184. A competent engineer-manager was immediately appointed and on November 15, 1920, he submitted his appraisal of the canal system, amounting to $1,804,137. An option on the property was taken at $1,750,000 and at a special election February 8, 1921, a bond issue of that amount was approved by a vote of 1568 to 74, together with an additional issue of $250,000 for some major improvements, which was carried by a vote of 1501 to 98. The purchase of the canal system was effected May 16, 1921.

Soils and topography.—The soil in the northerly part of the district is largely San Joaquin sandy loam, of somewhat uneven surface and underlaid by hard-pan.* East and west of Fresno it is largely Madera

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California, and Soil Survey of the Fresno Area, California.

sandy loam and Oakley and Madera sands undifferentiated. A few miles south and southeast of Fresno and extending to the westerly boundary of the district, Fresno sandy loams and Fresno fine sandy loams predominate. The general slope of the area is from northeast to southwest at about five feet to the mile. Before the canals were constructed it is reliably reported that the ground water was 50 to 60 feet below the surface. As irrigation proceeded the ground water rose very rapidly, and in 1900 it was within ten feet of the surface over a considerable area south and southwest of Fresno. In 1902 an extensive drainage survey was made by the U. S. Department of Agriculture and a system of drainage recommended, but this was not constructed. By 1918 the ground water, in many places, was within three or four feet of the surface and had rendered approximately 40,000 acres in the south and southwest portions of the Fresno area relatively unproductive on account of alkali. This condition prevailed until 1924 when, by reason of an extremely dry season, pumping and pumping facilities for use of ground water were so much increased that, with other controlling factors put into effect by the district, this high ground-water condition was controlled. In 1928 there is no water table less than ten feet from the surface.

The net irrigable area in the district is reported as 239,080 acres, or only 2200 acres less than the gross area, this 2200 acres being reported as alkaline. The area irrigable from the distribution system is 220,000 acres. There are no incorporated cities and towns in the district, no waste land reported, and no deductions made for roads or canal rights of way.

Development.—The Fresno area is well known as one of the most highly developed sections of California. It is the acknowledged center of the raisin industry, and also produces large quantities of juice and table grapes. These crops comprise about 97,000 acres. Figs, peaches, apricots, and other deciduous fruits are produced on about 25,000 acres. The dairy industry, together with alfalfa, pastures, etc., utilizes about 58,000 acres. Cotton, melons, berries, citrus fruits, and miscellaneous crops, cover about 10,000 acres. The remaining 50,000 acres is dry-farmed to a considerable extent for the production of grain, but in most years a large portion of it is unproductive.

A total of 8570 landowners are reported, giving an average area per holding of about 28 acres. There are three large holdings of 12,903, 5030, and 2664 acres.

Fresno District is unusually well supplied with highway and railway transportation. Improved paved highways extend throughout the area in a close net work and the main north and south San Joaquin Valley highway passes through Fresno. The Southern Pacific has two main lines running into Fresno and several branch lines extending into different parts of the district. The Santa Fe main line passes directly through the district and one branch line of considerable extent serves the east half of the area.

The total estimated population within the district, not including towns and cities, is 50,000. Fresno has an estimated population of 75,000 and the other cities and towns, of which Clovis, Malaga, and Kerman are the largest, report about 1900. The estimated assessed value of land in the district for city and county purposes in 1927 was $25,000,000.

Water supply.—The water rights of Fresno Irrigation District are among the earliest on Kings River. As previously indicated, the first rights of the first ditch were initiated in 1867, the next important rights to which the district succeeded being initiated by 1870. How the predecessors of the Fresno Irrigation District finally consolidated their water rights through litigation agreements and purchase has already been briefly told.

Diversions from Kings River are now made in accordance with the 1927 schedule of Kings River Water Association. This schedule, which purports to set up rights only at certain specified stages of the river, gives the district water every month of the year except October and November in amounts varying from 300 cu. ft. per sec. at a river flow of 1700 cu. ft. per sec. in January, to 1475 cu. ft. per sec. at a river flow of 9450 cu. ft. per sec. in May. Fresno District has, however, in practically all of the months when the river flow at Piedra has been above the stages indicated, diverted larger volumes and still follows the same practice and claims the right to do so. The district is the successor, as trustee for the so-called Pine Flat project, of the Nares-Teilman filings on surplus and flood waters in Kings River for storage at the Pine Flat site, together with application 360 for the same rights made to the State Division of Water Rights. The district has taken a very active part in water-right and other negotiations relating to the development of storage at Pine Flat.

In addition to the gravity flow from Kings River, the lands in Fresno Irrigation District obtain a considerable quantity of water by pumping. The district itself owns and operates but seven pumps, these each having a rated capacity of 5.25 cu. ft. per sec. There are in the district, however, approximately 3320 private pumping plants. The district organization and the landowners now realize that the ground water resource throughout the district is an important element in supplementing the water supply demands, and during the last few years great improvements have been made in the character and extent of equipment which is utilized for obtaining the ground water. The pump lifts vary from 30 to 60 feet, and of the irrigated area within the district, 32,271 acres was supplied entirely by pumping in 1927. The engineer of the district estimates that in 1924 more than 100,000 acre-feet of water was made available by pumps, and that the average pumping in the last 4 years has aggregated about 60,000 acre-feet per year. Besides recovering a very large portion of the water lost by seepage in the canals, this pumping has demonstrated, as previously indicated, the possibilities for practically a complete reclamation of the water-logged area within the district boundaries.

Works.—Fresno Irrigation District has two diversions from Kings River, those of Gould and Fresno canals. The diversion into Gould Canal is regulated by vertical headgates after the water is deflected into the canal by a concrete weir equipped with flashboards. Gould Canal is about 25 feet wide near the intake and has a capacity of 470 cu. ft. per sec. Enterprise Canal takes out of Gould Canal about 2 miles below the river diversion. The northern branch of Gould Canal, known as Helm Canal, passes to the west of Clovis. Below Helm Canal, Gould Canal merges into Herndon Canal, which extends to San Joaquin River north of Biola. Fresno Canal diverts from Kings River about 1.5 miles below the Gould head, as does Consolidated Canal

of Consolidated Irrigation District, the concrete joint diversion weir being 300 feet long. Fresno Canal is about 50 feet wide at the head and carries about 1,160 cu. ft. per sec. It divides into two main branches, Mill Ditch and Fancher Creek canal. The canal system embraces 580 miles of main canals and main laterals.

Since taking over the Fresno Canal system, Fresno Irrigation District has not greatly extended the system, but it has very materially improved it. In addition to improvements made with the second bond issue of $250,000, from $50,000 to $100,000 is expended annually on such betterment work as replacement of wooden structures with concrete. The capital invested in works as of January 1, 1928, was $2,265,912.56, of which $304,512 has been raised from general district assessments, the remainder having come from the two bond issues of 1921. The district has seven 18-inch wells varying in depth from 308 to 562 feet, from which they pump into the irrigation canals with 16-inch turbines operated by 30 h.p. motors. These pumps have rated capacities of 5.25 cu. ft. per sec. The wells draw down from 25 to 50 feet when delivering full heads. They are located at widely separated points in the district. While very effective in lowering ground water, these wells are considered by the district to be combined irrigation and drainage units.

Use and delivery of water.—The unit area to which the district delivers water varies from 20 to 640 acres. No comprehensive system of measurements of deliveries to individual irrigators is in use but the diversions from the river to the main canals are measured by continuous recording instruments and the flow into the main laterals of the system is adequately measured with weirs and other standard facilities. During the last three years the district has made rapid progress in the establishment of reliable measuring devices at the heads of many of the smaller laterals and neighborhood ditches. The district has also extended its supervision and control over more than 300 miles of lateral ditches that were under private control when the system was purchased by the district.

In general, water is distributed among the landowners under rotation schedules prepared at the beginning of each irrigation season, and providing for continuous use of water all days and nights, including Sundays and holidays. During the spring months, unless limitation in the supply requires otherwise, water is furnished on demand. The field forces of the district extend supervision and control over all lateral and neighborhood ditches to the extent necessary in carrying out schedule deliveries. The operating force of the district, working under the engineer-manager, is composed of one assistant engineer, two superintendents, and twenty-five ditchtenders. The divisions controlled by the ditchtenders vary in size from 5000 to 14,000 acres.

Bonds.—Fresno District has issued no bonds since the $2,000,000 put out in 1921, and of those bonds, $1,035,000 had been retired to January 1, 1928. Both issues are dated March 1, 1921, and have maturities 1923 to 1932. An estimated total of $3,012,820 in bonds is outstanding against lands in the district, in addition to the irrigation district bonds. Of these, $1,400,000 are general county bonds, $548,000 are bonds of 21 of the 58 elementary school districts in the district, $717,700 have been issued by 7 high school districts, and $347,120 are outstanding as special improvement district bonds in road improvement

districts 1 to 12. Combining the irrigation district bonds with those of the county, school, and road improvement districts, there is a total bonded indebtedness of only about $16.50 per acre. Of the latter amount, only $4 per acre are irrigation district bonds.

Assessments and water tolls.—All income of Fresno Irrigation District is derived from district assessments, the amounts raised annually since 1921–22 having varied from $441,867 to $576,608. The amount in 1927–28 was $459,913. About 12 per cent of the total income is derived from lands which receive no direct water service, these lands relying upon pumping from underground. About 90 per cent of the area is valued for purposes of district assessment at $100 per acre. Land classed as poor is valued at $50 to $75 per acre. Prior to 1927–28 a lower annual assessment rate was applied to nonirrigated land, although valued for purposes of district assessment at the same figure as irrigated land. In 1927–28 the assessed value of nonirrigated land was reduced to 60 per cent of that of irrigated land and a uniform assessment rate levied. For the past five years the annual rate per $100 valuation has varied from $2.40 to $2.60 for irrigated land; during the year 1923–24 to 1926–27, the rate on nonirrigated land ranged between $1.45 and $1.60.

CONSOLIDATED

Location: southeast of Fresno, west of Kings River, mostly in Fresno County, with small areas in Kings and Tulare counties. (Pl. XXIV.)
Date of organization election: August 23, 1921.
Gross area: 149,047 acres; **area assessed 1927:** 149,047 acres.
Adjacent cities and towns outside of boundaries: Sanger, Selma, Fowler, Kingsburg, Parlier, Del Rey, Caruthers, Monmouth, Bowles.
Post office: Selma.
Railroad transportation: Southern Pacific and Santa Fe railroads.

*History**.—Irrigation in the area now covered by Consolidated Irrigation District extends back to 1878 in the eastern portion and to 1883 in the northwestern portion. The former was covered by Centerville and Kingsburg Canal, which was constructed in 1877–78, and the latter by Fowler Switch Canal, constructed in 1883. These were both farmers' canals, financed and largely built by the local landowners. In both cases companies were formed and capital raised by the sale of shares to the farmers. In the case of Fowler Switch Canal a total of 1800 shares were issued, and it was agreed that in payment for each share labor and material might be contributed to the extent of $200, the remainder to be paid in cash.

In the case of Centerville and Kingsburg Canal, the capital stock was $35,000 divided into 50 shares. For the purposes of construction, the main canal was divided into sections, each of which represented one share of stock, these sections being allotted to the various stockholders who were required to complete them. Extensions to the system were made mostly by the farmers as needed. Water was delivered proportionately to the shares owned. The maximum capacity of Fowler Switch Canal was estimated at about 700 cu. ft. per sec. in 1900, and the area served, including some of the land under Emigrant Canal,

* See also U. S. Dept. of Agr., Office of Experiment Stations Bul. 100, 289–293, and State Dept. of Eng., Bul. 7, 23–34.

was estimated at 10,000 acres. In the same year the area irrigated by the Centerville and Kingsburg Canal, or in some way benefiting from the supply of the Centerville and Kingsburg system, was estimated at about 20,000 acres.

Both canal companies were beset by water-right litigation, each being enjoined from diverting water, yet both continuing to operate, hoping for a more favorable outcome of future litigation. Later, these conditions were partly corrected by the leasing of rights from Emigrant Canal Company by Fowler Switch Canal Company, and the granting to Centerville and Kingsburg Canal Company of the right to divert 600 cu. ft. per sec., subject to certain priorities. These difficulties of litigation were at that time common to the Kings River area.

The situation was finally cleared by the organization of Consolidated Canal Company August 12, 1901, by interests controlling Fowler Switch, Centerville and Kingsburg, and Emigrant canals, who sold Consolidated Canal to the owners of Fresno Canal. Water was delivered under contracts of the original Fowler Switch and Centerville and Kingsburg Canal companies and other contracts analogous to them. All contracts were to remain in force until 1921. The water was charged for at the rate of $0.75 per acre and delivered on the basis of 1 cu. ft. per sec. to each 80 acres, when 1200 cu. ft. per sec. was available. Lateral ditches were operated by consumers. Surplus water was sold without contract at $1 per acre per year. Consolidated Canal Company operated as a public utility under rules laid down by the State Railroad Commission.

Formation of an irrigation district was promoted by the Fresno County Farm Bureau. Only 62 votes out of a total of 1183 were cast against organization.

Soils and topography.—Soils are mainly classified as San Joaquin, Madera, and Fresno sandy loams, Fresno fine sandy loam, and Oakley and Fresno sands, undifferentiated, the latter classification predominating in the western portion of the district.* Much of the topography is very even, but swales and depressions are common, particularly west of Selma. An area of 2190 acres is reported in these swales or 'pond' areas, and 1100 acres as alkali, these two groups covering the only non-irrigable land in the district.

Development.—Consolidated Irrigation District is primarily a horticultural area, raisin grapes predominating, with peaches, figs, apricots, and other deciduous fruits, and some dairying. With the exception of 12,000 acres not in crop, the area is highly developed and has been for many years. Nine cities and towns within the area, none of which is included in the district, have an estimated combined population of 9500. The population on the land which makes up the district is about 24,250. The approximate number of farms is 4850, giving an average size of holdings within the net irrigable area of 30 acres. One individual owns 492 acres, in scattered tracts, one bank owns 800 acres, also scattered, and there is one 640-acre holding.

The main state highway down San Joaquin Valley passes through the district; also two main lines and one branch line of the Southern Pacific Railroad, and the main line and one branch line of the Santa

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Upper San Joaquin Valley, California, and Soil Survey of the Fresno Area, California.

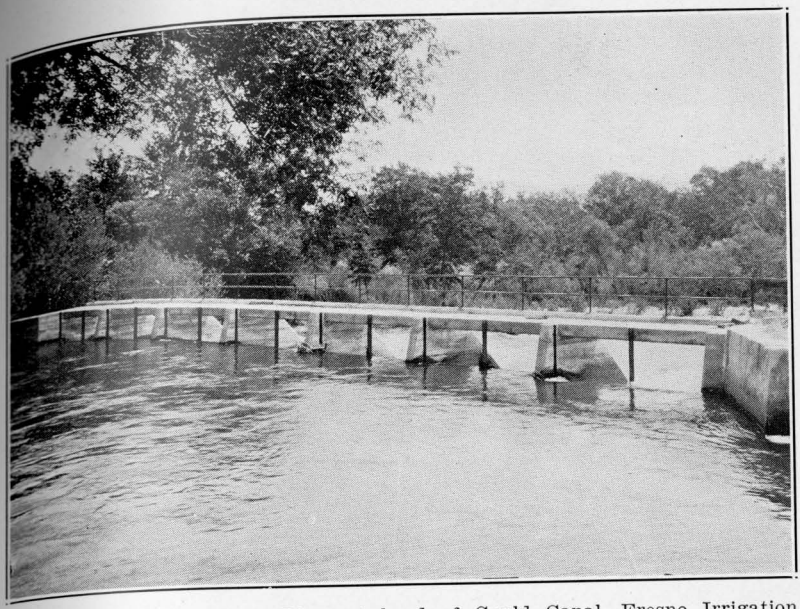


FIG. 1. Weir across Kings River at head of Gould Canal, Fresno Irrigation District.

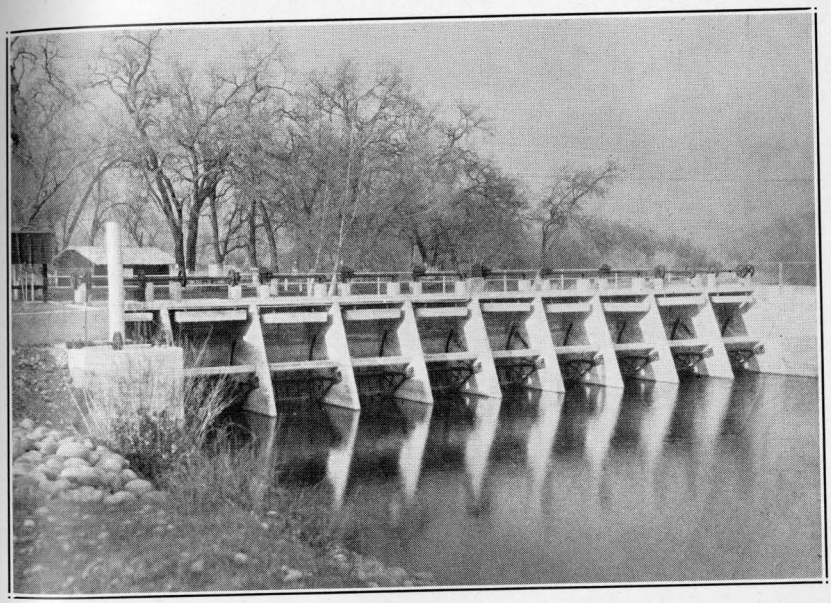


FIG. 2. Headgate of Consolidated Canal on Kings River, Consolidated Irrigation District.

Fe. There are 40 elementary and 9 high school districts within the area. The estimated assessed value of land for county purposes in 1927 was $20,723,000, of which $5,523,000 covered improvements.

Water supply.—The water supply of the district comes from Kings River, supplemented by about 1300 private pumping plants. Under the schedule of the Kings River Water Association, which allots the water of the river up to 9450 cu. ft. per sec., diversions from the river by Consolidated District are confined to the months February to August, inclusive, of each year. Under this schedule the district can take 50 cu. ft. per sec. in February when the river is flowing 1500 cu. ft. per sec. at Piedra, increasing to 200 cu ft. per sec. if the river flow reaches 2100 cu. ft. per sec. In March the schedule allots the district up to 600 cu. ft. per sec. if the river reaches 4000 cu. ft. per sec., in April up to 1350 cu. ft. per sec. with the river at 6400, in May up to 1500 cu. ft. per sec. with the river at 9450, in June up to 1500 cu. ft. per sec. with the river at 9000, in July up to 1350 cu. ft. per sec. with the river at 7000, finally dropping to 450 cu. ft. per sec. in August with the river at 2800.

Since 1916 the actual annual diversions have ranged between 28,600 acre-feet, in 1924, and 342,800 acre-feet, in 1927. In three of the twelve years since 1916 the total diversion has exceeded 300,000 acre-feet, in two it has ranged between 250,000 and 300,000 acre-feet, in four between 200,000 and 250,000 acre-feet, and in two between 150,000 and 200,000 acre-feet, going below 150,000 acre-feet only in 1924. These diversions are for Consolidated and Lone Tree canals.

Approximately one-third of the total quantity of water used annually in the district comes from the private pumping plants. These serve generally about 100,000 acres and furnish all or most of the supply to 42,500 acres. The district is a participant in the proposal to store flood waters at Pine Flat. At present it has no storage.

Works.—When Consolidated Irrigation District purchased the system of Consolidated Canal Company it took over 190 miles of unlined main canals, including Fowler Switch, Centerville and Kingsburg, and Lone Tree systems and their various branches—25 separate canals in all, varying from 0.5 mile to 23.67 miles in length. The district also has 98 miles of unlined and 2 miles of lined laterals, and 3000 lineal feet of 18-inch and 24-inch lateral pipe lines.

Reconstruction work was immediately started, one of the principal items being substitution of substantial concrete units for old wooden structures. After the special $75,000 bond issue voted for improvements was exhausted, money for improvements was obtained from general district tax. Improvements completed to July 31, 1927, involved expenditures of $280,900, of which $13,100 went for main diversion works, $4,200 for Fowler Switch intake, $3,900 for Centerville and Kingsburg intake, $15,700 for the Cole Slough flume, $107,600 for 374 checks and drops, $10,300 for 9 siphons, $52,700 for 1330 standard outlet gates, $7,600 for concrete lining, $15,600 for the Ward drainage pumping plant, and $20,000 for reconstruction of old canals. In rebuilding the new main headworks, 10 radial steel gates, each 4 feet by 8 feet, were set in a structure containing 170 cu. yds. of concrete. An electrically operated control installed on these gates automatically regulates the required diversion from Kings River.

Cole Slough Flume, which carries water to lands served on Island No. 3, involved the construction of 2 steel trusses each 121 feet long, supported on 25-foot concrete piers resting on piles. Two concrete girder spans 30 feet in length connect the trusses with the banks at each side of the slough. The flume supported by this structure is of metal, semi-circular, designed to carry 100 cu. ft. per sec.

The drainage pumps installed by the district consist of two 12-inch centrifugal pumps, each delivering 10 cu. ft. per sec., one 6-inch, delivering 2 cu. ft. per sec., and one deep-well turbine delivering 2000 g.p.m. To July 31, 1927, the capital invested in works amounted to $1,055,900, made up of $775,000 for the Consolidated Canal system, and $280,900 for the improvements previously listed.

Use and delivery of water.—The district keeps no records of the areas irrigated each year. It reports that out of a net irrigable area of 145,757 acres, there is 12,000 acres of good unimproved land which receive no water because of the deficiency in the district supply. The supplemental use of private pumping plants, serving generally 100,000 acres and supplying most or all of the water used on 42,500 acres, has already been referred to.

As a rule, water deliveries by the district are to main laterals only, this having been the practice in past years under both Consolidated Canal Company and its predecessors. At the request of owners on some of the larger laterals, however, the district has agreed to take over such laterals without cost and to maintain them and distribute the water carried. The general policy adopted provides for taking over such laterals only when they serve 1000 acres or more. At this time, about 100 miles have been taken over and are being operated by the district. On laterals not controlled by the district, the landowners make their own arrangements regarding maintenance and water distribution. The district is encouraging organization of these private laterals, having prepared an outline of a desirable lateral organization for the use of the landowners. There are still some laterals on which there is no organization and under these distribution is unequal and inefficient.

The district is improving measurements of deliveries as well as measurements on the main system. A concrete measuring section 30 feet in length, with float gage and automatic recorder, has been installed in the main canal a short distance below the headgates. Experiments have been conducted with a view to perfecting the measurement of water turned into the main laterals and from the laterals to the service ditches. Thus far, six concrete venturi meters have been installed at the heads of main laterals and others will follow if these prove successful. A standard outlet gate for deliveries has been designed and measurements through it are made by means of a portable Pitot tube designed by the engineer of the district. Old wooden undershot gates are gradually being replaced with concrete structures.

Records of ground-water fluctuations have been made throughout the district since 1922. These show a general drop of about 1 foot per year for the five years up to 1927. During 1927 a slight recovery took place, due to increased diversions from Kings River.

Bonds.—The Consolidated Canal system was purchased by the district in 1922 for $775,000, this being covered by bond issue No. 1

which was sold July 29, 1922. A second issue of $75,000 was sold on the same date, this being used for improvements to the system. The bonds are dated July 1, 1922, and run from 1924 to 1933. Bonds to the amount of $300,000 had been paid by January 1, 1928. No additional bond issues are anticipated, except for participation in the proposed Pine Flat storage project. The district has now no other outstanding indebtedness, and there are no other bond issues against land in the district except for general county and school district purposes. Out of a total of forty elementary school districts, sixteen have a prorated outstanding bonded debt estimated at $438,900, nine high school districts in whole or in part within the district have a prorated bonded debt estimated at $590,800, and county bonds for highways, etc., prorated to lands in the district are estimated to amount to $686,700. These make a total bonded debt against lands in the district, including the $550,000 of district bonds outstanding, of $2,664,000. This is at the average rate of $15.11 per acre of which $11.44 is for county and school district bonds and $3.67 for irrigation.

Assessments and water tolls.—The district income is entirely obtained through annual district assessments, except in the case of water supplied to Island No. 3 and to city lots holding water rights. In fixing assessment valuations for district purposes, the usual classifications based on the character of the land are included, but also consideration is given to the slightly earlier priorities of land watered by the old Church Ditch system, and also the fact that some of the lands are served by pumping. The assessment classification for 1927–28 is given below:

Land classification	*Area, acres*	*Assessed value per acre*	*Total assessed value*
Served by Church water	7,975	$110	$877,250
Served by other canals	76,836	100	7,683,600
Served by pumping	42,518	30	1,275,540
Unirrigated (raw land)	10,250	30	307,500
Pasture land	8,100	25	202,500
Subirrigated from river	35	30	1,050
Alkali land	1,099	15	16,485
Free water-right land	44	35	1,540
Waste land (ponds)	2,190	1	2,190
Town lots (water-right)	216	5	1,080
Additional valuation—special improvements, etc.	----	----	100,340
Totals	149,047 acres		$10,469,075

When fixing the valuation of lands irrigated by private pumping plants in 1925–26, the valuations were reduced from $35 per acre to $30 per acre due to gradual drop in the water table, which in many cases made lowering of the pumps necessary, and this lower rate has been used since then.

Since 1922–23, the total annual assessments have varied between $191,692 and $252,261. The district assessment rate per $100 of valuation for the past six years has ranged between $1.88 and $2.53 and has been $2.20 during the last three years. The total amounts levied annually since 1922–23 have ranged from $191,692, in 1922–23, to $252,261, in 1923–24. In 1927–28 the total levy was $230,319.

Tolls charged to lands in Island No. 3 under the old water-right contracts are at the rate of $0.75 per acre per year, regardless of whether water is used. During the past four years city lots with water rights have been charged $2.25 per annum.

ALTA

Location: east of Kings River, in Fresno, Tulare, and Kings counties. (Pl. XXIV.)
Date of organization election: August 14, 1888.
Gross area: 129,300 acres; **area assessed 1927:** 127,000 acres.
Principal cities and towns: Dinuba, Reedley, Orosi, and Cutler.
Post office: Dinuba.
Railroad transportation: Southern Pacific and Santa Fe railroads.

*History.**—This is one of the original Wright irrigation districts, one of the three that has been continuously active since formation. It was organized by a vote of 326 to 19 to take over the '76 Canal, which was built by a private corporation in 1882. The original '76 Canal enterprise was successful from the start. The company sold both land and water rights, the latter being made appurtenant to the land, each 40-acre right calling for 40 inches of water. The charge for each 40-acre right was $200, with an annual assessment on each right of $20 to cover expenses of maintenance and operation. In 1890 the system was purchased by Alta Irrigation District with bonds in the amount of $410,000, these covering repayment to water-right holders of the amounts paid for water rights. The canal system was extended by various individuals under the direction of the engineer of the district, these individuals being repaid in district bonds. By 1900 the area irrigated had reached 50,000 acres.

From early days Alta Irrigation District was involved in litigation respecting its water rights. There was also litigation regarding the legality of certain acts of the board of directors, the first bond issue, out of which the system was purchased, being declared void by the superior court on August 18, 1898, when bonds of this issue in the amount of $543,000 were outstanding. These were the 'dark days' of the district. For several years most of the district assessments remained unpaid and development was halted, although the canal system was continued in operation and the district organization remained more or less active. In 1901 a compromise with the bond-holders was reached. Under this compromise 5 per cent refunding bonds in the amount of $500,000 were issued on February 4, 1902, $492,000 of these being used to redeem all of the outstanding bonds and the defaulted interest coupons for the years 1898, 1899, and 1900. The basis for exchange was $0.75 on the dollar. Since this refunding, the district has been in sound financial condition, meeting all interest and principal payments as due, and even retiring bonds in the amount of $53,500 in advance of maturity out of accumulated surplus.

Soils and topography.—The soils of Alta District are generally light in character, the principal classifications being Fresno, Madera, and San Joaquin sandy loams and Fresno fine sandy loams.† In the areas generally surrounding Reedley and Dinuba, Madera and San Joaquin

* See also State Dept. of Eng., Bul. 2, 84–86; also U. S. Dept. of Agr., Office of Experiment Stations Bul. 100, 292–296.
† U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Upper San Joaquin Valley, California, and Soil Survey of the Fresno Area, California.

sandy loams and Fresno fine sandy loams predominate. San Joaquin loams occur very largely in the northern portion of the district, with Fresno fine sandy loams around Traver, and Fresno loams in the southern portion of the district. The topography is somewhat rolling in the northern portion, but even and gently sloping in the southern portion.

Ground water is available throughout nearly all the district, the level having fluctuated considerably during past years. Before 1883 the ground water was 20 to 50 feet below the surface, but it is reported to have risen by 1900 to within 5 to 8 feet of the surface around Dinuba, and to within 2 to 8 feet of the surface at Traver. Prior to the dry period 1922–25, about 20,000 acres had a water table within 3 feet of the surface, but, due to this dry period and the operation of many private irrigation pumping plants, it has been reduced. In 1926 not over 1000 acres are reported to have had a water table at less than 4 feet. At the end of the irrigation season of 1927 it varied from 10 to 45 feet below the surface north of Reedley, from 4 to 16 feet north of Monson, and from 4 to 9 feet in the lower lands in the southern portion of the district near Traver. Since 1921 the district has kept a record of ground water levels throughout the district, the number of test wells approximating 160.

Alkali is present in injurious amounts in southern portions of the district, as around Traver, but, as the water table has receded, more and more of this land has been brought under at least pasture crops. About 20,000 acres is reported to be sufficiently impregnated with alkali to affect crop production, almost all of this being south of the township line between townships 16 and 17 south.

Development.—The district assessment books show about 2000 separate farms and about 2600 separate city holdings, the average size of farm holdings approximating 54 acres, but with many small holdings of 10 and 20 acres. There are two large holdings within the district, one of 1500 acres in vines, the other 2000 acres, mostly pasture. The district includes seven cities and towns, two of which are incorporated, with a total estimated population of 20,500. It is well supplied with excellent railroad and highway transportation. The estimated assessed value of land for city and county purposes in 1927 was $1,400,000 in cities and $6,200,000 outside of cities, or a total of $7,600,000. The estimated value of farm lands in the district is $33,000,000 out of a total of $38,000,000 for the entire district. In the estimate of farm lands, about three-fifths of the total are valued at $300 per acre and about one-fifth each at $150 and $50 per acre. The estimated value of improvements on farm lands is $5,000,000, and in cities and towns $5,000,000.

Water supply.—Alta Irrigation District obtains its water supply from Kings River, having a relatively late priority on the river. Under the 1927 Kings River schedule it obtains no water in January, but begins receiving 50 cu. ft. per sec. in February if the river carries 1600 cu. ft. per sec. at Piedra, this increasing with 2100 cu. ft. per sec. at Piedra to 200 cu. ft. per sec. during the month. In March its schedule allotment is 100 to 500 cu. ft. per sec. with the river at Piedra carrying from 2400 to 4000 cu. ft. per sec. The allowances under the schedule reach 1050 cu. ft. per sec. in April, 1200 cu. ft. per sec. in

May and June, and 1050 cu. ft. per sec. in July, dropping to nothing in August and reaching maxima of 585, 475 and 450 cu. ft. per sec., respectively, in September, October, and November.

Since Kings River is yet without storage, the amounts actually received by the district depend upon the quantity at Piedra; consequently, the variation in the supply may be wide from year to year. For instance, in 1927 the district diverted about 256,800 acre-feet, while in 1924 only 15,000 acre-feet was available, the remainder of the water used being supplied by 1500 private pumping plants which partially serve about 60,000 acres. During the period 1910 to 1927 the average annual diversion by the district has been about 160,000 acre-feet. Since water is not available from Kings River throughout the season, heavy applications are made while it can be had, much of the water applied seeping into the underlying gravels from which it can be later withdrawn by the private pumping plants.

Whenever storage is built at Pine Flat, Alta Irrigation District will participate along with other Kings River users. Owing to the Kings River agreements, the district is not now involved in litigation over its water rights.

Works.—The Alta Irrigation District canal system comprises 61 separate canals or ditches, aggregating 304 miles in length. There are also 20 private ditches aggregating 35 miles in length which supply 6.90 per cent of the total area. Diversion from the river is made a few miles below Piedra where a low weir is constructed on a cobble riffle to divert water into an old natural channel of the river. After flowing about 5 miles down this natural channel it reaches the headgates of the Alta main canal. This main canal, with a capacity of about 1450 cu. ft. per sec., follows for about 6 miles along the eastern boundary of the district, where it diverts into the Traver canal and the east branch, the latter continuing about 16 miles along the eastern boundary. The Reedley main canal takes out about 1.5 miles above the east branch and supplies the western part of the district. The canal system is not extensive south of Monson.

The district has installed no drainage works, the large number of private pumping plants generally eliminating the need for them.

The actual value of the district works as of December 31, 1927, is given as $1,700,000. Expenditures on the works have been $492,000 from bond issue and $298,633 from general maintenance and operation assessments. The system was appraised in 1922 and an appraisal increment approximating $930,000 added. In making this appraisal, the major item, which was earth construction, was figured at 12 cents per cu. yd.

Use and delivery of water.—The allotted water turned into the Alta main canal is distributed according to 'customary percentages' to the various laterals. This apportionment is based on the diversions which have been made in the various laterals since the system was constructed, rather than the acreage supplied by each. Irrigators are required to file applications for water and they are served, as a supply is available, according to the priority of the various requests, each lateral being considered a unit in delivery service. Alta Irrigation District is very largely devoted to raisin vineyards, 54,840 acres being reported in 1925, which was the last year of crop census. Other crop acreages reported that year were: grain, or grain hay, 6950 acres; deciduous

fruits and nuts, 5560 acres; alfalfa, 4690 acres; figs, 3400 acres; citrus fruits, 930 acres; olives, 500 acres; truck crops, 450 acres; field crops, 430 acres; cotton, 200 acres. While crop acreages have not greatly changed since 1925, some grapes have been replaced by alfalfa and the dairy industry is gradually growing. According to the secretary of the district, 80,000 acres is a fair estimate of the area usually irrigated annually.

As already indicated, the water available to Alta Irrigation District varies over a considerable range, owing to fluctuation in the seasonal flow of Kings River. Since 1915, the maximum annual diversion has been 255,478 acre-feet, in 1927, and the minimum 14,990 acre-feet, in 1924. However, in no year since 1915, except 1924, has the amount diverted fallen below 100,000 acre-feet. In two years it was above 200,000 acre-feet, in seven years it was between 150,000 and 200,000 acre-feet, and in three years it was between 100,000 and 150,000 acre-feet. Deliveries to irrigators are not measured.

Bonds.—Alta Irrigation District has issued no bonds other than the $675,000 put out in 1889 and the refunding issue of $500,000 in 1902. The refunding bonds began to mature January 1, 1923, and will be retired by January 1, 1943. There is still unredeemed one $500 bond of the first issue, this never having been presented for payment. Of the refunding bonds of 1902, $8,000 were never issued. Not including the unredeemed $500 bond of the first issue, the outstanding bonds amounted to $296,500 on January 1, 1928. These carry 5 per cent interest. There are no other outstanding bonds against lands in the district, except general county bonds, school district bonds, and municipal bonds of Reedley and Dinuba, estimated to total $1,190,000.

Assessments and water tolls.—Average farm lands in the district served by ditch are assessed for district purposes at $60 per acre and those not served by ditch at $40 per acre. Pastures sometimes irrigated are given values of $10 to $25 per acre. The minimum assessed valuation in the district for farm land is $2.50 per acre. Prior to 1927–28 town lots were assessed at from $300 to $1,200 per acre, but in 1927–28 the rate was lowered to $25 for each 25 by 150-foot lot. The total assessed valuation for district purposes was $5,566,939 in 1927, this having increased from $3,012,678 in 1914. The total annual levy has increased from $68,086 in 1913–14 to $153,556 in 1927–28. The amounts levied on lands within cities and towns is relatively small—$9,820 in 1926–27 and $5,338 in 1927–28. The annual assessment rate per $100 valuation for 1927–28 is $2.65, or from $1.06 to $1.59 per acre for average farm land. For the past five years the district assessment rate per $100 of valuation has ranged between $1.90 and $3.196.

Alta District follows the old provision of the law and collects all district assessments in one installment. No water tolls are charged.

FOOTHILL

Location: east of Alta Irrigation District, in Fresno and Tulare counties. (Pl. XXIV.)
Date of organization election: May 3, 1920.
Gross area: 50,687 acres; **area assessed 1925:** 50,687 acres.
Principal towns: Navelencia, Orange Cove, East Orosi.
Post office: Orange Cove.
Railroad transportation: Minkler-Orosi branch of Santa Fe railway.

History.—This district, organized by a vote of 356 to 3, represents a move of landowners in the area east of Alta Irrigation District to participate in the benefits of storage at the proposed Pine Flat site. When organized in 1920, ground water underlying the lands of the dis-

trict was available in unknown quantities. Plantings had, or have since, been made to the extent of nearly 17,000 acres in the belief that the underground water would carry them through until a Kings River supply or its equivalent could be obtained. The draft by the large number of wells that have been put down, however, caused material lowering. Some of the wells have been drilled deeper and some have gone dry, and some of the plantings have, therefore, been abandoned.

In the meantime, plans have gone actively forward for obtaining an outside supply. The district has been accepted as a participant in storage at Pine Flat if built. Since none of the normal flow of Kings River is available directly to the district, a contract for a supply has been entered into with Murphy Slough Association operating in the lower Kings River country. Under old rights, Murphy Slough Association ditches are entitled to divert certain quantities of water from Murphy Slough, which leads off from Cole Slough near Laton; and adjoining the Murphy Slough lands is an area known as the Conejo tract, from which ground waters can be pumped.

The contract between Foothill Irrigation District and Murphy Slough Association provides that out of the underground waters at Conejo tract, the district shall pump a maximum of 100 cu. ft. per sec., up to a maximum of 50,000 acre-feet per annum, and deliver this water to Murphy Slough Association ditches. In exchange for this supply, the district is proposing to receive the water available for diversion by the Murphy Slough Association ditches, taking this out of Kings River below Piedra near the diversions of the upper Kings River canals. Necessary land in the Conejo area is under option to the district and the engineering studies indicate to the satisfaction of the engineers of the district that the supply proposed to be diverted there can be obtained. The district has bored 4 test wells in the area, showing yields of 2000 to 3000 g. p. m each. An engineering report and cost estimates have been made covering the proposed diversion canal from Kings River and a distribution system, together with a pumping project for the exchange of water.

The contract with Murphy Slough Association has been given legal approval by the attorney general's office. Among other things, it provides that the title to the water in lower Kings River to which Murphy Slough Association ditches have acquired a right shall remain in that association, and that if at any time there is default by the district in meeting the minimum requirements of the contract, the district may not divert any of the association water from Kings River. Although, in at least one other state, Colorado, exchanges of direct flow and stored water are common, the practice of exchanges is new in California, and is not covered by any specific statutory provision, as is the case in Colorado.

Early in July, 1928, suit was brought against Foothill Irrigation District by Peoples, Last Chance, and Lemoore canal companies, seeking to prevent the proposed pumping from the Conejo tract, on the ground that it would deplete the supply in Kings River above the heads of their canals. Trial of the case started at Hanford on November 8, 1928.

Soils and topography.—Soils of the district are chiefly of the San Joaquin series, including both loams and sandy loams, but with a

considerable area of adobe.* The area covers the upper plains, extending to the rough land of the lower foothills, and is interspersed with granitic knolls and outcrops. While hard-pan is close to the surface in some of the area, most of the land is reported to be of sufficient depth for successful cropping. The topography is uneven, but can be satisfactorily worked over for planting. Some soil in the district is classed as best suited for pasture, for which it is now used.

Some alkali exists in the district, but the appraiser for the Bond Certification Commission reports no black alkali noted and no excessive accumulation of chlorides. He states, however, that, particularly at the southerly end, it is possible that alkali concentrations in greater than allowable amounts may occur. He further reports that with proper care in choice of plantings and local treatment of minor drainage problems, no drainage hazards need be apprehended.

Development.—The crop census for 1923 showed 19,950 acres planted to vines, citrus fruits, and deciduous fruits, including figs, olives, and avocados, 10,500 acres of the total being in vines and 7000 acres in citrus. A crop census for 1927 shows 16,970 acres in the fruits mentioned and 3000 acres in grain. Orange Cove, with a population of 600, Navelencia, with a population of 50, and East Orosi, with a population of 15, are unincorporated cities and towns within the district, and there is an estimated population in the district outside of cities and towns of 3000. Dinuba, Reedley, and Sanger in the neighboring Alta Irrigation District furnish additional trading centers. The approximate present number of farm holdings is 1200 and the average area per holding 38 acres. There is one holding of 1200 acres, mostly sold, and others of 1059, 899, and 656 acres, but each is comprised of a number of separate tracts. Good surfaced highways out of Fresno and Visalia transverse the district.

Water supply.—The present water supply for lands within the district comes from private pumping plants, which serve about 16,000 acres. In April, 1928, 776 dry wells and 120 active wells were reported. The contemplated annual supply includes 38,700 acre-feet to be diverted from Kings River in exchange with Murphy Slough Association, as referred to above, 18,400 acre-feet from local pumping, and 3500 acre-feet from the purchase of Liberty Canal, a total of 60,600 acre-feet. It is estimated in a report made to the district that 1.75 acre-feet per acre will be required on 8000 acres of citrus fruits and 1.33 acre-feet per acre on 32,000 acres of vines and orchards; these being considered desirable minimum amounts.

Works.—As already indicated, no works have yet been purchased or constructed, other than the four test wells in the Conejo well field. It is proposed to construct 48 miles of main diversion canal and 74 miles of laterals, with all necessary controlling equipment, and also to purchase the additional lands needed and install the necessary pumping equipment in the Conejo well field. There will be gravity diversion and distribution throughout the district, except for a relatively small area to which water will be pumped. Construction of the system is estimated to require one and one-half to two years. The total estimated cost, including interest during construction, is $2,270,000. This is an average of $44 per acre on the gross acreage, and about $50 on the net

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

irrigable area. The district has already purchased stock in Liberty Canal Company at a cost of $8,484. It has expended a total of $33,437 in test wells and $3,500 in advances on Conejo tract lands. Including engineering and the previous items, the total capital invested in works as of January 1, 1928, was $46,921.

Use and delivery of water.—Delivery of water is not yet a district problem, since the entire supply is obtained from underground pumping by individuals. The use of water will be confined almost entirely to citrus and deciduous orchards and vines. It is estimated by the district that the annual maintenance of the proposed irrigation system, including interest on bonds, will not exceed $5 per acre per annum.

Bonds.—A bond issue of $2,270,000 was carried by a vote of 606 to 14 and bonds in that amount, carrying 6 per cent interest and dated September 1, 1927, with maturities from 1948 to 1967, have been prepared but none sold. On the advertised sale date no bids were received. School and county bonds outstanding are estimated as follows: Fresno County—elementary school, $21,300; high school, $48,400; general county, $36,100; total $105,800; Tulare County—elementary school, $20,100; high school, $20,000; general county, $21,600; total $61,700; total both counties, $167,500.

Assessments.—The district has levied assessments in each of the years since 1921 except 1924–25, 1926–27, and 1927–28. In 1921 county assessed valuations were used. Since then the district has made an independent assessment, land valuations ranging from $20 to $100 per acre, with a normal valuation of $60 per acre. Lands of no agricultural value are assessed nominally at $0.50 per acre. The total assessed valuation within the district for 1925–26 was $2,980,652. The assessment rate levied per $100 of valuation was $1 in 1921–22, $0.60 in 1922–23, $1 in 1923–24, and $2 in 1925–26. The total amounts levied have varied from $12,735 in 1923–24, to $59,613 in 1925–26.

ISLAND No. 3

Location: between Cole Slough, Kings River, and Dutch John Cut, a few miles south of Kingsburg and west of Laton, in Kings County. (Pl. XXIV.)
Date of organization election: May 3, 1921.
Gross area: 4620 acres; **area assessed 1927:** 4620 acres.
Principal towns: none.
Post office: Laton.
Railroad transportation: Santa Fe railway at Laton and Southern Pacific railroad at Kingsburg.

*History.**—This district was formed, by a vote of 88 to 13, primarily to deal with Consolidated Canal Company in the matter of water service. Being at the lower end of the Consolidated Canal system, service was unsatisfactory and was the subject of complaints made to the State Railroad Commission, which advised the landowners to organize in order to deal as a unit with Consolidated Canal Company. Island No. 3 users were under water-right contracts with Consolidated Canal Company and were paying annual water charges of $0.75 per acre. Shortly after the organization of Island No. 3 Irrigation District, the Consolidated Canal system passed to Consolidated Irrigation District. The latter sought to include within its boundaries the lands within Island No. 3 District, but the owners of the latter preferred to stand on their original water-right contracts.

* See also State Dept. of Eng., Bul. 7, 24–25.

Soils and topography.—The soils of the district are classified by the soil survey as Hanford fine sandy loam.* The soil map shows alkali indications. The surface is flat, sloping gently to the southwest. About 400 acres in the central portion is badly spotted with alkali, the top soil being underlaid with hard clay which prevents subsoil drainage. Ground water stands 12 to 15 feet below the surface.

Development.—Information is not available as to the area irrigated from the canal supply, but the area irrigable from such supply is given as 3000 acres, and from the present distribution system as 4500 acres. Because of uncertainty of the gravity supply, practically all land irrigated receives a supplemental supply by pumping from private wells. The lands were originally subdivided and colonized by Laguna Lands, Ltd., which was controlled by the same interests that controlled Fresno Canal and Irrigation Company prior to the formation of Fresno Irrigation District.

The approximate number of farm holdings is 155 and the average holding is 26 acres. There is one holding of 240 acres and two of 140 acres each. The estimated population within the district is 600. Except for the 400 acres of alkali land, the district has good drainage into the surrounding natural channels.

Water supply.—As already indicated, the district obtains water from Consolidated Irrigation District under water-right contracts issued by the old Consolidated Canal Company, supplemented by private pumping plants which furnish about 50 per cent of the total quantity used. There are about 150 of these plants. The water-right contracts with the old Consolidated Canal Company call for 1 cu. ft. per sec. for each 80 acres. The quantities obtained from Consolidated Irrigation District are measured by a venturi meter installed in the main canal in 1927, but no measurements of delivery are made to the laterals. Owing to the recent series of dry years, the quantity of water available to the Island from Kings River has been small, and the private pumping plants have been the chief reliance. However, the farmers report that in 1927 more water was delivered than for several years previous. The amount of the 1927 diversion is reported to have been about 8000 acre-feet.

Works.—The district owns no works, but the Island is supplied by about 10 miles of unlined canals. Cole Slough Canal, which delivers water to the head of the Island, has been cleaned out and a new steel flume has been built to carry the supply across the river channel separating the two districts.

Use and delivery of water.—No special system of water distribution is followed. Consolidated Irrigation District cares for the main canal while the farmers maintain the laterals. Landowners at the upper end of the Island are said to be receiving most of the water. Consolidated Irrigation District is seeking to induce Island No. 3 District to take over water distribution within its boundaries.

Bonds.—The district itself has no outstanding indebtedness. Outstanding county bonds are reported by the county auditor to amount to less than 5 per cent of the assessed valuation.

Assessments.—District assessments are levied annually and small amounts collected for general expenses within the district. For this purpose county assessed valuations are used, these ranging from $18 to

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

$60 per acre, with a normal valuation of about $40. The total assessed valuation has ranged between $192,027, in 1927-28, and $245,316, in 1922–23. In 1922–23 the assessment rate per $100 of valuation was $1, but for each succeeding year, it has been $0.25. The amount raised by the district in 1922-23 was $2,453; in succeeding years it has ranged between $480 and $495.

Present status.—No district activity is contemplated for the immediate future. The prevailing idea seems to be to protect existing rights and to hold operating costs to a minimum until the economic situation in agriculture improves. The district is not participating in the proposed Pine Flat storage project, but since its water supply is derived from Consolidated Irrigation District, it will benefit from storage water obtained by the latter.

LAGUNA

Location: lower delta of Kings River about 20 miles south of Fresno and 8 miles northwest of Hanford, in Fresno and Kings counties. (Pl. XXIV.)
Date of organization election: February 20, 1920.
Gross area: 34,858 acres; **area assessed 1927:** 34,858 acres.
Principal town: none; principal adjacent towns: Laton and Riverdale.
Post office: Laton.
Railroad transportation: Hanford-Summit Lake branch of Southern Pacific railroad and Laton and Western railroad connecting with the Santa Fe at Laton.

*History.**—This district comprises about half of the area in the old Laguna de Tache Rancho. It was deeded by the Mexican government to one Manuel Castro, January 10, 1846. The land is directly in the lower delta of Kings River and as such has been riparian thereto, the riparian rights of the rancho being the basis for long-continued and extensive litigation directed against the upper users on Kings River. In 1891, in order to bring an end to the litigation, Fresno Canal and Irrigation Company interests purchased the grant. Eleven years later an affiliated corporation, known as Laguna Lands, Ltd., subdivided and colonized the area. Fresno Canal and Irrigation Company retained title to the old canal system but entered into water-right agreements with Laguna Lands, Ltd., by which water-right contracts were sold with the land, these being appurtenant thereto. These water-right contracts were similar to those under Fresno Canal and were to remain in force, as in the case of those of Fresno Canal, until 1921.

At the approach of the expiration date of these contracts a move was made to form an irrigation district and take over the canal system watering the grant, this largely being an effort to forestall higher rates for water. Organization carried by the large vote of 251 to 4. An appraisal of the irrigation system was made and at an election May 26, 1921, bonds to the amount of $265,000, which was approximately the amount of the appraisal, to be used in purchasing the local system, were voted. Transfer of the properties was made in due time and the system is now operated by Laguna Irrigation District.

Soils and topography.—The soils are typically deltaic and are mapped by the soil survey under various classifications, being mainly loams and

* See also U. S. Dept. of Agr., Office of Experiment Stations Bul. 100, 308–310, and State Dept. of Eng., Bul. 7, 68–76.

sandy loams of the Hanford, Merced, and Foster series.* The surface slopes toward the west at a rate of about 5 feet per mile, and the area is traversed by a number of sloughs and channels of Kings River. Ground water is 2 to 12 feet below the surface. Reclamation Districts 770, 776, 779, 2048, and a small portion of Reclamation District 801 lie within Laguna District. About 20,000 acres is provided with drainage and about one-fourth of the area of the district would be benefited by additional drains. About 1500 acres lies above the canals and 3358 acres is classed as alkali land and land in sloughs. About 10 per cent of the land is reported to have sufficient alkali to affect crop production.

Development.—The land has always been well watered and has been partly irrigated for many years, the reports available showing 15,000 acres irrigated in 1910, 17,000 in 1916, 25,000 in 1921, and 25,000 in 1927. There are two large holdings of 3870 and 3050 acres. Much of the land has been subdivided, there being now about 800 holdings averaging 38 acres. The estimated population in the district is 3000. The estimated assessed valuation for county purposes in 1927 was $1,416,640.

Water supply.—The water supply from Kings River is based on both riparian and appropriative rights and is received through "A," Grant, Island, and Summit Lake canals. Since 1918 the amounts diverted have varied between 10,829 acre-feet in 1924, and 74,731 acre-feet in 1927. In two of the ten years the amount has exceeded 70,000 acre-feet, in one year it was 65,431 acre-feet, in four years it has been between 50,000 and 60,000 acre-feet, and in two years between 40,000 and 50,000 acre-feet.

About 10 per cent of the total water used in the district is obtained by 250 private pumping plants which furnish water to about one-fourth of the total irrigated area. Of the supply received through the four canals named, the principal portion is delivered by Grant and Island canals.

Works.—The works taken over from the Fresno Canal interests comprise the Grant, Island, "A," and Summit Lake canals, with their principal branches. There were 14 separate canals with an aggregate length of 61 miles. The district now operates 65 miles of unlined main canals and 15 miles of unlined laterals. Improvements have not been extensive and have consisted mainly of repairs and replacements to wooden structures. During 1927 the directors adopted the policy of replacing larger wooden structures with concrete. This has been done in the case of four headgates to main laterals and four checks in main canals, these replacements costing an average of $230 each. At the point where Grant Canal crosses an old water course on an earth dam, a length of 65 feet has been lined with concrete to prevent seepage. The only large structure built by the district is a concrete weir 200 feet long across Zalda Canal, this replacing the wooden structure built in 1903 and washed out in 1925. The cost of this new structure was $19,800. The district has participated with interests lower on the river in constructing a concrete weir at the point where Cole Slough divides, this point in times past having been the scene of bitter contentions between rural claimants to the water supply. The expenditure for permanent improvements to April 1, 1928, has been about $28,350. The total

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

investment in works to December 31, 1927, has been $305,000, all of which came from bond issues except $40,000 raised from general district taxes.

Use and delivery of water.—At first the district continued the practice of Fresno Canal and Land Corporation by turning water into the laterals and letting the farmers look after the distribution from the canals. At the request of various landowners the district has recently taken over some 15 miles of larger laterals and on request will do the same with others where 12 or more irrigators are being served. Because of the flat grades, measurement of deliveries is difficult and has not been undertaken, although the superintendent has recently been requested to provide some means of doing this.

Bonds.—The district has issued $265,000 in 6 per cent bonds dated July 1, 1921. Maturities range from 1923 to 1932 and half of the bonds have been paid. There are no overdue obligations. During the period 1920 to 1924 it was necessary to borrow amounts ranging from $900 to $3,000 from banks for operating purposes, but these sums have all been repaid. Bonds outstanding against lands in the district, other than irrigation bonds, amount to $94,300, comprising $44,300 of eight elementary school districts, $16,900 of three high school districts, and $33,100 of highway bonds. There are no reclamation district bonds outstanding.

Assessments and water tolls.—The entire income of the district is obtained from district assessments. Most of the land is given a flat valuation for district purposes of $100 per acre, poor land being reduced according to the judgment of the directors. The lower valuations have ranged from $20 to $70 per acre, the low valuation in 1927-28 being $60 per acre. The total district assessed valuation for 1927-28 was $3,197,000, and the total district levy was $59,512. Annual district assessment rates per $100 of valuation for the past five years have ranged between $1.85 and $2.40, the former being the rate for 1927-28.

RIVERDALE

Location: about 25 miles south of Fresno, south of Murphy Slough, in Fresno County. (Pl. XXIV.)
Date of organization election: April 10, 1920.
Gross area: 15,830 acres: **area assessed 1927:** 15,830 acres.
Principal town: none; nearest town: Riverdale.
Post office: Riverdale.
Railroad transportation: branch lines of Southern Pacific and Santa Fe railroads.

*History.**—Organization of this district was prompted by the proposed Pine Flat storage project, through which it was hoped a late water supply might be made available to lands under Turner and Riverdale ditches and Burrel Lateral from Riverdale Ditch. Irrigation development under these various ditches began more than 50 years ago, but they have been limited in water supply to high or flood flow of Kings River during brief periods in the winter and longer periods during May and June, in recent years supplemented by pumping from wells.

Turner Ditch was built in 1875 or 1876 and was owned by Turner Ditch Company, an incorporated mutual company. Sixty out of the 90

* See also U. S. Dept. of Agr., Office of Experiment Stations Bul. 100, 306–7; and Calif. State Dept. of Eng., Bul. 7, 55–61.

shares of the company were apportioned to a 2560-acre area known as the Johns tract, the remaining shares being held by seven or eight stockholders. Riverdale Ditch was built about the same time, and was owned by Riverdale Ditch Company, also a mutual company, organized by farmers. Both of these ditches were diverting water from Murphy Slough, originally having separate headgates but later using the Turner Ditch headgate jointly. Burrel Ditch, or lateral, is managed by a separate company and originally received about two-thirds of the water diverted by Riverdale Ditch from Murphy Slough.

Shortly after organization of Riverdale Irrigation District, an engineering firm was employed to value the properties of the three companies. Their report, dated August 12, 1921, gave a valuation of $60,630.28 for the property of Turner Ditch Company, $16,031.41 for the property of Riverdale Ditch Company, and $46,032.46 for the property of Burrel Ditch Company, the total being $122,694.15. A bond issue of $123,000 was used to acquire these properties through purchase of the stock in the three companies.

Soils and topography.—As classified in the soil survey, soils in the district are mainly Merced loams, with small areas of Hanford sandy loam in the eastern portion.* The surface is flat, with a gentle slope toward the west. Elevations vary from 200 to 230 feet. Natural sloughs furnish the only drainage at present, and in some cases the effect of these has been lessened by reclamation levees crossing them. The western section of the district next to Fresno Slough is low and in need of drainage in wet years.

Development.—For the most part land in the district is devoted to cattle raising and dairying, with a portion still in pasture. The principal crop is alfalfa, with corn and grain in small quantities. A cooperative dairy has been operating at Riverdale for several years. There are about 250 separate holdings, averaging 60 acres, with two holdings of 640 acres each and one of 320 acres. The estimated population is 1200, there being 300 additional in the unincorporated town of Riverdale, which is excluded from the district boundaries. The estimated assessed value of land and improvements in the district for county purposes for 1927–28 was $1,237,000.

Water supply.—In 1898, Murphy Slough Association was formed by four ditch companies diverting water from Murphy Slough, viz.: Riverdale Ditch Company, Liberty Mill Race Company, Turner Ditch Company, and the owners of Reed Ditch. The agreement creating the association provided for distribution of the water available in Murphy Slough on the basis of one-third to Riverdale Ditch Company, one-third to Liberty Mill Race Company, one-sixth to Turner Ditch Company, and one-sixth to Reed Ditch Company. This agreement was supplemented by a new agreement on March 16, 1903, but the old basis of division of the water was continued. The agreement thus gives Riverdale and Turner ditch companies half of the total. The 1927 Kings River schedule allots water to Murphy Slough during each month of the year. The water supply, however, usually fails after June. With the exception of the dry year, 1924, when only 908 acre-feet was diverted by the Riverdale-Turner ditch, diversions during the past

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

ten years have ranged between 12,401 acre-feet in 1926 and 25,673 acre-feet in 1927. In five of the ten years, the diversions have exceeded 21,000 acre-feet, and in all but three of the ten years they have exceeded 18,000 acre-feet.

Works.—The main canals taken over by the district were the main, middle, and north Turner, Riverdale, and Burrel, the five aggregating 30.6 miles in length. The common intake on Murphy Slough is still used. Only 750 feet of the main canals are lined. The district has installed a number of timber side gates to replace old structures and anticipates beginning replacements in concrete at an early date.

Use and delivery of water.—Methods of use of water have not changed greatly in recent years.* In the years when water has been plentiful, little attempt has been made to systematize distribution, but each irrigator has been given as much water as possible. Delivery is made to the heads of laterals and individuals take the water from that point. The general rule of distribution is to allow each 20 acres a head of 1 cu. ft. per sec. for six hours, or 30 cu. ft. per sec. for three hours at each run. No measurements are made, the ditchtender estimating quantities. Practically the entire district gets partial irrigation during the early season. The district estimates that half of the ranches pump from wells to supplement the gravity supply. About 80 of the wells average 100 to 180 feet in depth, and the depth of 5 or 6 ranges between 1000 and 1200 feet. The district has recently adopted the policy of taking over laterals that supply five or more individual farms or irrigate in excess of 1000 acres.

Bonds.—The district has only put out the one bond issue of $123,000 for purchasing the stock of Riverdale, Turner, and Burrel ditch companies. Since the community was an old established one, early maturities were fixed, the last series coming due July 1, 1933. Bonds to the amount of $31,000 had been retired on January 1, 1928, leaving outstanding $92,000. Other bonds against lands in the district are estimated as follows: three elementary school districts, $43,000; one high school district $3,300; county highway bonds, $36,600; total, $82,900.

Assessments and water tolls.—Land is valued for district purposes at a flat rate of $75 per acre, the total assessed valuation being $1,121,256, this having held for the past eight years. The district assessment rate for each $100 valuation has been $3 for each of the past three years, $2.80 in 1924-25, and $1.50 in 1922-23. The total levy for 1927-28 was $33,637. No water tolls are charged.

CRESCENT

Location: northwest of Summit Lake and west of Bogg Slough, in Fresno and Kings counties. (Pl. XXIV.)
Date of organization election: February 5, 1925.
Gross area: 13,150 acres: **area assessed 1927:** 13,150 acres.
Principal town: none.
Post office: Fresno.
Railroad transportation: branch of Southern Pacific railroad at Burrel and Santa Fe railway at Lanare.

History.†—The purpose in forming this district was to provide an organization to deal with other Kings River units in connection with the proposed storage on Kings River at Pine Flat, and to furnish a means for participating in that storage if built. The land within the

* For description of method see Calif. State Dept. of Eng., Bul. 7, 56–61.
† U. S. Dept. of Agr., Office of Experiment Stations Bul. 100, 310–311; also, Calif. State Dept. of Eng. Bul. 7, 77–79.

district has been irrigated from Crescent Canal when water has been available. Crescent Canal was built in 1885–86 by Crescent Canal Company and was put in use in 1887. Crescent Canal Company, incorporated in September, 1885, was a cooperative enterprise, furnishing irrigation water to its shareholders. Each share of stock in the company entitled its holder to water for 320 acres, or a pro rata of the supply in case of a deficiency. Surplus water, if any, was sold at $0.75 per acre for irrigation. Expenses were met by assessments on stock of the company. In 1900 about 9400 acres were reported to be under irrigation, and in 1918 about 12,000 acres were reported served, with a maximum of 10,000 acres irrigated. The amount irrigated in any one year depended upon the flow available in Kings River.

Crescent Irrigation District has not purchased the irrigation system belonging to Crescent Canal Company, and does not anticipate doing so until the proposed Pine Flat storage project is undertaken. It is therefore not at this time an operating district, although organization is being maintained and assessments for general purposes levied annually, as needed. At the time of organization the district had in mind the possible development of underground water to supplement the present gravity supply, but this has not yet been undertaken.

Soils and topography.—The soils are mainly classified as Merced clays and clay loams and Panoche clay loams, the former predominating.* The surface is generally very flat, but there is some slope to the northeast. Ground water stands 10 to 15 feet from the surface. Drainage is not now a problem. There are a few bad alkali spots along the western boundary, but the district boundaries have been drawn to exclude alkali lands.

Development.—Practically the entire area has been planted to grain and has been at least partially irrigated from time to time. There are a few small areas of alfalfa in the southeastern portion. About 100 live within the district boundaries. There are about 60 separate holdings averaging about 200 acres. Three large holdings contain 960, 880 and 520 acres. Graded and oiled county roads traverse the area, connecting with state and county highways on the east and north.

Water supply.—In early litigation Crescent Canal was decreed a right to 213 cu. ft. per sec., this being inferior to the upper southside canals, but superior to a right of 165 cu. ft. per sec. decreed to Stinson Canal.

Crescent Canal Company is a participant in the Kings River water-right agreement. The 1927 schedule allows it from 50 to 100 cu. ft. per sec. in January, February and March, with varying stages of the river at Piedra, beginning at 1400 cu. ft. per sec. in January, 1700 cu. ft. per sec. in February, and 3600 cu. ft. per sec. in March. First diversions are allowed Crescent Canal under the schedule during April, May, June and July when the river reaches a stage of 5600 cu. ft. per sec. The maximum diversion specified for Crescent Canal during the high-water summer flow is 200 cu. ft. per sec.

Records are available showing diversions by Crescent Canal since 1918. In 1924, a low-water year, nothing was taken out. In 1927, the maximum year, the diversion was 21,179 acre-feet. In five of the past ten years, the annual diversion has been less than 10,000 acre-feet, in

*U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

two it has been between 12,000 and 13,000 acre-feet, and in three, over 16,000 acre-feet. Generally speaking, the canal receives a run of water for a few weeks in December and January and a longer run during the floods of May, June and July.

Works.—Since the district has not taken over Crescent Canal, it owns no works. Crescent Canal diverts from the Zalda channel of Kings River about 3 miles east of Summit Lake, where a weir was built by Zalda Reclamation District to control the water in the channel of Kings River leading north. From this point the canal extends about 20 miles northwest, finally wasting any surplus into Fresno Slough. An old wooden headgate, built in 1900, was replaced in 1927 by a concrete structure costing $3,500, four concrete checks in the main canal, costing $1,700, also being installed to replace old structures. The area served has a maximum width of less than 3 miles, so that long laterals are not necessary. Numerous short laterals have been built by individuals along the canal.

Use and delivery of water.—Because the area served by Crescent Canal is so narrow, most of the diversions are made from the canal. On account of the shortness of the season and because the supply is likely to be ample, if there is any at all, simultaneous deliveries are made. The main canal is maintained by the company and the lateral ditches by the consumers. Water that is available in late June and in July is largely used to pre-irrigate grain land to be seeded in the fall. Sometimes the grain is irrigated in the spring. No measurements of deliveries are made.

Bonds.—The district has issued no bonds. An estimated total of $13,560 county and school bonds is outstanding against lands in the district.

Assessments and water tolls.—For purposes of maintaining the organization and participating in the Pine Flat project, assessments are levied annually, based on a valuation per acre ranging from $10 to $50 and averaging about $35. The low valuation is that given to alkali lands. The total district assessed valuation for 1926–27 and 1927–28 was $479,960. The assessment rate for each $100 of valuation was $1.25 in 1925–26, and $1 in 1926–27 and 1927–28. The total levy for 1927–28 was $4,799. No assessment was levied for 1928–29. The district has cut expenses and has about $2,000 available in the treasury in 1928.

STINSON

Location: on west side of Fresno Slough By-Pass, 25 miles southwest of Fresno, in Fresno County. (Pl. XXIV.)
Date of organization election: September 15, 1921.
Gross area: 11,750 acres; **area assessed 1927:** 11,150 acres.
Principal town: Helm.
Post office: Helm.
Railroad transportation: Hanford-Summit Lake branch of Southern Pacific railroad.

*History.**—Organization of Stinson Irrigation District was a move on the part of the majority landowners under Stinson Canal to increase their water supply by pumping, and ultimately, also, through participation in the Pine Flat storage project. Sentiment was divided, the vote on organization being 17 to 14. Landowners included stockholders in

* See also U. S. Dept. of Agr., Office of Experiment Stations Bul. 100, 311–312, and State Dept. of Eng., Bul. 7, 80–82.

Stinson Canal and Irrigation Company and some who held no stock. Subsequent to organization the area was decreased from 16,020 acres to the present area by petition of certain of the landowners.

Stinson Canal and Irrigation Company is a relatively old enterprise, having been incorporated, as a mutual company, in February, 1891. Stinson Canal had been constructed at a cost of about $23,000, and is reported to have had a capacity of about 120 cu. ft. per sec. and to have irrigated some 14,000 acres in 1900. The capacity reported in 1918 was 200 cu. ft. per sec. and the area irrigated, some 15,500 acres. Only flood waters have been available to this system, these coming during the rainy periods of December and January, and during the summer floods of May and June, the irrigation season normally being practically over by July 15. Grain has been the principal crop and in the average year less than one acre-foot of water per acre has been available.

In litigation the company has claimed a right to divert 190 cu. ft. per sec. This seems to have been generally conceded and is recognized in an agreement with Summit Lake Investment Company, dated January 27, 1913. Its rights, however, are inferior to most of the rights on Kings River. At present it is diverting under the schedule of the Kings River Water Association, which allows it 50 cu. ft. per sec. in January, when Kings River is flowing 1400 cu. ft. per sec. at Piedra, increasing to a diversion of 100 cu. ft. per sec., with the river flowing 1700 cu. ft. per sec. The schedule allows up to 100 cu. ft. per sec. in February with the river at 2100, and up to 100 cu. ft. per sec. in March, with the river at 4000 cu. ft. per sec. In April, however, it can take nothing until the river reaches 5800, in May until it reaches 5700, in June until it reaches 5700, and in July until it reaches 5800.

Soils and topography.—The soils in the district are mainly classified as Merced loam, clay loam, and clay, with a strip of Panoche clay loam paralleling the lower portion of the canal.* Very little alkali is reported. The surface of the land is flat but somewhat cut by sloughs which, along with lateral drains, provide the district with an outlet for excess water. Ground water stands 6 to 14 feet from the surface. Certain areas still need leveling and checking for irrigation.

Development.—The land under the canal has always been in relatively large holdings, the larger of these now ranging from 900 to 6500 acres. The average of the 20 holdings in the district is 550 acres. Grain and cotton are the principal crops, 6000 acres of the former and 2000 acres of the latter being grown in 1927, together with 500 acres of alfalfa and 200 acres of field crops. The estimated total population of the district is 300, and of the town of Helm, 15. The estimated assessed valuation of land for county purposes in 1927 was $534,600.

Water supply.—Stinson Irrigation District acquired 43¾ shares in Stinson Canal and Irrigation Company, or 58 per cent of the 75 issued. In November, 1927, the 75 shares of the company were re-divided into 300 shares, of which the district owns 183, the remaining 117 being held by 30 individuals or companies. The block of stock controlled by the district gives it 61 per cent of the water diverted by Stinson Canal.

As indicated under "History," water is available by diversion from Kings River only during the rainy season of December and January and the summer flood period in May and June. The district has, how-

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

ever, supplemented its supply from Stinson Canal by some 25 pumping plants which, operating against a head of 56 feet, furnish over 50 per cent of the water used. The combined supply irrigated 9000 acres in 1927. A large number of chemical analyses of the water pumped from the wells has been made, and while injurious salts have been found, the advice received by the district from commercial chemists is that, when mixed with water from Kings River, the well water can safely be used. Since 1922 the share of the district in the water diverted by Stinson Canal has ranged from nothing in 1924, to 10,200 acre-feet in 1923. Its share in the other years since 1922, in acre-feet, has been 7300 in 1922, 4400 in 1925, 5800 in 1926, and 8300 in 1927. The computed amounts pumped in 1925, 1926, and 1927 have been 12,100, 12,600, and 8700 acre-feet, respectively.

Works.—Stinson Canal and Irrigation Company diverts from Bogg Slough by means of a concrete headgate erected in 1926 to replace the timber structure built there some years previously. The canal section is in earth, unlined. The district has built, or purchased, 12 miles of main and 33 miles of lateral distribution canals, all unlined, leading from the pumping plants, and has put in one-fourth mile of 14-inch pipe.

The pumping plants include twenty-five turbines, two with 7-inch and twenty-three with 10-inch discharge pipes. The two 7-inch turbines are operated by 25 h.p. and the others by 30 h.p. motors. The wells vary in depth from 400 to 1300 feet, and supply about 1000 g.p.m. each. The district also has two pumps to boost water from drainage sloughs back into the irrigation canal. Plant No. 1 has a 9-inch discharge and is operated by a $7\frac{1}{2}$ h.p. motor, and Plant No. 2 has a 10-inch discharge and is operated by a 15 h.p. motor.

Six of the wells and a portion of the lateral system owned by the district were purchased from Fitzwilliam Lands at a cost of $30,000. The district has built concrete structures on the canals, and sloughs traversing the area have been opened to provide drainage. Lateral drains have been constructed by property owners.

Through construction of its wells, the district has been able to keep pace with demands for water. To date the district has made a total capital investment in works of $342,120.67. This does not include purchase of any stock in the canal company, since the owners turned over their shares without cost after equalizing values among themselves. In 1921 an evaluation of the property of Stinson Canal and Irrigation Company, in which the district owns 61 per cent interest, showed a total of $89,048.11.

Use and delivery of water.—The area devoted to cotton in the district is increasing. Grain receives about two irrigations per season, while cotton requires three or four. The additional water needed is being obtained by drilling more wells.

Water is distributed generally in rotation. When flood waters are available, the superintendent has authority to make and enforce special regulations looking to the most beneficial and equitable division of the available water among those requesting it. Irrigators are notified 12 hours before water is available.

Bonds.—The district has issued $360,000 in bonds, dated April 1, 1923, all of which have been sold. These bonds were carried by a vote

of 19 to 0, March 13, 1923. The entire amount was outstanding May 1, 1928. Maturities range from 1931 to 1950, and the coupon interest rate is 6 per cent.

The district lies within Reclamation District 1605, which constructed levees in 1914 with the proceeds of bonds amounting to $210,000, spread over 19,000 acres of land. Maturities began in 1926, when 10 per cent of the bonds were retired. A refunding issue of $151,000 was put out by Reclamation District 1605 in 1928 which will mature from 1930 to 1947. This gives an outstanding reclamation indebtedness on lands within the irrigation district amounting to about $8 per acre.

Assessments and water tolls.—Income of the district is derived from district assessments and water tolls. Valuations for district assessment purposes are $50 per acre on all lands, the total valuation since organization ranging from $534,604, in 1923-24, to $805,502, in 1922-23. The total assessed valuation for 1927-28 is $558,341. During the past three years the assessment rate per $100 of valuation has been $8.50. In 1923-24 it was $4.127 and in 1924-25 it was $5.066. The annual levies have varied from $22,063.11, in 1923-24, to $47,485 in 1925-26 and 1926-27, that for 1927-28 being $47,458.99.

Water tolls are based on the actual cost of pumping, there being no toll for gravity water. The amount collected for tolls in 1926-27 was $11,083.

Recent improvements made in Stinson Canal were paid for by numerous stock assessments, the amount of these assessments paid by the district in 1926, 1927, and 1928 being $6,405.

JAMES

Location: about 30 miles southwest of Fresno, west of Fresno Slough by-pass, in Fresno County. (Pl. XXIV.)
Date of organization election: February 6, 1920.
Gross area: 26,265 acres; **area assessed 1927:** 26,265 acres.
Principal town: San Joaquin.
Post office: San Joaquin.
Railroad transportation: Hanford and Summit Lake railroad (Southern Pacific).

History.—This district comprises a portion of the old James Ranch which originally included 72,000 acres lying on both sides of Fresno Slough in what was known as the Fresno swamp region. In early days the land was used mainly for pasture, rough diversions being made to flood the cattle ranges. Among the ditches constructed were James East Side Canal, built in 1885, and the two James West Side canals, constructed in 1892–93 and 1899. James East Side Canal diverted from the eastern side of Murphy Slough just above the head of Steamboat Slough; James West Side canals, each about 10 miles long, diverted from Fresno Slough, and irrigated land in the vicinity of the present James Irrigation District. The principal crops were then wheat and corn. Water was delivered free for a time, but the tenants were required to keep the canal in repair. Later, James Canal Company was formed to serve the lands under water-right contracts, calling for an annual charge of $0.60 per acre.

After the death of J. G. James, the original owner, the property passed to B. F. Graham, and was acquired by San Joaquin Valley Farm Lands Company in 1912. This company engaged in farming and in

subdividing the land. In 1914 they caused Reclamation District 1606 to be formed for the purpose of constructing levees to protect an area of 18,600 acres from flood waters of Kings River. This district voted bonds in the amount of $600,000, November 5, 1914. Of this issue $568,000 was sold, giving a bonded debt for reclamation purposes of about $30.50 per acre. The bonds are dated December 1, 1914, draw interest at 6 per cent, and have maturities from 1923 to 1942, with $30,000 to be retired each year. The old James irrigation system was extended and new laterals were built to serve the smaller units of the subdivided land. Thirty-six artesian wells, with depths ranging from 800 to 1200 feet, were drilled to supplement the gravity water supply diverted from Fresno Slough. A drainage canal was constructed connecting existing sloughs, and this led surplus water to an outlet through the levee system in the north end of the district.

As a part of its financing program, San Joaquin Valley Farm Lands Company proposed the formation of an irrigation district, and this was authorized by a unanimous affirmative vote of 8. The area included comprised all of that in Reclamation District 1606, and about 7600 acres additional south and southeast of the reclamation district boundaries. Under this organization it was proposed to take over and complete the irrigation works thus far built and paid for by the land company. The water supply was inadequate, and it was proposed to develop a series of pumping plants on water-bearing lands east of Fresno Slough. An engineering report presented to the district February 17, 1920, set forth the rights of way and the construction costs to January 1 of that year, as taken from the land company books, which totaled $451,821.41. The report estimated the cost of completing the project at $541,207.25, and recommended a bond issue of $1,000,000, which would give an irrigation cost of $37.75 per acre on top of the reclamation costs of about $30.50 per acre. These bonds were authorized April 27, 1920, by a vote of 35 to 1. The irrigation system of the land company was taken over, and in the course of the succeeding five years the construction program outlined was carried out.

During the inflation period following the war, in 1920, San Joaquin Valley Farm Lands Company conducted a selling campaign and disposed of many small tracts at prices from $200 to $250 per acre. Sales were made on the basis of 10 per cent down with ten years to pay the balance. The company was able to use its land as security for a bond issue of $1,500,000, which was put out in December, 1921. The boom accompanying the sales campaign died down and many of the tracts sold reverted to the company. For a time the company carried the various taxes and assessments and $90,000 of the reclamation bonds were retired. On July 1, 1926, however, the interest and principal due on the reclamation bonds went delinquent and the company defaulted in payments on its corporation bonds, and failed to pay irrigation district assessments. Since the company controlled a large portion of the land within the irrigation district, the latter was unable to meet its bond interest due on January 1, 1927. Other landowners in the district followed the lead of the land company and refused to pay district assessments, pending the clearing up of the involved financial situation. Many of the people felt that they had lost their equity in the lands purchased because of the failure of the land company, and they defaulted in county taxes. As a result of this, payments of the bonds

on San Joaquin school district went delinquent. A bondholders' reorganization committee of San Joaquin Valley Farm Lands Company was formed in 1927. This committee foreclosed and purchased at public sale for $71,000 all of the land held as security for the bonds. On April 27, 1928, it obtained a deficiency judgment amounting to $1,369,634 to cover the balance due on the corporation bonds. Several attempts have been made to bring the holders of the reclamation district, irrigation district, and corporation bonds together to work out a refinancing scheme, but up to May, 1928, no solution had been reached.

Pending some solution of the financial tangle, the bondholders' reorganization committee of San Joaquin Valley Farm Lands Company has been protecting a large area of the best land in James Irrigation District by redeeming it from unpaid reclamation assessments just ahead of the date set for passing title to the county treasurer, in this way hoping to maintain a hold on the property until a favorable compromise can be reached with the other interests concerned. Meanwhile they are offering big inducements to settlers in the district who were buying land from the old company to pay up on their contracts. Deeds to properties are given for cash payments of less than half the amounts originally called for. The bondholders' reorganization committee of San Joaquin Valley Farm Lands Company controls 14,106 acres, San Joaquin Valley Farm Lands Company controls 4644 acres, and various individuals control 7516 acres within the irrigation district boundaries.

Soils and topography.—Soils of the district are mainly Merced loams, clay loams, and clays, with a very flat surface somewhat cut up by old slough channels.* There is a strip of Fresno sandy loam and fine sandy loam along the eastern boundary which is heavily impregnated with alkali. About 1000 acres in the north end of the district is in need of drainage, but this has been only partly provided. The entire area has natural drainage into old sloughs which have been opened up to form a main drain. The water table is from 5 to 15 feet below the surface.

Development.—There are about 190 landowners in the district, and aside from the land company properties, the holdings average about 40 acres each. The population of the district is about 600. The town of San Joaquin, lying within the exterior boundaries of the district but excluded from the district, has a population of 150.

Water supply.—Water has been developed to supply about 12,500 acres, leaving something over 5000 acres of irrigable land for which water is not yet available. Water for the district is obtained mainly from wells owned by the district, but also from flood flow of Kings and San Joaquin rivers. The district controls one-third of the amount diverted by Beta Main Canal and the entire amount diverted by James Main Canal. The district has old appropriative rights. It is a member of Kings River Water Association and obtains water under the Kings River schedule when the flow at Piedra reaches 6000 to 6100 cu. ft. per sec. The Kings River schedule makes water available to the district only in the months of April, May, June, and July. On an average, only about 25 per cent of the water used in the district comes from this source, the main portion being pumped from former artesian wells situated within the district southwest and southeast of the town of San Joaquin, and from shallow wells in the higher lands east of Fresno

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

Slough, extending as far as ten miles east and four miles north of San Joaquin. The district is a participant in the proposed Pine Flat storage project.

Wells, formerly artesian, number 36 and the wells or batteries of wells to the east number 43. Gravity water is measured at the point of diversion and that obtained by pumping plants is measured by weirs and orifices, except that for the past three years the supply from the deep wells has only been estimated.

For the past four years the total amount of water available has ranged from 31,674 acre-feet, in 1924, to 44,359 acre-feet, in 1927. From 1918 to 1927, not including 1924 when no water was available, the one-third share in Beta Main Canal ranged from 1040 acre-feet, in 1925, to 7382 acre-feet, in 1922. During the period 1920 to 1927, but again not including 1924, gravity diversion available to James Main Canal varied from 1496 acre-feet, in 1925, to 22,946 acre-feet, in 1927.

In addition to the gravity and pumped water mentioned above, the district in 1927 pumped 550 acre-feet of backwater from San Joaquin River by means of a booster plant of 15 cu. ft. per sec. capacity installed on the main drain.

The water supply available to the district has been carefully studied for its chemical content by commercial chemists, and data regarding the quality of the water in the area are also available from government investigations.* Tests by commercial laboratories have resulted in advice that the underground waters can be safely used for irrigation when mixed with such surface waters as those of Kings River.

Works.—The irrigation system of San Joaquin Valley Farm Lands Company was purchased by the district for $503,105.94. Works taken over included James Main Canal paralleling the west levee of Fresno by-pass and running the entire length of the district; a one-third interest in Beta Main Canal diverting from Fresno Slough; all of the laterals of Alpha Mutual Water Company, a subsidiary organization for distribution of water; and all of the deep wells within the district, including those of Omega Mutual Water Company, which had been organized to distribute well water to company lands.

After purchasing these works, the district completed the lateral system with necessary structures and installed 43 pumping plants on the higher lands lying to the east of the district. The district now has 87 wells, 85 of which are equipped with pumps, 76 of these being 12-inch turbines operated by 15 to 20 h.p. electric motors, and three being 10-inch horizontal centrifugal "battery" pumps, each drawing from 3 wells, the pumps being operated by 30 h.p. electric motors. The average capacity of the turbines is 1.75 cu. ft. per sec., and of the 3 "battery" pumps, 3 to 4 cu. ft. per sec. The lift from the deep wells is about 60 feet and from the shallow wells 40 feet. The water from the east-side wells is carried through two main canals to Fresno by-pass, under which it is conveyed to the district through a reinforced concrete siphon 5 feet in diameter and 1245 feet in length. A booster plant with a capacity of 15 cu. ft. per sec. is installed in the main drainage canal at the north end of the district, and at certain stages of San Joaquin River backwater from that stream coming in through Fresno Slough can be pumped to an area of about 6000 acres claiming riparian rights to this

* Dept. of Int., U. S. Geol. Survey, Water Supply Paper 398, pp. 237–239.

flow. The district operates in all 30 miles of unlined main canals and 1.75 miles of lined and 60 miles of unlined laterals. A gate and pump pit have been provided to lift water from the lower end of the drainage canal, but no pumping plant has yet been installed. The total capital invested in works to January 1, 1928, has been $1,641,952.21.

Use and delivery of water.—The district specifies no fixed land unit to which water shall be delivered, and deliveries are not measured, charges being based on the number of acres irrigated. The gross duty of water according to district records was 3.21 acre-feet per acre in 1924. No records are available of the total amount of water used by irrigators, but the district engineer estimates conveyance losses to be about one-third of the total. As previously stated, the total water available through Beta Main and James Main canals and from the district wells in 1927 was 44,359 acre-feet. In 1928, over half of the irrigated area was in alfalfa, a little less than one-third in vines and trees, about one-seventh in cotton, and the remainder in grain and field crops.

According to the rules of the district, water is furnished in rotation to each irrigator, commencing at the upper end of each distributing section. The usual irrigation head is 3 cu. ft. per sec., which is allowed for not to exceed 1 hour and 20 minutes to irrigate one acre of land. The rules also provide that in case of shortage, priority shall be given, first, to garden crops and, second, to first-year alfalfa, young trees, cotton, and vines. All water users served by the same sublateral are required to maintain, operate, and repair such sublateral, the expense to be apportioned according to the areas served.

The district has kept careful record of the cost of pumping. From 1924 to 1927 the average cost of operation for shallow wells per acre-foot has varied from $1.083, in 1924, to $1.63, in 1927, and the average operation cost for lifting one acre-foot one foot high has varied from $0.0292, in 1924, to $0.0415, in 1927. Costs of pumping from deep wells have been supplied for 1924 only, and averaged $1.432 per acre-foot or $0.0331 per acre-foot per foot of lift.

Bonds.—The district has put out one bond issue of $1,000,000. It is dated May 15, 1920, bears 6 per cent, and carries maturities from 1928 to 1947. For reasons indicated under "History," interest payments on these bonds due January 1 and July 1, 1927, and January 1, 1928, have been defaulted. On each of these dates, $30,000 was payable. The payment of $50,000 on principal due January 1, 1928, has also been defaulted. The present outstanding indebtedness of the district, therefore, includes the entire bond issue of $1,000,000, plus the defaulted interest. Other bonds against lands in the district amount to $544,200, of which $31,800 are elementary school bonds, $8,400 high school bonds, $26,000 county highway bonds, and $478,000 bonds of Reclamation District 1606, which, with $50 per acre estimated for corporation bonds, makes a total of about $116 per acre.

Assessments and water tolls.—District assessments are based on valuations of $150 per acre on land having ditches and susceptible of irrigation from the system, and $25 per acre on about 2500 acres without ditches and not prepared for irrigation. The total district assessed valuation for 1927–28 is $3,620,938, and the total levy was $168,733. During the current season the total assessment rate per $100 of valua-

tion is $4.66, of which $3.05 is for bond interest and retirement, and $1.61 for the general fund. During the preceding four years, the total rate was $3, of which $1.66 was for bond interest and $1.34 for the general fund. Up to 1926, inclusive, water tolls were $3.50 per acre irrigated for four irrigations. In 1927 the toll was $1 for each irrigation, and in 1928 $1.75 for each irrigation. The high rate for 1928, which is collected in advance, is due to the fact that district assessments are not being collected, and operating charges must be met from water sales.

TRANQUILLITY

Location: west of Fresno Slough about 30 miles west of Fresno, in Fresno County. (Pl. XXIV.)
Date of organization election: January 3, 1918.
Gross area: 10,750 acres; **area assessed 1927:** 10,190 acres.
Principal town: Tranquillity.
Post office: Tranquillity.
Railroad transportation: Hanford and Summit Lake railroad (Southern Pacific).

History.—As in the case of James Irrigation District, Tranquillity Irrigation District covers land formerly in the old James Ranch. The land, originally in the swamp and overflow area, was protected from Kings River by small levees, and was irrigated by a crude irrigation system. The canal now known as Beta Main was constructed in 1899 by certain tenants on the James Ranch and reverted to the ranch after the tenants left. James organized a water company and sold water rights to farmers who settled near Tranquillity. He established a pumping plant on Fresno Slough through which backwater from San Joaquin River could be pumped.

The property was acquired in 1912 by San Joaquin Valley Farm Lands Company, and was subdivided and placed on sale. Water service by the company was unsatisfactory to the farmers and a petition for the formation of an irrigation district was filed July 2, 1917, with a view to taking this system over. Organization was approved by a unanimous vote of 68. Plans were prepared for putting the system in good working order and were submitted in August, 1919, with recommendation for a bond issue of $250,000, of which $50,000 was for the purchase of the old canal system. A bond issue of $260,000 was voted December 6, 1919, and construction work was immediately started. It was later found necessary to raise $50,000 additional by special assessment to complete the works.

The financial collapse of San Joaquin Valley Farm Lands Company in 1926, which caused a default on the bonds in James Irrigation District, had its effect also in Tranquillity, since that company owns about 20 per cent of the land in Tranquillity District. The land company ceased paying its district assessments after 1925, but in spite of this, the district has been able to meet its obligations and by reducing expenses has been able to lower its assessment rate during the last two years.

Soils.—The soils of Tranquillity are similar to those of James District, mainly Merced loams, clay loams, and clays.* The major portion is heavy clay or adobe. The district comprises a flat plain with a

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

slight slope toward the north. Ground water is 5 to 15 feet below the surface. Drainage is not a problem at present because lack of water is the main difficulty. Less than 5 per cent of the land is reported as showing sufficient alkali to affect crop production.

Development.—The district has 185 farms and there are 70 lots in the town of Tranquillity. The average farm holding is 54 acres. San Joaquin Valley Farm Lands Company owns 2123 acres and there are two other holdings of 590 and 640 acres. Tranquillity has a population of 300 and the estimated population outside of the town is 400. The assessed valuation of land and improvements in the district for city and county purposes in 1927 was about $550,000.

Water supply.—In the main, water is available only during short periods at the time of the summer floods in Kings and San Joaquin rivers. The principal portion comes from Kings River through Fresno Slough, the district being a member of Kings River Water Association and receiving water under the Kings River schedule when the river flow at Piedra reaches 6000 cu. ft. per sec. Backwater from San Joaquin River pumped from Fresno Slough is only available when the flow of the San Joaquin at Friant reaches 1360 cu. ft. per sec., a court decree awarding the Miller & Lux interests the flow up to that point.

The district owns two-thirds of the supply of Beta Main Canal, the other one-third belonging to James Irrigation District. During the period 1918 to 1927 the Tranquillity share of diversion by Beta Main Canal ranged from 2080 acre-feet, in 1925, to 14,764 acre-feet, in 1922, not counting 1924, when no water was available. From 1922 to 1927 water pumped from Fresno Slough ranged from 3835 acre-feet, in 1922, to 10,268 acre-feet, in 1925. In 1927 the Tranquillity share of Beta Main Canal diversion was 10,826 acre-feet, and 7719 acre-feet was pumped from Fresno Slough. Water rights of Tranquillity Irrigation District are both riparian and appropriative. The district is a participant in the proposed Pine Flat storage project. Some private pumping has been attempted but proved unsatisfactory owing to the alkalinity of the water obtained.

Works.—Beta Main Canal, which is a gravity diversion from Fresno Slough, skirts the western edge of the district and extends to the northern end. Diversion of San Joaquin River backwater from Fresno Slough is effected by two pumping units, one supplying the north half and the other the south half of the district. Plant No. 1 is at the road crossing between Kerman and Tranquillity, and plant No. 2 on the road between Tranquillity and San Joaquin. The pumps at both plants are 26-inch centrifugal, operated by 150 h.p. motors, and deliver 25,000 g.p.m., or approximately 55 cu. ft. per sec. The lift at plant No. 1 is 10 feet and at plant No. 2, 11 feet. The old James steam pumping plant, taken over by the district, is located at the same point as present plant No. 1, but has been abandoned.

Three booster plants raise water to higher levels from the distributing systems of plants 1 and 2. Plant No. 3, a 24-inch booster pump on the canal from plant 2, has a capacity of about 45 cu. ft. per sec., and is driven by a 100 h.p. motor. Plant 4, located about one mile southwest of plant 3, lifts water an additional 4 feet by means of a 12-inch pump driven by a 15 h.p. motor, the pump having a capacity of 7 cu. ft. per sec. Plant 5 lifts water 3 feet from the canal leading from main pumping unit No. 1, using a 12-inch pump delivering about 7 cu. ft. per sec. and driven by a 15 h.p. motor.

The irrigation district has also provided a public water supply for the town of Tranquillity. Water is pumped from a well 900 feet deep to an elevated steel tank having a capacity of 50,000 gallons. Prior to extension of electric service by San Joaquin Light and Power Corporation, the district, at a cost of about $45,000, installed a central generating station to supply power to its pumping plant, but this is now idle.

The district operates 20 miles of unlined main canals and 50 miles of unlined laterals. The total capital investment by the district to January 1, 1928, was $300,000.

Use and delivery of water.—The district delivers to each 40-acre tract, but deliveries are not measured. To aid in financial retrenchments, the district has dispensed with its engineer and management rests with the board of directors, who are donating their time and doing everything possible to economize. During the irrigation season a ditch tender and two assistants are employed.

Bonds.—The bond issue of $260,000 put out by the district is dated January 1, 1920, carries interest at 5½ per cent, and has maturities from 1924 to 1955. The entire issue was sold January 13, 1920. Bonds to the amount of $4,000 were paid to January 1, 1928. Other outstanding bonds prorated to the district amount to $23,300, or at the rate of $2.30 per acre. These comprise $5,500 elementary school bonds, $4,300 high school bonds, and $13,500 county highway bonds.

Assessments and water tolls.—With the exception of a charge of $1.50 per lot per month in the town of Tranquillity, all district income is obtained from district assessments. Town lots are given a uniform valuation of $100 each and farm lands a uniform valuation of $150 per acre. The total district assessed valuation in 1927 was $1,528,520, and the total levy was $30,570. During the past five years the assessment rate per $100 of assessed valuation has been as follows: 1923–24, 1924–25, and 1925–26, $3; 1926–27, $2.30; 1927–28, $2.

LUCERNE

Location: south side of Kings River, a short distance west of Hanford, in Kings County. (Pl. XXIV.)
Date of organization election: January 8, 1925.
Gross area: 33,407 acres; **area assessed 1927:** 33,407 acres.
Principal town: Armona, excluded from district.
Post office: Hanford.
Railroad transportation: Coalinga and Collis-Armona branches of Southern Pacific railroad.

*History.**—The area embraced in Lucerne Irrigation District is that covered by Last Chance Water Ditch and its laterals. Last Chance Ditch was constructed in 1873 and 1874 by Last Chance Water Ditch Company, which was organized by farmers to whose lands it was to supply water. Originally 30 shares of capital stock with a par value of $1,000 each were issued, this capitalization later being increased to 60 shares of the same par value. Each share of stock was intended to furnish water for 640 acres of land. The entire capital stock has never been issued, the shares now outstanding numbering 45, held by 325 individuals. Each share of stock entitles its holder to a proportionate amount of water available in the canal.

* See U. S. Dept. of Agr., Office of Experiment Stations Bul. 100, 300–301, and State Dept. of Eng., Bul. 7, 41–45.

Last Chance Ditch is the central one of the three south-side canals that water the area south of Kings River and generally north of Tulare Lake. It lies between Peoples Ditch on the east and Lemoore Canal on the west. This group of canals has acted more or less as a unit in negotiations and controversies with upper Kings River users, and at times has employed the same engineer. The area under Last Chance Ditch has been developed to its present extent for some years, and the methods of handling water put into effect during the early history of the enterprise have continued with little change.

As has been the case with other south-side ditches, Last Chance Ditch has been involved in litigation with both upper and lower Kings River users and, from time to time, it has been decreed various quantities of water as against other claimants. An agreement was finally reached between the Last Chance and other south-side ditches and the Fresno Canal group October 4, 1897.

Lucerne Irrigation District was organized, by a vote of 138 to 26, primarily to deal with other Kings River water users in connection with the proposed storage at Pine Flat.

Soils and topography.—Most of the soil in Lucerne Irrigation District is Hanford fine sandy loam, with loams and sandy loams of the Foster and Chino series predominating at the southern end.* The surface is generally evenly sloping but with some depressions. The soil maps indicate alkali scattered south from Armona to Tulare Lake bed, but the district reports only 10 per cent of the area sufficiently impregnated with alkali to affect production. Ground water, generally at depths of 16 to 18 feet below the surface, fluctuates with the amount of water diverted from Kings River and with the operation of pumping plants.

Development.—The last crop survey in the Last Chance area was made in 1921 and covered 34,200 acres. Of this area 4600 acres was in alfalfa, 6050 acres in orchard, 7080 acres in vines, 7240 acres in grain, and 9230 acres in pasture. The entire area is under irrigation. The average size of holdings is 92 acres, but there is one holding of 2400 acres, another of 2000 acres, and others ranging from 320 acres down.

Two unincorporated towns, Hardwick and Grangeville, each with an estimated population of 100, are included within the district, and the district surrounds Armona, with a population of about 500. The estimated population, other than in these three cities and towns, is 1200. In 1927 the assessed value of real property in the district for city and county purposes was $2,774,800, of which $540,800 was for improvements. Main highway transportation is furnished by the state highway between Hanford and Coalinga.

Water supply.—In common with other Kings River users, Last Chance Ditch is operating under the 1927 schedule of Kings River Water Association, by which water is allocated to it each month in the year except November. The maximum quantities allocated during the different months, in cu. ft. per sec., are: January, 150; February, 165; March, 225; April, 300; May, 325; June, 325; July, 250; August, 150; September, 65; October, 75; and December, 95. These maxima, however, are, of course, only available during certain high stages of Kings

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

River. The water delivered from the canal is supplemented by 74 private pumping plants, their total capacity aggregating 63 cu. ft. per sec. Diversions from Kings River since 1918 have ranged between 18,270 acre-feet, in 1924, and 97,125 acre-feet, in 1927. In five of the ten years the diversion has exceeded 60,000 acre-feet and in four years it ranged between 50,000 and 60,000 acre-feet. The supply is said to be sufficient in most years. There is, however, about 5000 acres within the district, the owners of which have no stock in Last Chance Ditch.

Works.—The main canal was built in 1873 and 1874. It runs southwesterly from Kings River a distance of 7 miles through the town of Grangeville, where it forks into the east, west, and middle branches, which extend southerly to serve lands in the vicinity of Armona and south to Tulare Lake. The aggregate length of main canals, all unlined, is about 20 miles. A valuation of the property of Last Chance Water Ditch Company prior to the formation of Lucerne Irrigation District gave a total of $193,759. This includes a concrete diversion structure at the river built in 1919 at a cost of $37,365, which eliminated the need of annually constructing a brush and sand dam at the point of diversion. Other major items in the valuation included land held in fee by the company, $18,768; rights of way, $23,836; excavation, $86,126; structures, $21,705. Since this valuation there have been a number of improvements, most important of which is a new concrete headgate at the river completed in January, 1928, at a cost of $7,000.

The 74 private pumping plants, mentioned above, are, with one exception, centrifugal. Twenty-two are operated by electric motors, 32 by gas engines, and 20 by tractors and automobiles. From readings taken at wells throughout the district during the last three years, it appears that present canal diversions are sufficient to maintain the ground water level.

Use and delivery of water.—There has been little change in methods of use and delivery of water under Last Chance Ditch for many years. Water is maintained in the main canal and laterals throughout the season. Delivery is made to lands adjacent to the main canal and to main laterals according to the amount of stock held. Deliveries are not measured but are made on a time basis. There are seven subsidiary organizations which control laterals, these organizations distributing over half of the water diverted from the river. All but one of these are mutual companies which distribute according to stock held. The other, known as Lone Oak Canal Company, was organized to sell water, for which it charges at the rate of $1.50 per acre per year, its rates having been fixed by the State Railroad Commission in Decision 2040, rendered December 31, 1914.

Bonds, assessments and water tolls.—No bonds have been voted and no assessments levied, and water tolls are those charged by Last Chance Water Ditch Company, already referred to. The estimated county and school district bonded indebtedness against land in the district amounts to $152,600, or at the rate of $4.60 per acre. This total is made up of $51,900 issued by five of the eleven elementary school districts, $61,200 issued by two high school districts, and $39,500 issued by the county for highway purposes.

Present outlook.—Future activities of Lucerne Irrigation District will depend upon the outcome of negotiations regarding Pine Flat storage. At present, Last Chance Water Ditch Company is paying

all costs connected with these negotiations. There is not unanimous opinion within the district regarding the desirability of purchasing the Last Chance system and reorganizing water deliveries on an acreage basis, or such other basis as the district might adopt. Some of the landowners in the northern portion of the district who have orchards and vineyards which are at present subirrigated are generally content with present conditions. No conclusion on such matters is deemed necessary until a decision is made regarding Pine Flat storage, and until the district is called upon to bear its proportion of the cost of constructing that project.

LEMOORE

Location: east of South Fork of Kings River, surrounding Lemoore, in Kings County. (Pl. XXIV.)
Date of organization election: October 11, 1920.
Gross area: 53,100 acres; **area assessed 1925:** 52,300 acres.
Principal cities and towns: Lemoore, excluded from district, and Stratford.
Post office: Lemoore.
Railroad transportation: Coalinga and Stratford branches, Southern Pacific railroad.

*History.**—Irrigation in the area now embraced within Lemoore Irrigation District was started under Lower Kings River Canal, built by Lower Kings River Ditch Company, a mutual company incorporated October 16, 1873. This latter company was superseded by Lemoore Canal and Irrigation Company, also a mutual organization, incorporated September 8, 1902.

Work on Lower Kings River Canal was begun in 1870, when 27 interested landowners joined in an agreement under which each was to bear a proportional part of the cost. Each share in the company represented a proportional part of the flow in the canal and was supposed to represent sufficient water for 320 acres. At first assessments were levied, then money for expenses was raised by the sale of the water. In 1900 the capacity of Lower Kings River Canal was reported to be 245 cu. ft. per sec. and the area irrigated about 20,000 acres. In 1916 the main canal was reported to have a capacity of 600 cu. ft. per sec., with usual diversions of 400 to 450 cu. ft. per sec. In that year the land reported as benefited by surface and subirrigation totaled about 43,000 acres, and the land represented by water stock, 30,920 acres.

When the second company was organized, shares were issued at the rate of one to each 640 acres, with a par value of $2,000 per share, and a market value in 1918 of $4,000 per share. The canal system was operated by the officers, the president of the board of directors acting as superintendent. Landowners on two of the main laterals were organized as Jacobs Ranch Water Company and Empire Water Company, but other laterals were not organized. In 1916 Stratford Irrigation District was formed covering 9200 acres of land watered under the Empire ditch system near Stratford, but this district was never active and is now included within Lemoore Irrigation District.

When Lemoore Irrigation District was formed in 1920 the primary purpose of organization was participation in the pending Pine Flat storage project. It was the intention also to purchase and operate the

* See U. S. Dept. of Agr., Office of Experiment Stations Bul. 100, 302–304; also State Dept. of Eng., Bul. 7, 45–50.

Lemoore Canal and Irrigation system. After organization of the district an appraisal was made and an agreement reached on a purchase price of $418,400. A bond issue of $420,000 was approved by the Irrigation District Bond Certification Commission November 6, 1922, but was defeated at an election December 30, 1922. The district therefore owns and operates no works, its principal present activity being participation in the negotiations with reference to Kings River and storage at Pine Flat. Future activities of the district are expected to be governed largely by the outcome of the Pine Flat storage project.

Soils and topography.—With the exception of a small area of Sacramento clays and clay loams at the extreme southerly portion of the district below Stratford, and of a strip of Merced clay loams and clays along Kings River on the westerly boundary, soils are light in character and of gently sloping surface. The principal classifications in the soil survey include Hanford fine sandy loam, Foster sandy loam, and Chino and Foster loams, undifferentiated.*

The soil survey map shows considerable alkali present, but only 5 per cent of the land is reported by the district as showing sufficient alkali to affect crop production. A considerable portion of the district could be benefited by drainage, ground water standing from 2 to 10 feet below the surface. No drainage ditches have been constructed, although two drainage pumps which have been placed along the main canal in the northern part of the district are reported to be affecting beneficially about 1000 acres.

The central portion of the district is adapted to fruit growing, while the heavier lands along the river and in the southern part are used mainly for alfalfa and grain.

Development.—The last crop survey of the area under Lemoore Canal was made in 1921. This showed 24,780 acres in alfalfa, 6165 acres in deciduous orchards, 7885 acres in grain, and 13,470 acres in pasture, a total of 52,300 acres. About 2000 acres was double-cropped. The above areas cover practically all of the land in the district, and there has been little change since 1921, except by slight increase in alfalfa and corresponding decrease in pasture.

There are three large holdings of 12,800 acres, 1400 acres, and 1000 acres. Exclusive of the larger holdings mentioned, the average size of farms is 58 acres. There are 670 farms, 920 families, and 681 assessment payers. The estimated population within the district, not including any cities and towns, is 3800. Lemoore has a population of 2500 and Stratford about 200. The state highway from Hanford to Coalinga passes through Lemoore.

The estimated assessed valuation of real estate in the district for city and county purposes in 1927 was $1,880,000 on land, and $376,100 on improvements.

Water supply.—Water rights of Lemoore Canal and Irrigation Company were initiated by its predecessor, Lower Kings River Canal Company, when it began construction of Lower Kings River Canal in 1870. Lemoore Canal and Irrigation Company, along with Peoples and Last Chance systems lying to the east of it, were in early days in litigation with the upper users on Kings River, principally Fresno Canal and Irrigation Company. A compromise was entered into October 4,

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

1897, and embodied in a judgment of the superior court of Tulare County October 18, 1905. This agreement arranged for the distribution of water of Kings River up to 2200 cu. ft. per sec. A second agreement was made with the two south-side canal companies just named and incorporated in a judgment July 19, 1898. The amount taken by Lemoore Canal and Irrigation Company under the agreements varied from 70 to 242.5 cu. ft. per sec., depending upon the flow of the river turned to the south-side ditches, up to 1000 cu. ft. per sec. Lemoore Canal and Irrigation Company and its south-side neighbors were also in litigation with Alta Irrigation District and with the Stinson and Crescent canals on the lower river.

At present, Lemoore Canal and Irrigation Company obtains water under the Kings River Water Association schedule, this allocating water to it during each month in the year. The schedule allows it maxima of 360 cu. ft. per sec. in January and February and the following maxima, in cu. ft. per sec., during the remaining months: March, 325; April, 350; May and June, 450; July, 400; August, 350; September, 250; October, 375; November, 150; and December, 250, all of these quantities, of course, depending upon the flow of Kings River at Piedra.

The total annual diversions by Lemoore Canal and Empire Canal No. 2 since 1918 have ranged from 48,419 acre-feet, in 1924, to 146,191 acre-feet, in 1922. During all but three of the ten years they have exceeded 100,000 acre-feet. Diversions by Empire Canal No. 4 are not included in these totals, since most of the water diverted by that canal goes to lands outside of the district. There are 25 private pumping plants in the district which furnish a supplemental supply to 400 or 500 acres in the latter part of each season.

Works.—As previously stated, Lemoore Irrigation District has not yet purchased the irrigation works of the existing canal company and local organizations. The works which the district proposed to purchase in 1922, with their valuations as fixed by engineers employed by the board of directors, were as follows: John Heinlen Ranch system, $13,729; Empire Water Company (east side), $125,526; Jacobs Ranch Ditch, $77,737; and the system of Lemoore Canal and Irrigation Company, $255,259. The total appraised value was $472,252. The Heinlen and Jacobs Ranch ditches are branches of the Lemoore system. The total length of canals in the district, all unlined, is about 75 miles.

Since the above mentioned valuations were prepared, Lemoore Canal and Irrigation Company has made numerous improvements on its system. The old wooden weir across Kings River at the intake of Lemoore Canal, built in 1902, was replaced in 1924 with a concrete structure costing $35,000. About 100 concrete side gates, checks, and drops have been constructed to replace wooden structures. The company has, however, done little to better drainage conditions, although, as previously indicated, two drainage pumps have been installed in the northern part of the district. These are 3-inch and 6-inch centrifugal pumps, with a $2\frac{1}{2}$-inch centrifugal portable outfit for emergencies.

Use and delivery of water.—Lemoore Canal and Irrigation Company has issued 53 shares of stock at the rate of one share to each 640 acres. These shares are now held approximately as follows: Heinlen Ranch, 12; Empire Ranch, 9; Jacobs Ranch, 8; north-end landowners, 24. The

stock is not appurtenant to the land, although no water is delivered except to stockholders. Annual assessments equivalent to $0.62\frac{1}{2}$ per acre are made on stock for operation and maintenance. The rental value of the stock is $1.25 to $1.50 per acre per year. Empire Water Company operates under water contracts which impose a charge of $1 per acre per year regardless of use. When water is plentiful, simultaneous deliveries are made, but when scarce, deliveries are made in turn. Practically the entire net irrigable area of 51,500 acres in the district is irrigated; pasture lands, of which 13,470 acres was reported in 1921, receive one irrigation in most years. The engineer of the district estimates a seepage loss of about 25 per cent in the main canals of the system and about the same percentage loss in the laterals. Deliveries of water to irrigators are not measured. Occasional current-meter measurements are made in the main canal and rough flashboard measurements are made at the heads of main laterals.

Bonds.—The district has no bonds or other outstanding obligations. There are, however, outstanding against lands in the district school district bonds in five elementary school districts amounting to $65,400, high school bonds of $110,000, and county highway bonds of $38,600. This is a total of $214,000, an average of only about $4 per acre.

Assessments and water tolls.—Since the district operates no irrigation works there are no district water tolls, all water charges being made by the operating canal companies as previously referred to. For general expenses of the district, however, assessments were levied for 1921–22, in 1923–24, and for 1925–26. For 1921–22 there was a flat assessment of $0.25 per acre. In 1923–24 the best lands were valued for assessment purposes at $100 per acre and poor lands at $32 per acre, and an assessment levied of $0.15 per $100 valuation. For 1925–26 the best lands were valued at $100 per acre, the poorer lands at $50 per acre, and intermediate lands at $75 to $85 per acre, both the character of land and water rights being the determining factors in these valuations. The assessment rate for 1925–26 for each $100 of valuation was $0.30. The total amount raised by assessments to date has been $34,121. The total assessed valuation of land for district purposes in 1923–24 was $4,678,870, and for 1925–26 it was $4,681,629.

Present outlook.—Future developments in Lemoore Irrigation District will probably be dependent upon whether the existing irrigation and canal systems are taken over. Defeat of the bond issue for that purpose in 1922 is largely accounted for by inequality of water-stock distribution within the district. Landowners in the northern end of the district with about 15,270 acres held 23–19/64 shares, or one share to about 650 acres, while Empire Ranch with 9600 acres held only $8\frac{5}{8}$ shares, or one share to each 1130 acres. As distribution of water had been made on the basis of stock owned, the northern owners considered themselves well taken care of and did not support the bond issue, although they had been offered a bonus of $1.50 per acre over the average value of $8 per acre which had been placed upon the stock as a sale value to the district.

TULARE

Location: adjacent to Tulare, in Tulare County. (Pl. XXVI.)
Date of organization election: September 21, 1889.
Gross area: 34,000 acres; **area assessed 1927:** 34,000 acres.
Principal towns: part of Tulare.
Post office: Tulare.
Railroad transportation: main line of Southern Pacific railroad; branch of Santa Fe railway.

History.—The history of this district to 1915 is given in some detail in a previous publication.* The district was organized shortly after the passage of the Wright Act at a time of rather bitter controversies between riparian proprietors and the owners of land dependent on appropriation for an irrigation water supply. Community leaders believed that organization of an irrigation district would furnish a means of obtaining water for the nonriparian lands of the Tulare area, while still supplying the needs of the riparian owners. Their original proposal was an irrigation district of 210,000 acres, extending from the foothills to Tulare Lake. Opposition of many landowners resulted in reducing the area to 39,360 acres. The town of Tulare was included and furnished most of the 484 votes cast in favor of organization. Only seven negative votes were cast.

The first engineer employed by the district proposed to divert water from the south bank of the Kaweah River. That plan would have involved heavy tunnel work, and so aroused opposition. A north-side diversion from St. Johns River, one of the branches of the Kaweah, with a flume across to the south side, was substituted. Settlers and Kaweah canals were purchased for $250,000 in bonds. The remainder of a $500,000 bond issue was used for construction and other expenses.

When the district was organized, not to exceed 3500 acres was being watered from Kaweah and Rocky Ford canals. The work done by the district made water available to more land, and extension of the irrigable area started. The financial difficulties of the early nineties, however, caused a setback, and attacks on the legality of the bonds and on the legality of the district management made matters worse. By 1895 most of the landowners had begun to default in payment of district assessments. For a number of years the district practically ceased operating, although water was kept running in the ditches. During this period the litigation over the bonds continued, farms became dilapidated, and economic conditions in both Tulare and the surrounding country reached a low ebb. Leaders in the community, however, never lost faith in the district and stoutly contended that it should meet its financial obligations, at least to the extent possible to a bankrupt enterprise.

A local committee was organized to deal with the situation and it began negotiations with the bondholders. A survey of the ability of the landowners to meet the debt led to the conclusion that settlement with the bondholders would be possible on the basis of $0.50 on the dollar for the face value of the bonds. This was finally agreed to and the bonds collected and put in escrow until the money necessary for the settlement could be raised. To do this an assessment approximating 36 per cent of the valuation within the district was

* Calif. State Dept. of Eng., Bul. 2, pp. 28–30, 87–89.

required. Concessions to some of the bondholders were necessary, but the debt was finally cleared by the payment to the bondholders of $273,075, and on October 17, 1903, the bonds were burned and the district again commenced operations as a solvent enterprise.

For a number of years the district system was operated more as a cooperative company than as a district, the only really active officer being the superintendent, who managed the system on water tolls, it being understood that no district assessments would be tolerated. Although, in 1909, an assessment of $10,000 for betterments was agreed to and collected, it was not until 1918 that the annual levying of assessments was resumed. After this assessment was collected, most of Tulare was excluded. Later exclusions reduced the area to the present 34,000 acres. No more bonds have been issued, Tulare District being one of the two operating districts in the state that have no bonded indebtedness.

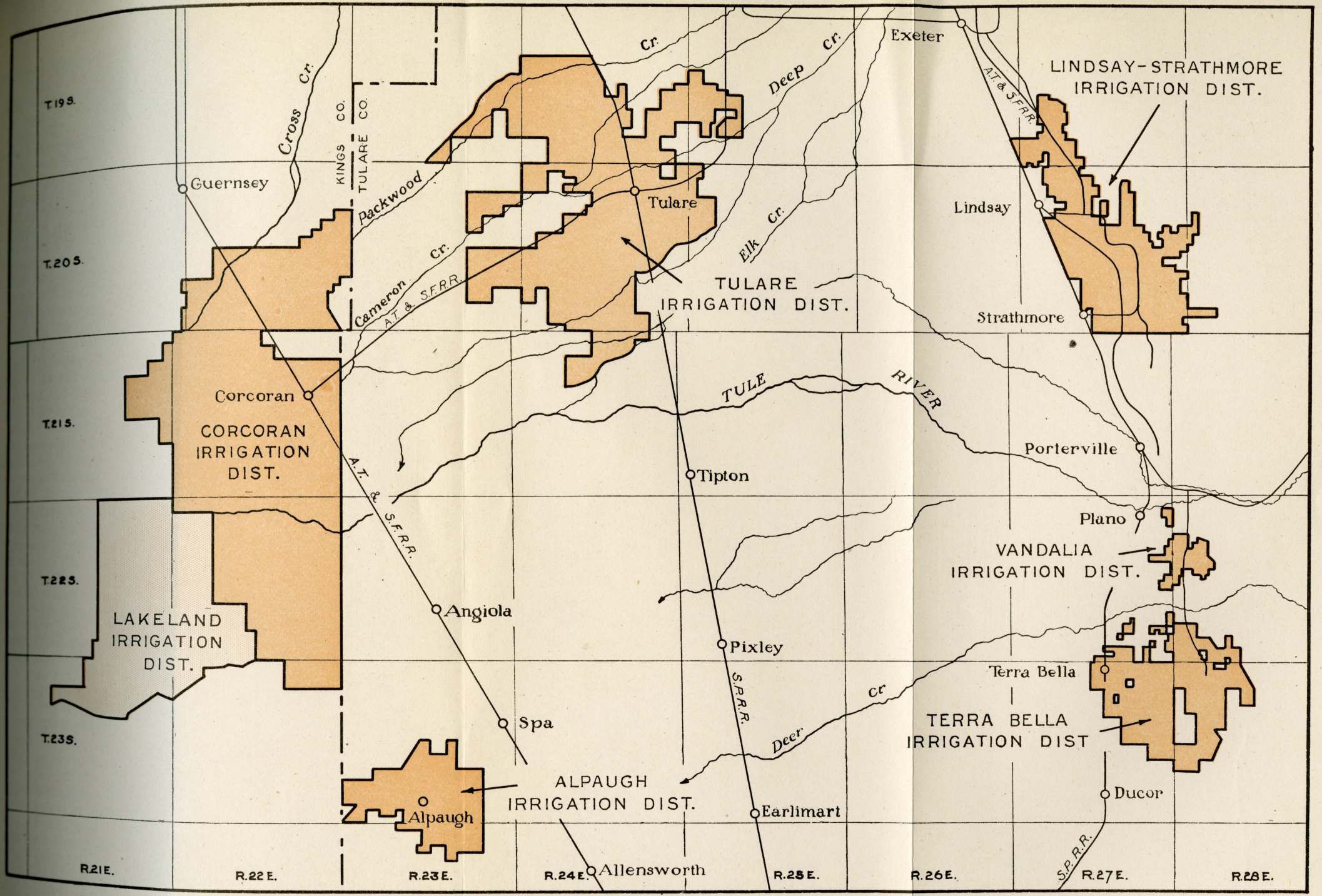
Soils and topography.—Tulare District is part of Kaweah River delta, the soils being mainly sandy and fine sandy loams of the Foster and Hanford series.* The surface is gently sloping, the elevation at Tulare being 282 feet. Alkali of sufficient concentration to affect crop production is reported by the district over about 7000 acres. Ground water levels range from about 40 to 65 feet below the surface, having receded about 10 feet since 1921.

Development.—As indicated under "History," development in this district has been under way since about 1890. The area irrigable by the district varies from year to year with the water supply available from Kaweah River. In 1913 it was only about 100 acres; in one year it is reported by the superintendent to have reached about 15,000 acres. A crop report in 1917 showed 12,199 acres irrigated by the district, of which nearly 8000 acres was alfalfa. In 1927 the area was 7100 acres. However, the superintendent estimates that there are 600 private pumping plants in the district, furnishing all or part of the supply to about 15,000 acres. The estimated population of the district is about 4,000, not counting those who reside in the area of the district, about 100 acres, that lies within the city of Tulare. The assessed valuation within the district for both county and district purposes for 1927-28 was $1,978,870, no change in this valuation having been made since 1925. In 1927 there were 735 holdings, averaging about 38 acres. One large holding contained 2800 acres and another 1500 acres.

Water supply.—Tulare District obtains water from Kaweah River through the St. Johns branch under old appropriations taken over with the purchase of Kaweah and Settlers canals in 1892 and through subsequent use. The rights of the district are defined in the agreement of St. Johns River Association, signed January 31, 1925. This provides for the division of the water of St. Johns River and its continuation, known as Cross Creek, among eight different canals. Total diversions for Tulare District for 1917, 1920 and 1921, so far as shown in existing records, are given in Bulletin 3, Division of Irrigation and Engineering, State Department of Public Works, pages 45-47.†

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

† Calif. Dept. of Public Works, Division of Engineering and Irrigation, Bul. 3, Water Resources of Tulare County and their Utilization.



Location and boundary map of irrigation districts in Tulare and lower Kings counties.

The maximum diversion during these three years was 62,300 acre-feet in April, May, June and July, 1917. Not counting 1926, for which no record has been furnished, the minimum diversion between 1920 and 1927 was 695 acre-feet, in 1924, and the maximum was 64,765 acre-feet, in 1927.

Besides belonging to St. Johns River Association, Tulare District is a member of Kaweah River Association. These two associations have settled all controversies between themselves as to the division of the flow of Kaweah River at McKay Point, which is the point at which Kaweah and St. Johns rivers divide. The purposes of Kaweah River Association are to clean out and keep in good repair the channels of Kaweah River and Mill Creek, and to take such action as is necessary to keep in those channels the water to which the members of the association claim a right, doing this in conjunction with St. Johns River Association and others.

Since 1916 Tulare Irrigation District, jointly with other users from Kaweah River, has been in litigation with Lindsay-Strathmore Irrigation District, in which injunction has been sought against the latter to prohibit it from diverting water by pumping from the gravels underlying Kaweah Rancho. The injunction was allowed, but the case is still on appeal to the Supreme Court.*

When Tulare District purchased Kaweah Canal in 1892, water rights were reserved for lands outside of the district which were entitled to one-third of the flow of the district main canal at the point that canal enters the district. The stockholders of the old canal company holding these reserved rights pay for water used at the rate of $1.25 per acre irrigated each year.

Works.—Tulare District diverts water from the east or north bank of St. Johns River above Visalia and at Crocker Cut and Deep Creek Cut on Kaweah River. The diversion from the St. Johns flows along the north side of the river about 2.5 miles, when it turns south and crosses the St. Johns in a metal flume 540 feet long. About one mile farther south water is carried under Kaweah River through a concrete siphon with a capacity of about 300 cu. ft. per sec. Still farther south the water joins with that diverted from the south side of the Kaweah and, from the point of junction, Kaweah and St. Johns Canal, which is the main canal of the district, has a capacity of about 500 cu. ft. per sec. and extends about eight miles to the northeastern corner of the district. At that point about one-third of the water is turned into North Branch lateral, the remainder flowing southwesterly through the central section of the district in the main Kaweah Canal.

All district ditches, including laterals, are unlined, and less than half of the water diverted reaches the district boundaries. The lengths and sizes of the various canals and laterals are not recorded, but the superintendent estimates the total length of all canals at 300 miles and claims that about 300 canal structures are in place. Most of the dams, checks and drop structures are of concrete, this material having replaced the original timber construction. No appraisal has been made of the system. The 1926 annual report estimated that up to that time $54,626 from tolls had been spent on works, making the total expenditures, including the compromise settlement with the

* See report on Lindsay-Strathmore Irrigation District, p. 248.

bondholders in 1903, $327,701. It is obvious, however, that the value of the system is much in excess of that amount. Canals and water rights are nominally valued on the books of the district at $1 for each item.

Use and delivery of water.—Water deliveries are under the management of the superintendent. Water is delivered on demand on application through the office of the secretary in Tulare. As previously indicated, the areas irrigated by the district vary widely with the gravity water available from Kaweah and St. Johns rivers. The district keeps a record of the dates of deliveries and the areas served, but these records have not been compiled.

Bonds.—As already shown, this district has no outstanding bonds. Elementary schools bonds are estimated to total $63,000, high school bonds $30,500, and general county bonds $75,400, making a total of $168,900.

Assessments and water tolls.—The district valuation for assessment purposes is based on county valuation, generally ranging from $1 to $100 per acre. Average valuation is given as $58 per acre. The total assessed valuation for district and for county purposes during the past four years has been $1,978,870. The highest assessment rate per $100 valuation during the past ten years has been $1.50. For the past five years the rate usually varied from $0.50 to $0.90 and was $0.60 in 1927-28. The total levy for 1927-28 was $11,873. The water toll during each of the seven years beginning in 1920 was $1.50 per acre; for 1927 it was $1 per acre, and the total water tolls collected amounted to $6,211. As previously indicated, water sold to stockholders of old Kaweah Canal and Irrigation Company is charged for at the rate of $1.25 per acre.

LINDSAY-STRATHMORE

Location: along the foothills at the eastern edge of San Joaquin Valley, in Tulare County. (Pl. XXVI.)
Date of organization election: October 16, 1915.
Gross area: 15,250 acres; **area assessed 1927:** 15,250 acres.
Principal adjacent towns: Lindsay and Strathmore.
Post office: Lindsay.
Railroad transportation: Famosa-Goshen branch of Southern Pacific railroad, branch of Santa Fe railway, and Visalia Electric railway.

History.—Prior to the organization of Lindsay-Strathmore Irrigation District, several thousand acres of citrus groves had been planted in the area adjacent to Lindsay and Strathmore, but they were dependent for irrigation water on pumping from underground. As the plantings increased and the groves became older, it was clear that the draft on the underground supplies was greater than the annual replenishment. Water levels were receding and much of the water being pumped was found to be alkaline. About this time there was a general trend in the state toward horticultural development, and the district was organized to include a considerably greater area than was covered by existing plantings. The vote on organization was 150 for and 20 against.

The only available source of water was Kaweah River. This stream was claimed by prior users to be fully appropriated except as to flood waters. The district was advised, however, that much of the water

diverted from the river by earlier appropriators was not beneficially used, and that a surplus of water not necessary for the use of such early appropriators could be made available to the district. Therefore, at a cost of $120,000, the district purchased the Rancho Kaweah. Some thirty-seven 18-inch wells with an average depth of 100 feet and a maximum depth exceeding 200 feet were drilled in this property and a pipe line leading from these wells to the Merryman Ditch was constructed, this ditch having been purchased and reconstructed by the district. Near the northern end of the district pumps were installed to raise water to higher levels.

Pumping from the Kaweah Rancho wells began about April 18, 1918. Prior to this, however—that is, on July 15, 1916—action was brought against the district by seventeen ditch companies diverting water from Kaweah and St. Johns rivers, and by many owners of land riparian to those streams, seeking to enjoin the district from pumping water out of the Kaweah Rancho and conveying it to the land in the district, which is claimed to lie outside of the Kaweah-St. Johns watershed. Even before the commencement of the construction by the district—that is, on June 5, 1916—the district had been served with notice by the plaintiffs in the above-mentioned suit that the proposed diversion from the Kaweah Rancho would be an invasion of their rights. The suit, filed July 15, 1916, entitled *Tulare Irrigation District et al.* vs. *Lindsay-Strathmore Irrigation District,* is not yet finally disposed of. A decision against Lindsay-Strathmore District was rendered July 9, 1919, by the superior court of Tulare County, but this decision was later vacated by the Supreme Court through disqualification of the judge rendering it, and the case sent back for a new trial.* On May 16, 1925, the court entered its findings, again upholding the contention of the plaintiffs, but withheld its decision, hoping that the controversy would be adjusted by agreement. Judgment was subsequently entered in May, 1926, and the appeal to the Supreme Court, which has not yet rendered a decision, followed.† Up to the close of 1927 the district had expended in its defense in this case and on other litigation a total of $671,611, or nearly half as much as the original bond issue for construction.

Pending the final outcome of this case, the court entered an order permitting the district to continue its pumping operations subject to the restriction that five specified wells should not be pumped except in the case of the breakdown of other wells which the district had a right to pump. The district has, at a cost of $165,000, purchased water stock in twelve mutual water companies diverting water from the Kaweah. However, there are two cases pending in the superior court of Tulare County which involve the right of Lindsay-Strathmore District to take water represented by this stock. These suits have not been set for trial pending outcome of the case of *Consolidated People's Ditch Company et al.* vs. *Lindsay-Strathmore Irrigation District,* in which case the plaintiffs obtained a temporary injunction preventing the district from taking any water from Kaweah River, by reason of

* 182 Cal. 315.

† This appeal involves such questions as the rights of appropriators, riparian owners, overlying landowners, the constitutionality of section 11 of the Water Commission Act, and various questions of procedure.

its water stock purchases, at a higher point of diversion, but did not pass on its right to take such water from the regular canals.*

Soils and topography.—The lands in the district range from steep slopes in the foothills along the easterly boundary to flat areas where the district extends into the main valley. Three principal soil classifications are found: San Joaquin loam, covering the bulk of the district extending from Strathmore north; Madera sandy loam around Lindsay; and San Joaquin sandy loam in the central area between Lindsay and Strathmore.† The foothill soils are generally of shallow depth. No drainage is required, ground water standing about 100 feet below the surface in the lower lands.

Development.—The district is mainly a citrus area, 84 per cent of its plantings being of that class. Approximately one-third of the area has not been planted, owing to uncertainties caused by the water-right litigation. There are about 500 individual holdings, averaging 25 acres. There is one holding of 1000 acres and another of 380 acres. The population of the district is estimated at 1500. This does not count either Lindsay or Strathmore, which are not part of the district. Farm improvements are generally of high grade. The district is well served with paved highways in addition to the railroads. The value of the area for citrus plantings has been established by years of successful culture.

Water supply.—Reference to water supply has already been made in discussing the history of this district. Deliveries to the district during the past nine years have ranged between 14,607 acre-feet, in 1919, and 13,312 acre-feet, in 1927. The minimum delivery was 12,709 acre-feet, in 1926, and the maximum 14,607 acre-feet, in 1919. As the water is conveyed in pipes and concrete flumes, it is estimated by the district that leakage losses do not exceed 5 per cent of the water pumped from the Kaweah Rancho wells. Under the present court orders the district is permitted to operate 34 of its 39 pumping plants in the Kaweah Rancho between April 15 and November 15. From November 15 to April 15 the district is permitted to pump 3 cu. ft. per sec. for domestic use. The amount to be obtained from the ditch-stock ownership is uncertain, but the engineers of the district estimate that the stock purchased represents a mean annual supply of not less than 20,000 acre-feet.

No storage is provided except for balancing purposes in distribution. The district has, however, an option on the Lind Cove Reservoir site which it has considered using for the storage of water obtained under the water stock purchased.

Works.—The irrigation system of the district consists in the main of 39 wells in Rancho de Kaweah, 12 of which are now 300 to 400 feet deep; 16.57 miles of wood stave pipe, 14 to 48 inches in diameter, by which the water is collected from the wells and conveyed to the district; a concrete-lined main canal 6 miles long leading to the district from the end of the collecting pipe line; a main pumping station with a capacity of 37,000 g.p.m., lifting water against a total head of 162 feet through two 36-inch riveted steel pipe lines a distance of 1040 feet to the high-line bench flume; a high-line bench flume 6 miles long which

* Since the above was written the supreme court has upheld this injunction.

† U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

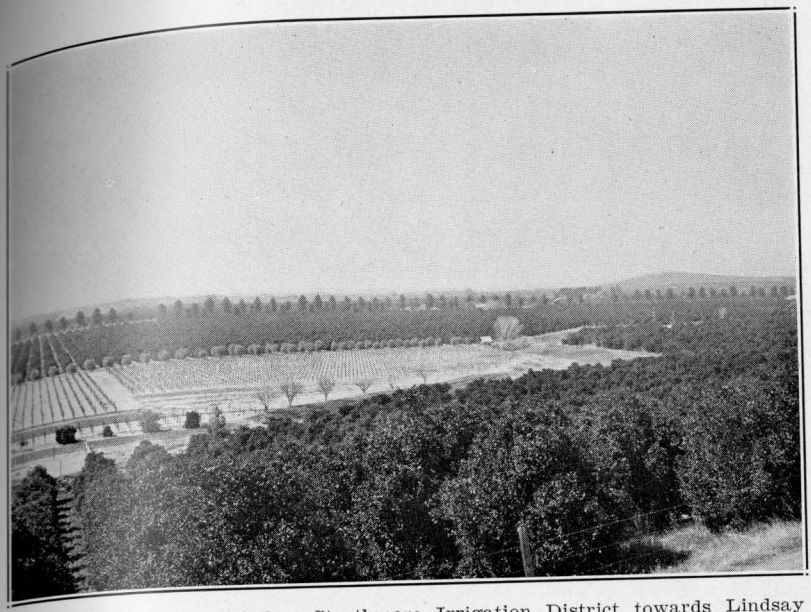


FIG. 1. Looking over Lindsay-Strathmore Irrigation District towards Lindsay and Strathmore.

FIG. 2. Northeastern portion of Terra Bella Irrigation District.

follows the eastern boundary of the district to about its center; a main pipe line extending from the end of the high-level canal south and east through the center of the district; a second main pipe line extending from the lower end of the high-level flume east and south 3.5 miles to the northeastern corner of the district, where it discharges into a balancing reservoir; a second booster pumping plant lifting water from the second main pipe line through 3000 feet of 20-inch riveted steel pipe against a total head of 160 feet to the high land along the eastern margin of the district, this second booster discharging 4260 g.p.m. under full load; a second high-level conduit approximately 14,500 feet in length made up of open concrete-lined section, 24-inch concrete pipe, and 12-inch concrete pipe; and, finally, the distribution system comprising 87.6 miles of riveted steel pipe lines 4 to 16 inches in diameter.

The total motor horsepower installed at the wells in Rancho de Kaweah is 1560, and the total installed in the two booster pumping plants is 2175, with an average lift at the Kaweah de Rancho wells of 125 feet. The maximum pumping head to the high lands in the southeast corner of the district, including lift from wells, is 447 feet. However, 9200 acres of the district is covered by a lift of 287 feet. In addition to the above works, there are approximately 100 pumping plants in the district, which are used to supplement the district supply.

The capital invested in works, not including stock in ditch companies, was $1,688,818 on December 31, 1927. Of this, $1,645,080 was covered by bond issues and $43,738 by district tax. Payment for the water stock purchased is being covered by a special assessment voted May 28, 1927, and to be levied in the years 1927–28, 1928–29, 1929–30, the principal and interest amounting to $183,287.

Use and delivery of water.—The distribution system reaches all parts of the district under pressure, the delivery unit being 10 acres. All deliveries are measured by either displacement or propeller-type meters.

Bonds.—The original bond issue authorized in 1916 by a vote of 191 to 15 was for $1,400,000, and was expected to complete the construction. The bonds were dated July 1, 1916, with maturities from 1927 to 1946, and carried 6 per cent interest. They were sold August 18, 1916. A second issue of $250,000 was authorized in 1918 by a vote of 65 to 8. These bonds are dated October 1, 1918, have maturities from 1929 to 1948, and also carry 6 per cent interest. They were sold April 4, 1919. Bonds outstanding January 1, 1928, amounted to $1,636,000.

Assessments and water tolls.—The district assesses land for district purposes at the flat rate of $175 per acre, except that 500 acres of rough land is given the nominal valuation of $1 per acre. The total assessed valuation for 1926–27 was $2,447,225. Prior to 1927–28 the annual levy varied from $107,638, in 1917–18, to $188,925, in 1926–27. Because of the special assessments to pay for stock of water ditches, the annual assessment rate was materially increased in 1927–28, the levy in the latter year being $324,813. The rate for each $100 of assessed valuation ranged between $6.96 and $7.72 during the years 1923–24 to 1926–27, but was $13.73 for 1927–28. The district also receives income from water tolls, the present rate for irrigation being $10 per acre-foot, while the rate for domestic use is $20 per acre-foot. The amount raised by irrigation and domestic water tolls for 1927 was $135,054. Water bills are collected monthly.

Present outlook.—The future of Lindsay-Strathmore Irrigation District is contingent on the outcome of its water-right litigation, and on the ability of the district finally to obtain an adequate water supply. High values have been created in the planted lands; otherwise, the heavy drain resulting from long-continued litigation would have brought disaster.

VANDALIA

Location: five miles southeast of Porterville, in Tulare County. Pl. XXVI.)
Date of organization election: September 17, 1923.
Gross area: 1276 acres; **area assessed 1927:** 1276 acres.
Principal town: none.
Post office: Porterville.
Railroad transportation: branch line of Santa Fe railway.

History.—This is a small, compact district, about 80 per cent of which was developed in citrus plantings prior to organization. The purpose of organization was to provide for the development of additional water by pumping from a gravel basin near Tule River. The existing underground supply in the district had been drawn down by private pumping to an extent which made the new supply economical. The district purchased rights and properties of Vandalia Ditch, and these are now utilized, water being conveyed through the ditch to the district 'well farm.'

Soils and topography.—The soils are classified as Porterville adobe* and are underlain by a heavy subsoil with no definite hard pan. The surface is rolling and the elevations vary from 500 to 600 feet. No drainage has been found necessary. The ground water within the district is 140 to 175 feet below the surface during the pumping season. The net irrigable area is 1204 acres, all of which can be irrigated with the present developed water supply and distribution system.

Development.—The plantings are entirely of citrus, of which there are 1069 acres of mature groves in 44 holdings. The largest holdings are 184, 71, 80, and 55 acres, the average being 27 acres. There are 28 residences, and these with the well-kept groves give the district a substantial appearance. Two packing plants located on the spur railroad track serve the area. The estimated population in the district is 100.

Water supply.—As available during the winter, water is diverted from Tule River by Vandalia Ditch and carried something over a mile to the well farm of about 70 acres and stored in the underlying gravel strata. The water table stands within a few feet of the surface when the irrigation season begins, and gradually recedes during the summer to give a maximum drawdown in the wells of about 120 feet. Since 1925 the spreading area has been replenished annually and appears to have a storage capacity of about 2000 acre-feet. From this source it is pumped into the pipe lines running to the district, with an average drawdown at the wells of about 50 feet. The lift at the main booster plant is 50 feet, and that from the main pumping plant is from 100 to 120 feet. Nine of the eleven wells are used, the minimum supply from these varying from 0.18 to 0.64 cu. ft. per sec., and the maximum from 0.60 to 1.38 cu. ft. per sec. The amount of water pumped annually by the district during the past three years has been

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

as follows, in acre-feet: 1925, 1120; 1926, 1982; 1927, 1650. These figures do not include 26 acre-feet pumped in 1926 and 18 acre-feet in 1927 for domestic purposes. The amount of water diverted from Tule River is said not to exceed 5 per cent of the quantity delivered. Twenty-two private irrigation pumping plants supplement this supply. In 1925 it was estimated that these furnished 1500 acre-feet. As the district has delivered water since June of that year, the amounts pumped by private plants have probably decreased since then.

Works.—The pipe line leading from the well farm is of steel, 26 inches in diameter. The 10 pumping plants at the well farm are operated by 15 to 40 h.p. motors. There are two main booster pumping plants, both equipped with centrifugal pumps of 8-inch and 12-inch discharges, respectively. The 8-inch pump delivers 4.68 cu. ft. per sec. at a head of 115 feet, and is operated by a 75 h.p. direct-connected motor. The 12-inch pump delivers 7.35 cu. ft. per sec. at a head of 115 feet, and is operated by a 125 h.p. direct-connected motor. The upper booster plant is a 5-inch centrifugal pump delivering 1.8 cu. ft. per sec. at a head of 140 feet, and is operated by a 50 h.p. direct-connected motor. Of the 1069 acres irrigated, the total lift to 919 acres is 200 feet, and to 150 acres it is 320 feet. The distribution system includes 10.5 miles of 4-inch to 26-inch pipe line made of 12 to 16 gauge steel.

The initial cost of construction of the district system was $199,004.52, of which $40,330 was for lands and rights of way, $12,489 for pump stations, $83,292 for pipe lines, $16,062 for well pumps, $10,030 for wells, and $7,218 for meters and services. The total invested in works to December 31, 1927, was $206,844.93, of which $192,400 was derived from bond sales and $14,444 from district assessments.

Use and delivery of water.—Forty-two irrigation services and 28 domestic connections were used in 1927. Water is measured to users through propeller type meters.

Bonds.—The district has issued 6 per cent bonds to the amount of $210,000, dated April 1, 1924, with maturities from 1928 to 1947. The bonds were sold October 1, 1924. On January 1, 1928, bonds to the amount of $5,250 were retired, leaving outstanding $204,750. General county and school bonds against lands in the district total $18,600, divided as follows: general county, $5,900; elementary school district, $5,600; high school, $7,100.

Assessments and water tolls.—All land in the district is assessed for district purposes at $200 per acre, the total valuation in 1927–28 having been $255,267. Railroad rights of way are not assessed, but 22.85 acres of railroad land is given the same valuation as other land. The total amounts raised annually by district assessments have ranged during the past four years between $10,254 and $22,974. The district assessment rate per $100 of valuation during this period has increased from $4 in 1924–25 to $9, which was the rate for 1926–27 and for 1927–28.

Water tolls for irrigation were at the rate of $7 per acre-foot in 1925 and $8.50 per acre-foot in 1926 and 1927. The amount raised by water tolls in 1927 was $14,948, of which $817 was from water used for domestic purposes. The domestic rate is $1.50 per month minimum, with an allowance of 500 cu. ft. and a charge of $0.02 per 100 cu. ft. in excess of 500.

TERRA BELLA

Location: 8 miles south of Porterville, in Tulare County. (Pl. XXVI.)
Date of organization election: August 7, 1915.
Gross area: 12,285 acres; **area assessed 1927:** 12,285 acres.
Principal town: Terra Bella.
Post office: Terra Bella.
Railroad transportation: main line of southern Pacific railroad and branch of Santa Fe railway.

History.—The history of this district is largely a history of its efforts to obtain an adequate water supply. Construction of the Terra Bella irrigation system was commenced in 1916 and it was ready to begin water deliveries in the latter part of 1917. During the construction of the system plantings were started and 2211 acres was ready to receive water during the first year. Very shortly after water deliveries began, however, it was evident that the water supply available to the district would be less than originally contemplated, and the general recognition of this fact has been a very definite deterrent in the growth of the district. Efforts were immediately made to increase the water supply. Additional wells were drilled, additional water-bearing lands purchased, and the water available from Deer Creek Ditch, which had been acquired in 1916–17, was turned into the main channel of Deer Creek for underground storage. Surveys were made for a storage supply on Deer Creek and an application was filed in April, 1920, with the State Water Commission for a permit to impound 20,000 acre-feet. Subsequent studies indicated that the proposed storage would conflict with rights farther down Deer Creek, and the application before the Water Commission was withdrawn without prejudice.

In 1921 a new study of the water supply situation was ordered. The possibility of storage in Tule River Basin was considered, but found not feasible because of excessive cost and conflicting water rights. In this study, the total ultimate requirements of the district were placed at 18,665 acre-feet annually, or at the rate of 1.70 acre-feet per acre for the 10,980 acres of irrigable land.

In the same year, an infiltration gallery at the Deer Creek intake collapsed and surface pumping equipment was installed. Repairs made the following season were only temporarily effective. By the close of the season of 1922 the average depth of water at what are termed the 'valley' wells had dropped to 61 feet below the surface, as compared with 53 feet when pumping was started. At the end of the season of 1923 the average water level had lowered to 66 feet, in 1924 to 68 feet, and in 1925 to 71 feet. In 1926 many of the wells were deepened and additional pump bowls installed. In that year an additional 240 acres of water-bearing land was purchased and further well developments started. This resulted in protests and six suits to enjoin the district from taking water from this additional area, these suits later, in 1928, being settled out of court in a manner satisfactory to the district. At the end of the season of 1927 the average water level at the valley wells was 79.1 feet below the surface, which, although a slight recovery from 1926, showed a net lowering since pumping started in 1917 of some 57 feet. Maximum deliveries of water to the district in any year up to this time had been only 7725 acre-feet, or more than 10,000 acre-feet less than the 18,665 acre-feet estimated in 1921 to be necessary for full supply.

In 1927 surveys were made to determine the feasibility of surface storage of the water available from Deer Creek Ditch, the estimated cost of this additional development being $50,000. The desirability of this storage development, however, has not been demonstrated.

Soils and topography.—The soils are classified as Porterville and Ducor adobe and San Joaquin loam.* The surface is flat to gently rolling, the elevation 450 to 800 feet. Ground water stands 100 to 200 feet below the surface, so there is no drainage problem.

Development.—There are about 650 separate holdings in the district, giving an average of 17 acres. Two holdings contain 600 acres each, and one 240 acres. The largest area is in citrus fruits, with a total of 1786.9 acres, of which all but 35.8 acres are Navel and Valencia oranges. Terra Bella, not incorporated, has a population of about 150, and there is an additional population in the district of about 800. A concrete highway passes through the town of Terra Bella. The estimated assessed value of land in the district for city and county purposes in 1927 was $515,000.

Water supply.—The first proposals for furnishing water to the area included within Terra Bella Irrigation District contemplated surface storage on Deer Creek. This plan not being found feasible, it was decided to obtain the main supply by pumping from underground sources fed by Deer Creek, this to be supplemented by diversion through an infiltration gallery near the head of the old Deer Creek ditch. With the exception that the infiltration gallery has not continued to function as originally planned, and that Deer Creek surface water is now in part diverted at the main pumping station, these sources of water have continued to be the entire reliance of the district. There are now 21 wells, known as the 'valley' wells, located along Deer Creek a few miles west of the district. In 1927, 72.2 per cent of the entire supply came from these wells, the remainder having come from the following sources: Wells Ranch wells, 6.1 per cent; Station 3 wells, 1.1 per cent; Station 3 (Deer Creek), 6.8 per cent; Deer Creek Ditch at the main pumping station, 4.6 per cent; other wells, 9.2 per cent.

The amounts of water diverted or pumped are not measured, but since, in the opinion of the district engineer, transmission losses do not exceed 1.5 per cent, the amounts delivered represent approximately the total available. The total amount delivered to irrigators in 1927 was 6154 acre-feet, or approximately the same quantity that was delivered in 1922. From 1923 to 1926 the total deliveries ranged from 6806 to 7725 acre-feet, which was the maximum figure thus far reached. On the basis of the estimated average duty of 1.70 acre-feet per acre, the amount thus far developed is sufficient for only about 4500 acres, or, in the opinion of the district, for only about 4000 acres when the present plantings shall have reached maturity.

Works.—Although begun in 1916, the irrigation system of the district was not completed to its present status until 1921. The principal features of the system are 18 wells pumping against a head of 190 feet through about 2.5 miles of 30-inch riveted steel pressure pipe leading to the main booster pumping station on Deer Creek, about one mile north of Terra Bella; two pumps raising water against a head of 142 feet to a main booster pumping plant; one pump delivering water

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Upper San Joaquin Valley, California.

against a total head of 200 feet directly into the district system; and booster plants 1, 3, 4 and 5, raising water to higher lands against heads of 144, 170, 188, and 38 feet, respectively. Also, the flow from four small wells is pumped into the main pipe line above the main booster pump by an auxiliary booster. The main pumping plant has a capacity of 14,000 g.p.m. and operates against a head of 92 feet. It draws from a receiving reservoir into which the Deer Creek wells discharge. Booster plant 1 has a total capacity of 9000 g.p.m.; booster plant 3, which pumps from the bed of Deer Creek near the infiltration gallery, has a capacity of 2800 g.p.m.; and booster plants 4 and 5 have capacities of 2400 and 700 g.p.m., respectively. The first of these two receives water from a small reservoir into which booster pumps 1 and 3 discharge, the other taking water directly from the pipe line. The Deer Creek wells are equipped with deep-well turbines, their bowl averaging 100 feet below the surface.

The distribution system carries water to all parts of the district through 81 miles of slip-joint riveted steel pipe, varying in diameter from 4 inches to 30 inches. There are three private irrigation pumping plants supplying 60 to 75 acres. The various works of the district have been well maintained and efficiently operated. All pumps are well housed.

The total amount invested by the district in works to December 31, 1927, was $1,183,690.33, of which $950,272 was received from bond issue, $92,000 from special assessments in 1921-22, and $141,418 from general maintenance and operation taxes. Of the capital investment, pipe lines and fittings cost $494,309, pump stations $93,594, wells and casings $122,923, well pumping plants $77,471, meters and their installation $28,463, land and rights of way $77,355, water rights $13,731, reservoirs $16,633, engineering $20,340, and Terra Bella city water works $10,481, these being the larger items.

Use and delivery of water.—As stated in connection with water supply, the maximum amount available to the district in any one year has been 7725 acre-feet in 1926, with 6154 acre-feet in 1927. The areas irrigated in these two years were 4712 and 4490 acres, respectively. Pumping by the district began in 1917, but the first record is for 1918, when the amount used was 3326 acre-feet. Use increased nearly every year from 1918 to the maximum in 1926. Since 1926 the deliveries reported include domestic use, which amounted to 211 acre-feet in 1926 and 133 acre-feet in 1927. Irrigation water is measured with propeller type irrigation meters and domestic water with displacement type meters. The district keeps careful records of the quantity of water delivered.

The average amount of water applied has varied from 1.34 to 1.63 acre-feet per acre per year, although the estimated requirement is 1.70 acre-feet per year. The delivery schedule calls for 4 acre-feet to each 10 acres every 5 weeks, or proportionate amounts in periods of less than 5 weeks. The district engineer reports that experiments show this amount to be ample. For the different crops the average duty from 1918 to 1925 has varied from 1.16 acre-feet per acre for figs to 2.12 acre-feet per acre for cotton. Citrus fruits have shown an average use during that period, in acre-feet per acre per year, as follows: oranges, 1.74; lemons, 1.98; grapefruit, 2.08. The use on deciduous tree fruits has been from 1.27 acre-feet per acre for prunes to 1.45 acre-feet per acre for peaches, and on grapes, 1.68 acre-feet per acre.

Bonds.—Construction work of the district was done during a time of high prices and it has been estimated that the total cost was probably $250,000 more than if built under normal conditions. Only a single issue of bonds has been voted, this amounting to $1,000,000. Owing to the discount on the bonds and increased construction costs, due to high prices, a deficit occurred in the construction fund, for which registered warrants were issued, these being covered in 1922 by a special assessment of about $92,000. The bonds issued are dated November 1, 1916, and carry maturities from 1927 to 1946. Bonds to the amount of $10,000 due in 1927 and $3,000 due November 1, 1928, have been retired, leaving $987,000 outstanding. Other outstanding general obligations against the lands in the district are estimated at $81,900, as follows: general county bonds, $33,000; elementary school bonds, $6,200; high school bonds, $42,700.

Assessments and water tolls.—With the exception of 200 acres assessed at $25 per acre and 160 acres in the townsite of Terra Bella assessed at about $200 per acre, all land is assessed for district purposes at $100 per acre. The total district assessed valuation in 1927-28 was $1,211,114, this being substantially equivalent to the valuation each year since 1921. The annual district levy for 1927-28 was $105,972. During the past five years the assessment rates per $100 of assessed valuation have ranged between $7.50 and $8.75. Water tolls are billed at an estimated rate of $10 per acre-foot and any excess over cost of operation is rebated or any increase is added. There was no rebate in 1926. The actual rates for the three previous years were $8.65 in 1923, $9.15 in 1924, and $8.50 in 1925; for 1927, it was $11. Water tolls charged are made up of actual operation costs plus a maintenance reserve of 2.5 per cent. The amounts obtained from water tolls in 1927 were as follows: irrigation service, $60,212; domestic service outside Terra Bella, $4,272; domestic service in Terra Bella, $1,268; special domestic service, $444; total $66,197.

Present outlook.—The future of this district is to be entirely dependent upon the outcome of the water situation. It is obvious that the district can not continue with a net irrigable area of 10,980 acres liable to assessment and entitled to water, but with water available for only 4000 to 4500 acres. Since additional water seems out of the question at this time, a readjustment of acreage and indebtedness is inevitable.

CORCORAN

Location: surrounding Corcoran, in Kings and Tulare counties. (Pl. XXVI.)
Date of organization election: July 28, 1919.
Gross area: 51,605.51 acres; **area assessed 1927:** 51,605.51 acres.
Principal town: Corcoran.
Post office: Corcoran.
Railroad transportation: main and branch lines of Santa Fe railway.

*History.**—This, and Lakeland Irrigation District adjoining on the west, represent efforts of landowners east of Tulare Lake to gather up such scattered waters as are available and apply them to a fertile belt of land that thus far has not been very highly developed. The principal

* See also State Dept. of Eng., Bul. 7, 34–36.

hope of these two districts is participation in the proposed Pine Flat storage project, and the anticipation of such participation has led to the formation of these two districts.

Corcoran Irrigation District was approved by the electors of the district by the very large vote of 111 to 2. Prior to the formation of the district negotiations had been held with reference to acquiring the old Lakeland Canal, together with such water rights as it might hold.

Lakeland Canal had been built in 1903 and 1904 by Lakeland Canal and Irrigation Company and Union Water and Ditch Company. Under an agreement dated November 6, 1903, Lakeland Canal Company was to pay two-thirds of the cost of construction and receive a two-thirds share in the water obtained. A filing to the amount of 300,000 inches under a 4-inch pressure had been made under the old law by Lakeland Canal and Irrigation Company and recorded June 1, 1903. About coincident with the completion of the canal, however, lower riparian land owners, chief of which were the Heinlen Company, Laguna Lands, Ltd., and the owners of the Empire Ranch, succeeded in enjoining Lakeland Canal and Irrigation Company from diverting any water, and for years the old canal, intended originally to carry up to 1000 cu. ft. per sec., remained unused.

Then, as a part of its program to increase agricultural production for war purposes, the State Council of Defense on March 16, 1918, brought about an agreement permitting Lakeland Canal, as a war measure, to divert surplus water to the extent of 37,500 acre-feet, but only when the flow of Kings River at Piedra should exceed 8000 cu. ft. per sec. Although the old Lakeland Canal and its structures had greatly deteriorated, the superintendent of the canal succeeded in carrying through about 1700 acre-feet during the season of 1918, with a maximum flow of 55 cu. ft. per sec. With this water, and with from 25 to 75 cu. ft. per sec. of waste water from Alta Irrigation District, about 1760 acres received water in that year.

The friendly attitude toward Lakeland Canal stimulated by the State Council of Defense created a general community interest in continuing in some way a supply of water to the lands under the old unused system, since the operation of the system during 1918 had shown that it could function to some extent, at least, without injury to the holders of prior rights. This was the situation when Corcoran Irrigation District was formed in 1919.

Engineering reports, showing the probable practicability of proceeding along the lines contemplated, had been made prior to the organization of the district and were, in a large measure, the basis on which organization was approved by the state engineer. It had been ascertained that Lakeland Canal and Irrigation Compny would dispose of its interests for $300,000. A report submitted by the engineer of the district in 1919 estimated that $760,000 would be sufficient for purchasing Lakeland Canal and its structures and rights of way, making necessary improvements, purchasing water rights or constructing necessary pumping plants, and other necessary expenses. A bond issue in that amount was approved by the Irrigation District Bond Certification Commission and authorized by the voters November 25, 1919. Lakeland Canal and Irrigation Company properties were conveyed to Corcoran Irrigation District June 7, 1920, subject to an option to a third party

to purchase half of all the water flowing in the canal to which Corcoran Irrigation District might be entitled. This option was later exercised by Lakelands Option Syndicate on behalf of Lakeland Irrigation District for $150,000, and Corcoran Irrigation District carried out the construction program that had been outlined.

On August 20, 1928, by a vote of 122 to 62, the district authorized a special assessment of $120,000 for the purchase of approximately 780 acres surrounding the Cross Creek headgate, 160 acres near Tule River, and mutual ditch company stock; also to develop wells and install pumping equipment. The engineers of the district estimate that 7000 acre-feet of water can be developed on the 780-acre tract without serious lowering of the water plane, and that four wells on the 160-acre tract will yield about 2 cu. ft. per sec. each. The $120,000 assessment is to be levied in three annual installments of $40,000 each.

Soils and topography.—The soils of Corcoran District are mainly lake bed sediments, ranging from sandy loam to clay. The predominating type of soil, which extends northwesterly and southeasterly parallel with the Santa Fe railroad, is classified in the soils survey as Foster sandy loam.* There is a considerable area of Merced clay loams and clays; north of Corcoran are Chino and Foster loams undifferentiated; and in the south end of the district are Sacramento clay loams. The surface is smooth and flat, elevations ranging from 185 to 225 feet. Ground water is generally 30 to 50 feet below the surface. Less than five per cent of the district is reported to carry sufficient alkali to affect crop production.

Development.—Segregation of crops irrigated in Corcoran Irrigation District has not been made. The principal crops are cotton, grain, alfalfa, and melons, 19,000 acres being reported irrigated in 1927. There are 295 land holdings and the average area per holding is 173 acres. There are four large holdings of 3808, 2894, 2134, and 2015 acres, respectively.

The estimated population of the district is 1500, and of Corcoran, which the district surrounds but does not include, 1400. Assessed valuation of land in the district in 1927 for city and county purposes was $1,163,000, of which $128,000 was for improvements. Paved county highways cross the district and connect with state highways on the north at Hanford and on the east at Tulare.

Water supply.—As previously stated, the chief hope in the matter of water supply of Corcoran Irrigation District is storage at Pine Flat Reservoir, since the district is entitled to divert water from Kings River only when the flow at Piedra is in excess of 8000 cu. ft. per sec. The district is a party to the 1927 schedule of Kings River Water Association, and under this schedule it begins receiving water in May if the river is carrying 8000 cu. ft. per sec. The maximum allowance under the schedule in May is 500 cu. ft. per sec., in June, 450 cu. ft. per sec., and in July, 115 cu. ft. per sec. The 1927 Kings River water schedule, however, applies only to a flow at Piedra up to 9450 cu. ft. per sec., and the flow sometimes exceeds that amount. The district obtains surplus water from Alta Irrigation District, but the amount is indeterminate, although in some years it is of consequence. Occasionally floods pass down from Kaweah River through St. Johns and Mill Creek

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California.

channels and are intercepted by the channel of Cross Creek, which forms in part the main canal of the district. This flood flow is available to the district subject to certain small prior rights. In occasional years water is also obtained from Tule River through Lamberson Canal, which covers the southern portion of the district, and the district obtains some water from Peoples Ditch through a cross-cut canal between Peoples Ditch and Lakeland Canal, Corcoran and Lakeland Districts jointly controlling 13.4 per cent of the water flowing in Peoples Ditch.

Finally, in addition to the purchase of 940 acres authorized by the electors in August, 1928, referred to under "History," the district has acquired about 50 acres of land along the lower unit of Lakeland Canal where 6 wells are pumped and the yield mingled with the gravity supply. Seven other wells, in section 22, T. 20 S., R. 22 E., owned by private interests are being pumped by the district through agreement with their owners.

The total amount of water diverted by Lakeland Canal from 1918 to 1927 has ranged from nothing, in 1924, to 32,969 acre-feet, in 1922, and that available since 1923 through the cross-cut canal from Peoples Ditch has ranged from 1710 acre-feet, in 1923, to 37,560 acre-feet, in 1927. During the last five years, or since water has been available through the Corcoran cross-cut, the combined gravity supply available to the two districts, share and share alike, has ranged from 2277 acre-feet, in the low-flow year of 1924, to 57,635 acre-feet, in 1927. Water carried in the main canal is subject to heavy seepage losses. For instance, of 57,635 acre-feet diverted in 1927, it is reported that 38,357 acre-feet reached the upper end of the district. From 15 to 20 per cent of the total water supply available to the district is pumped from the 13 wells mentioned above. The six pumping plants owned by the district, which have a total capacity of about 5000 g.p.m., are being operated continuously during the irrigation season, and there are, in addition, about 200 private pumping plants.

Works.—The principal works owned by Corcoran Irrigation District are Lakeland Canal from Kings River to Cross Creek, a distance of about 10 miles; Cross Creek Channel, utilized for about 12 miles; and the lower unit of Lakeland Canal, which diverts from Cross Creek. One branch serves land in the vicinity of Corcoran and another, known as Sweet Canal, extends southerly, crosses Tule River, and supplies water through Lamberson Canal to serve the lower end of the district. The former dilapidated wooden headgate on Kings River has been replaced by a concrete structure and there is a concrete weir across Cross Creek, built in 1918. There is also a siphon under Tule River. The total length of canals, all unlined, approximates 140 miles, this including laterals. Development of pumping has not yet been carried out on the scale originally contemplated. The six wells thus far put down have 12-inch casings and range from 60 to 160 feet in depth. Five have deep-well pumps and the fifth a centrifugal. The total pumpnig heads of four plants tested varied from 39.86 feet to 54.6 feet. All of the plants are equipped with 15 h.p. motors.

To date, a total of $937,556.91 has been expended by the district in works and other capital equipment. Of this amount the major expenditures have been $561,887 for canals, $122,501 for headgates and

weirs, $35,237 for culverts and flumes, $38,000 for bridges, $29,413 for takeout gates, $43,820 for siphons, $18,344 for purchase of water stock, and $11,611 for wells.

Use and delivery of water.—Water is distributed without set rules and deliveries are not measured. While an irrigation is supposed to constitute an application of 6 acre-inches per acre, this quantity is estimated. Application blanks for water are furnished by the district and water users are requested to sketch on the back of such blanks the land for which water is desired. In the case of tenants, the water toll is collected in advance, while for property owners it is paid along with the annual district assessment. In the past, measurements on the main system have been more or less haphazard, but since agreements were made with Lakeland Irrigation District for division of the supply, measuring stations have been established near the head of the lower unit of Lakeland Canal, and also at the division point.

Bonds.—The bond issue of $760,000 is dated January 1, 1920, bears interest at 6 per cent, and has maturities running from 1931 to 1955. Bonds to the amount of $600,000 were sold January 7, 1920, and in the amount of $100,000 on May 11, 1921. The remainder were sold January 17, 1922. No additional bond issues are contemplated, except in connection with the Pine Flat project.

Other bonds outstanding against the lands in the district are estimated to total $96,000, of which $31,000 are elementary school bonds in Corcoran School District, $15,000 are bonds of Corcoran High School District, and $50,000 are county highway bonds.

Assessments and water tolls.—The income of the district is derived from both assessments and water tolls. All lands in the district are assessed for district purposes at the flat rate of $100 per acre and railroad rights of way at $360 a mile. The total district assessed valuation for 1927–28 was $5,160,551. The amounts raised annually by assessments have varied from $72,214, in 1924–25, to $86,732, in 1925–26, and the amount raised in 1927–28 was $69,537. During the past five years the district assessment rates per $100 of valuation have ranged from $1.35 to $1.65. For the years 1922–26, inclusive, the toll rate was $0.50 per acre per irrigation for alfalfa, and $1 per acre for other crops. Beginning in 1927, it has been $1 per acre for irrigation for all crops. Total water tolls collected have varied from $286, in 1924, to $20,238, in 1927.

LAKELAND

Location: southeast of Corcoran, in Kings County. (Pl. XXVI.)
Date of organization election: February 2, 1923.
Gross area: 23,282 acres; **area assessed 1927:** 23,282 acres.
Principal town: none.
Post office: Corcoran.
Railroad transportation: main line of Santa Fe railway at Corcoran and Kings Lakeshore railroad operated in connection with the Santa Fe.

*History.**—Reference to this district has already been made in connection with Corcoran Irrigation District with which it is associated in obtaining a water supply through the old Lakeland Canal. The land included is a portion of the southeastern sector of the old Tulare Lake bed. Prior to 1887 this land was beneath the water of Tulare

* See also State Dept. of Eng., Bul. 7, 34–36.

Lake. Between 1887 and 1889 recession of the lake uncovered most of it, but it was again submerged in 1889 and remained wholly or partially submerged until 1897. From 1897 to 1906 it was free from submergence and a considerable part was farmed by grain growers, who followed the margin of the lake with their seeding. As far as is known, the land was not surface-irrigated during this period, the crops being dependent on the moisture left by the receding lake. From 1906 to 1912 the land was again inundated, but during the dry period 1912–13 levees along the lake were constructed by El Rico Land Company and these have prevented overflow since then.

Lakeland Irrigation District includes within its boundaries all of Reclamation District 1618 and parts of Reclamation districts 690, 812, 825, and 826. Furthermore, Lakeland District is within Tulare Lake Basin Water Storage District.*

After the opening of the old Lakeland Canal to the flood flow of Kings River when in excess of 8000 cu. ft. per sec., as detailed in connection with Corcoran Irrigation District, the owners of lands now in Lakeland Irrigation District began to make plans for permanent development. The petition for the formation of an irrigation district was presented to the board of supervisors of Kings County, April 4, 1921, but was reported on unfavorably by the State Engineer because of insufficiency of water supply. A second petition was presented September 5, 1922, and approved by the State Engineer on the basis of riparian rights on Tulare Lake. The district was finally organized February 2, 1923. The principal objective was participation in the proposed Pine Flat project.

Soils and topography.—The soils of the district are finely divided lake sediment, classified as Sacramento and Tulare clay and clay loam.† The surface is almost an exact plane sloping slightly to the northwest, elevations ranging from 181 to 190 feet. Borrow pits constructed in reclamation work serve as drainage outlets for most of the area, and 9000 acres of the Gates tract have surface drains.

Development.—Most of the area is farmed extensively, the principal crops being grain and cotton. The area irrigated varies from year to year with the water supply, and was 9158 acres in 1927. Aside from three large holdings, containing 8537, 6704, and 3609 acres, the farm average is 156 acres. The total number of holdings is about 20. There are no towns in the district and the total population living on the land is only about 10. The assessed valuation of land within the district for county purposes was $342,488 in 1927, of which $14,728 was for improvements.

Water supply.—The petition for the formation of Lakeland Irrigation District specified that its water supply was to be obtained from Kings and Tule rivers, from Kern River through Buena Vista Slough and Goose Lake Canal, and Packwood Creek, Cameron Creek, Deep Creek, Cross Creek, and Elk Bayou, or pumping from underground or surface sources. The proposed surface water from Tulare Lake is no longer available and the supply from the other sources is entirely dependent upon flood flow. The most important source is or will be

* See page 381.

† U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Middle San Joaquin Valley, California, and Reconnoissance Soil Survey of the Upper San Joaquin Valley, California.

flood flow from Kings River through Lakeland Canal, either by direct diversion when the flow at Piedra exceeds 8000 cu. ft. per sec., or through storage if Pine Flat Reservoir is built. Diversion by the district under the Kings River schedule is usually limited to the months of May, June and July, and without storage there may be no water whatever from this source in dry years. In conjunction with Corcoran Irrigation District, the district has purchased 13.4 per cent of the stock of the Peoples Ditch Company from which they bring water through the Corcoran cross-cut. Lakeland Irrigation District, as yet, has no direct interest in Lakeland Canal water rights, but participates in them through lease of certain rights and properties held by the Lakeland Option Syndicate, for which it pays $25,000 per year. Option to lease these rights and properties was reserved when Lakeland Canal was sold to Corcoran Irrigation District for $300,000, the cost of the rights and properties covered by the option to be $150,000.

Water obtained through shares in Peoples Ditch is of material value, since Peoples Ditch has a priority which permits diversions when the flow of Kings River at Piedra reaches 300 cu. ft. per sec., which means that it receives water under the schedule during each month in the year. A share of stock in Peoples Ditch Company entitles its owner to water for 640 acres. The total amount of water diverted for the joint use of Corcoran and Lakeland irrigation districts through ownership of Peoples Ditch stock since 1923 has varied from 1710 acre-feet, in 1923, to 37,560 acre-feet, in 1927. During the other three years the amounts available, in acre-feet, were 2277, in 1924, 12,802, in 1925, and 11,670, in 1926.

The total amount diverted since 1918 from all sources other than pumping, for the use of the two districts, has varied from 2277 acre-feet, in 1924, to 57,635 acre-feet, in 1927. In three of the ten years the total diversion was between 2277 and 8700 acre-feet; during four years it ranged between 15,180 and 19,987 acre-feet; in the other three years it ranged between 22,408 and 57,635 acre-feet, the latter diversion being in 1927. Heavy seepage losses in the canals between points of diversion and use materially lessen the amounts available to the land. There are five private booster plants along the canals within the district, which in 1927 furnished all the water used on 9158 acres.

Works.—The district owns no major works, but, as already indicated operates under lease of properties and rights from the Lakeland Option Syndicate. The plans of the district include purchase of the rights and properties held under this option. Lakeland Canal down to the south line of section 6, T. 21 S., R. 23 E., is owned by Corcoran Irrigation District; from this point southerly to Tule River it is owned by Lakeland Option Syndicate. Water going through this canal to Lakeland Irrigation District is dropped into the channel of Tule River, in which it is carried to the northern end of the district.

The distribution canals within the district are of large capacity and are owned by private individuals and mutual water companies. The canals leading south from the Tule River channel are deepened below the stream bed to take water by gravity and the water is then pumped over the banks by the individual users. Large-capacity dis-

tribution canals are used in order to utilize the large heads which come in flood periods. If a storage supply is ultimately received from Pine Flat Reservoir, smaller distribution canals can be used, and, in the meantime, the district is postponing taking over or building a distribution system.

Steps are now being taken to eliminate part of the seepage losses by carrying the water from Lakeland Canal across, rather than down, Tule River channel. It can then be taken by a canal to the high point in the southeast corner of the district and distributed by gravity.

The total investment of the district in works and properties to January 1, 1928, was $27,583.71, all of which has been raised by water tolls and district taxes. Of this, $10,890.50 was paid for water stock in Peoples Ditch Company and Settler's Ditch Company, the balance having been used for betterment and minor structures.

Use and delivery of water.—Deliveries of water to the land are measured by rating the pumping plants which lift water from the river channel and from borrow pits. A 'water delivery' is fixed by the board of directors of the district as one-half acre-foot per acre on each parcel of land for which an assessment is paid for the current year. As far as practical, land which did not receive water the preceding year has a prior right of delivery. Payments for the water are required in advance.

Bonds.—The district has no overdue outstanding indebtedness. Other obligations against the land in the district total $492,400. These include a pro rata of Corcoran High School bonds amounting to $5,600, a pro rata of county highway bonds amounting to $4,800, and all of the outstanding bonds in Reclamation District 1618, amounting to $482,000, the latter being against the lands of El Rico Land Company and the Gates estate. The cost of works in other reclamation districts covering portions of the lands of Lakeland Irrigation District has been paid. The original authorized issue of Reclamation District 1618 was $837,185, of which only $712,000 was sold; $230,000 has been retired. These reclamation district bonds carry 6 per cent interest.

Assessments and water tolls.—The district raises money both by district taxes and water tolls. Land is assessed for district purposes at the flat rate of $100 per acre, the total assessed valuation being $2,328,277 for 1927–28. Railroad rights of way are not assessed. The annual tax rate per $100 of valuation during the past five years has varied from $1.55, in 1925–26, to $2.64, in 1923–24. In 1927–28 the rate was $2.52. The total amounts raised by assessments have varied from $39,674, in 1925–26, to $67,820, in 1923–24, the amount of the levy in 1927–28 being $58,611. Water tolls from 1923 to 1927 were at the rate of $0.50 per acre-foot, but for 1927–28 they were raised to $0.75 per acre-foot. For 1928–29, however, the rate was dropped back to $0.50 per acre-foot.

ALPAUGH

Location: southwestern Tulare County, about 7 miles south of Angiola. (Pl. XXVI.)
Date of organization election: March 22, 1915.
Gross area: 8175 acres; **area assessed 1927:** 8104 acres.
Principal town: Alpaugh..
Post office: Alpaugh.
Railroad transportation: branch of Santa Fe railway.

History.—*The area embraced within this district is the principal portion of what was formerly Alpaugh Colony, a land subdivision enterprise started in 1906. Water was developed from a number of flowing wells near Smyrna, 17 miles south of Alpaugh, and carried to the colony in an earthen canal which, because of its low grade, excessive width, and poor condition, lost much of the water before reaching the colony. One mile from Alpaugh a booster pump was installed to lift the water about 7 feet for distribution over the colony lands. About 9000 shares of water stock had been issued, but only about 7000 were in good standing when the district was formed. At that time, 2500 acres was irrigated. Owing to increased draft on the underground waters of the Kern River basin, in which the Smyrna wells are located, the latter ceased to flow, and centrifugal pumping units were installed. When the district was formed the total water supply being obtained from the wells was reported as 900 inches in the winter months, and from 500 to 600 inches in the summer. The pumping units were inefficient and the main canal was badly clogged with cat-tail growth, so that the quantity of water reaching the colony was altogether inadequate.

The first petition to form an irrigation district to take over and rehabilitate the colony water system was circulated in 1912, but was dropped in order to eliminate the town of Alpaugh. A second petition was also dropped, because of opposition, and a third was declared by the board of supervisors to be defective. The final and successful petition carried the signatures of 182 landowners. The organization of the district was finally approved, at a second election, by a vote of 71 to 14.

Soils and topography.—Alpaugh District is situated on an area slightly higher than that immediately surrounding it, this higher area at one time having been known as Atwell's Island. This area was then entirely surrounded by the waters of Tulare Lake, which have since receded as a result of the diversion of the inflowing waters and the reclamation of Tulare Lake bottom. The soil is all lake-formed, and is classified in the soil survey as Tulare sandy loams, sands, and loams.† The land surface is mainly smooth and easily brought under irrigation. Alkali is present in much of the area, but local opinion is that it is not very troublesome, since the soil is said to recover productivity and support good stands of alfalfa after two or three years of heavy irrigation. About 100 acres is reported to contain black alkali. No drainage has been provided and no drainage problem is reported.

Development.—The irrigated area within the district in 1927 was 4085 acres. The land holdings in 1927 numbered 306, of which about 75 per cent were owned by non-residents, the holdings averaging 26

* See also State Dept. of Eng., Bul. 2, 89–91.
† U. S. Dept. of Agr., Bureau of Soils. Reconnoissance Soil Survey of the Upper San Joaquin Valley, California.

acres. The four largest holdings contain 423, 130, 130, and 120 acres. Alpaugh, which is unincorporated and which has a population of about 75, is the only town within the exterior boundaries of the district. The population, exclusive of Alpaugh, is about 500.

Water supply.—The entire water supply of the district is pumped. The original water-bearing land and water rights were purchased from Second Extension Water Company in 1917. The number of wells near Smyrna has been increased to 18, and five additional wells have been put down along the canal near the district. The Smyrna wells are about 1000 feet deep, but the principal supply comes from depths around 600 feet. Water rises at times in these wells to within 10 feet of the surface, but when pumping the draw-down is about 55 feet. All of the wells of the district are now fully developed, so that additional water can only be obtained by the purchase of more water-bearing land and establishment of a right to take water from it to the district.

The eighteen wells at Smyrna have a combined capacity of 40 cu. ft. per sec. All but seven of the pumps installed in these wells are of modern make and have been installed since 1924. The five wells located near the district were drilled in 1917 and 1918; one of these supplies a domestic system which reaches throughout the district. These wells draw down about 50 feet, the water-bearing strata being about 350 feet below the surface.

A considerable part of the water pumped into the canal system is lost by seepage and evaporation before reaching the district, but there are no accurate measurements of this loss. Tests made in 1920 indicated it to be 40 per cent of the quantity pumped into the system. The main supply canal is now kept in better condition and tests in 1926 showed a much smaller loss. During the last five years the district has been delivering from 7000 to 10,000 acre-feet annually.

Each of the 18 wells of the district is equipped with an electrically-driven well turbine. In addition to these, three booster pumps, with capacities of 6, 12, and 20 cu. ft. per sec., lift water 12 feet from the main supply canal to the main high line. The main canal is 17 miles long and unlined, and has a capacity of 40 cu. ft. per sec. The irrigation distribution system has a total length of 55.83 miles. The domestic water system includes 1.5 miles of 8-inch steel pipe leading from the well to a tank, and from this the water is distributed under pressure through 11 miles of 6-inch and 28 miles of 4-inch steel pipe. The district has expended on its combined irrigation and domestic systems to December 31, 1927, a total of $368,603.96, of which $270,208 was covered by bonds and $98,395 from current income. The amount paid for the old Second Extension Water Company system and rights was $83,180.

Use and delivery of water.—Water is delivered to 10-acre units, deliveries being roughly measured in the checks. For some years it has been the practice to sell water to outside lands and the income from these sales has materially helped the district. Water actually delivered in 1926 and 1927, calculated from water-sales records, was as follows: inside of district, 1926, 7068 acre-feet; 1927, 4503 acre-feet; outside of district, 1926, 2460 acre-feet; 1927, 2750 acre-feet. The area irrigated inside of the district in 1927 was 4085 acres, and outside, 4000. A

large percentage of the district is in grain and cotton. The lack of intensive farming is due in part to the large number of absentee landowners.

Irrigation water is delivered on a rotation system inside of the district. Written orders for water are required in advance, delivery being made in 'heads' of 4 cu. ft. per sec. Pumping costs constitute the principal item in operation.

Bonds.—The district has put out but one bond issue. This was for $283,000. It bears 6 per cent interest and is dated July 1, 1916. The entire issue was sold December 15, 1917. Of these bonds, $5,660 were retired to January 1, 1928, leaving $277,340 outstanding, these having maturities from 1928 to 1946.

A proposed second issue of $300,000 approved by the Bond Certification Commission failed of passage by a vote of 40 to 27 at a special election January 10, 1921. This issue was intended to be used for replacing the large uneconomical main canal from the Smyrna wells with a more economical lined conduit, for improving and extending the well and pumping equipment, renovating the distribution system, and retiring outstanding construction warrants. The cost of works purchased and of those added later has exceeded the funds available, and the net income from assessments and water tolls has never been sufficient to catch up on outstanding warrants.

Bonds against lands in the district, other than those of the district, are estimated at $8,300, of which $1,150 are high school and $7,150 are county bonds. About 820 acres in the district west of Homeland Canal is in Tulare Lake Basin Water Storage District.

Assessments and water tolls.—Lands are graded into four classes in levying assessments for district purposes, viz: 'deep silt,' assessed at $60 per acre; 'shallow silt,' assessed at $50 per acre; and 'clay' and 'poor,' assessed at $40 per acre. The total assessed valuation for 1927–28 was $395,826, which does not include land deeded to the district for delinquent assessments. The levy for that year was $39,582. In each of the past four years the district assessment rate per each $100 of valuation has been $10; in 1923–24, it was $15.

Water tolls are also levied by Alpaugh District. Inside of the district the toll rate is $1 per 'head' of 4 cu. ft. per sec. per hour, or at the rate of $3 per acre-foot. Outside the district the toll is $4.50 per acre-foot. The domestic rate outside of Alpaugh is $1.50 per month minimum, with allowance up to 4000 gallons, and a charge of $0.10 per 1000 gallons above 4000. The district sells water to consumers in the town of Alpaugh, the minimum charge being $2.50 per month, with an allowance of 4000 gallons and a charge of $0.15 per 1000 gallons in excess of 4000. The distribution system in Alpaugh is not owned by the district. The amounts collected from both inside and outside of the district during the last four years have ranged between $25,682 and $44,073, under the irrigation rate, and from $2,187 to $3,272, under the domestic rate. The amount collected from water tolls on outside lands in 1927 was $12,389.

Present outlook.—Writing under date of March 28, 1928, the secretary of the district states that the capital outlay is about finished and that by increasing outside water sales and keeping down overhead expenses, the district should be able to meet bond interest and principal as payments come due. He states that there seems to be no limit

to the quantity of water that can be sold outside of the district, and that in the fall of 1927 and the spring of 1928 they had applications for water for 5000 acres in excess of the supply available. On March 28 the district had reduced its outstanding warrants from $45,175.24 on January 1, 1928, to $36,244.77. Warrants issued in 1927 were $10,000 less than in 1926 and there will be a further decrease in 1928. Outside water sales in 1928 are expected to double those in 1927.

PALMDALE

Location: on the southern edge of Antelope Valley, in Los Angeles County. (Pl. XXVIII.)
Date of organization election: July 9, 1918.
Gross area: 4756 acres; **area assessed 1927:** 4698 acres.
Principal town: Palmdale.
Post office: Palmdale.
Railroad transportation: main line of Southern Pacific railroad.

History.—The organization of the present Palmdale Irrigation District was not the first effort to establish an irrigation project about Palmdale. Although not the first settlement, there was activity and development during the relatively wet series of years 1887 to 1889. Alternate sections were held by Southern Pacific railroad, but otherwise the area surrounding Palmdale was generally in 160-acre tracts, with a number of 10 to 40-acre tracts immediately about Palmdale. Deciduous fruits and alfalfa were planted and it is reported that several hundred acres was being irrigated. A local irrigation company was in existence.

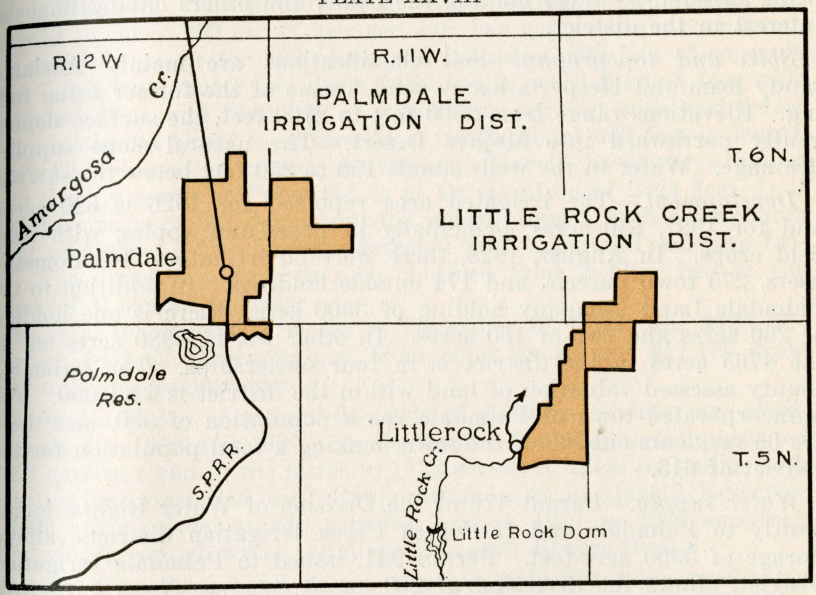
On February 2, 1890, an irrigation district, known also as Palmdale Irrigation District, was formed under the original Wright act. It contained approximately 50,000 acres, including a considerable amount of government land. It was proposed to bring water from Littlerock Creek and store it in Harold Reservoir directly south of Palmdale. Some preliminary work was done and bonds in the amount of $175,000 were voted, but before the enterprise really started, opposition landowners and a rival irrigation company brought about dissolution of the district on the ground that the petition for formation had not been signed by the required number of freeholders. The decision of the lower court holding the district organization void was sustained by the supreme court.*

In 1895, South Antelope Valley Land Company was organized with the intention of developing a plan similar to that of the irrigation district. The efforts of this company were not successful, for beginning with the season of 1894 there was an eleven-year period of low rainfall, during which very little water for irrigation was available. In 1912 the properties, including water rights and 3000 acres of land near Palmdale, were acquired by Palmdale Water Company. The experience of this company added further proof, if such proof were needed, that storage with a considerable carryover capacity would be required to accomplish the purposes in mind. In order to provide a means for financing this storage, Palmdale Irrigation Company, in 1918, brought about the organization of the present district.

* *Palmdale Irrigation District* vs. *Erdman Rathke et al.*, 91 Cal. 538.

About the time the original Palmdale Irrigation District was formed, Littlerock Creek Irrigation District, covering lands a few miles east, was also organized,* and had acquired rights to water from Littlerock Creek. It had, however, constructed no storage. A storage basin existed on the creek and Palmdale and Littlerock Creek irrigation districts, on May 2, 1922, entered into an agreement for the joint construction of a storage dam. It was proposed to develop a storage capacity of 6000 acre-feet. The plan was approved by the Bond Certification Commission, and bonds in the amount of $382,000 were voted to pay for the Palmdale District share of the cost, as well as to provide funds for enlarging and lining the main canal leading to Palmdale District, for increasing the capacity of Harold Reservoir, and for extending the Palmdale distribution system. A change in the first design of the multiple-arch dam which it was proposed to construct was required, this necessitating an additional bond issue of $63,000 by Palmdale District. Later, after the overburden at the dam site had been stripped, an unexpected depression in the bedrock was found. As a result of this and the extra expense previously mentioned, the final cost of the structure was $467,108, divided equally between Palmdale and Littlerock Creek districts. This amounted to approximately $85 for each acre-foot of storage capacity.

PLATE XXVIII



Location and boundary map of Palmdale and Littlerock Creek irrigation districts, Los Angeles County.

Littlerock Dam, as the structure is called, was completed in June, 1924. Unfortunately, the next two years constituted a period of low rainfall, and no water of consequence entered the reservoir until the spring of 1926, when it was filled within 36 hours.

Prior to beginning construction on Littlerock Dam, Palmdale Irrigation District purchased the system of Palmdale Water Company for

* See statement regarding Littlerock Creek Irrigation District below.

$33,000 in district bonds at par. The works purchased included a small diversion dam and reservoir on Littlerock Creek, a main canal leading from Littlerock Creek, and Harold Reservoir.

During the period of drought following completion of Littlerock Dam, the district undertook to develop an auxiliary underground supply. Four wells were drilled in 1925. The yield was not large, and, with the exception of one used for a time for domestic supply, they have not been equipped for pumping.

The district has not yet been able to complete the excavation and lining of the main canal leading from Littlerock Creek to Harold Reservoir, or to extend the distribution system in the district. A third bond issue of $100,000 was voted in December, 1924, but no bids were received and the issue has not been sold.

Owing to the water shortage resulting from the dry period and from the insufficient capacity of the main canal, and to other causes, the district did not meet its bond interest due January 1, 1926, and has continued to default interest payments since then. This was brought about largely by the failure of the largest land company, which owns 3300 acres, to pay its district assessments. An attempt is being made to bring about such reorganization of the district and of the land company as will clear up the present financial difficulties. This is being fostered by those holding the bonds and others having financial interest in the district.

Soils and topography.—Soil classifications are mainly Adelanto sandy loam and Hesperia loamy sand,* some of the former being rolling. Elevations range from 2500 feet to 2700 feet, the surface sloping gently northward into Mojave Desert. The natural slope supplies drainage. Water in the wells stands 150 to 250 feet below the surface.

Development.—The irrigated area reported for 1926 is 620 acres, and for 1927, 640 acres, principally in pears and apples, with some field crops. In August, 1928, there were 50 irrigators, 165 domestic users, 275 town parcels, and 174 outside holdings. In addition to the Palmdale Land Company holding of 3300 acres, there is one holding of 260 acres and two of 160 acres. In other words, 3880 acres out of the 4765 acres in the district is in four ownerships. The estimated county assessed valuation of land within the district is $200,000. The unincorporated town of Palmdale has a population of 550, and there are 65 residents outside of the town, making a total population for the district of 615.

Water supply.—Permit 476 of the Division of Water Rights, issued jointly to Palmdale and Littlerock Creek irrigation districts, allows storage of 5500 acre-feet. Permit 941, issued to Palmdale Irrigation District, allows the diversion of 250 cu. ft. per sec. from Littlerock Creek to fill Harold Reservoir. Prior to construction of Littlerock Dam, Palmdale and Littlerock Creek districts entered into an agreement under which each is entitled to half the capacity of Littlerock Reservoir. Littlerock Creek District has exclusive right to the flow of 13 cu. ft. per sec., measured at the point of inflow into the reservoir, and all flood waters of the creek in excess of 13 cu. ft. per sec. are divided on the basis of one-fourth to Littlerock Creek and three-fourths

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Lancaster Area, California.

to Palmdale District. Harold Reservoir, owned by Palmdale District, has a capacity of 7000 acre-feet.

The present diversion capacity of the canal from Littlerock Creek to Harold Reservoir is about 60 cu. ft. per sec. For the four years next prior to 1928, the total amount of water diverted by the district, in acre-feet, was as follows: 1924, 400; 1925, 100; 1926, 3500; 1927, 3000.

As previously indicated, the district has drilled four wells, but none of these are now being used. One yielded 8 miners inches, and was used in 1924 for domestic service.

Works.—The works of the district consist of a half interest in Littlerock Reservoir, 8 miles of diversion canal leading to Harold Reservoir, and a distribution system of concrete pipe and ditches carrying water to each 40 acres within the district. The irrigation laterals aggregate 12 miles in length, with diameters ranging from 10 to 20 inches. The domestic system includes 2 miles of 6-inch riveted steel pipe and 5.5 miles of 3-inch and 1 mile of 2-inch standard iron pipe.

Littlerock Dam is a multiple-arch structure having a height of 164 feet above foundation. An important feature of the structure is 16 siphon spillways with dimensions of 5.25 feet by 10 feet, and with total capacity of 14,300 cu. ft. per sec. The elevation on the spillway crest is 3260 feet. The main diversion canal leading to the district was designed to carry 200 cu. ft. per sec. but has not yet been completed. It is unlined, except for 3000 feet, and includes 1500 feet of concrete flume 7 feet wide and 5 feet deep, 2424 feet of wood flume 8 feet wide and 5 feet deep, and 2640 feet of wood flume 4.5 feet wide and 3 feet deep. Littlerock Creek is crossed by a trestle about 600 feet in length with a 60-foot steel span over the stream. Harold Reservoir, situated about 2 miles south of Palmdale, is at an elevation of 2824 feet. It is formed by an earth-fill dam about 0.5 mile in length with a maximum height of 40 feet. The dam is protected with a gunited concrete facing. The domestic supply is now obtained from a filter bed at the bottom of Harold Reservoir.

The total investment in works to December 31, 1927, was $428,785, of which $411,625 was obtained from bond issues and $17,160 from water tolls and assessments.

Use and delivery of water.—Records of delivery of water are available only for 1926 and 1927. In the former year deliveries amounted to 603 acre-feet and in the latter to 1133 acre-feet, these including both irrigation and domestic use. Evaporation losses in Harold Reservoir in 1926 are recorded as 440 acre-feet and in 1927 as 1520 acre-feet. As previously stated, water is delivered to each 40-acre tract.

Bonds.—The three bond issues, totaling $545,000, have previously been referred to. The first issue of $382,000 is dated January 16, 1920, and has maturities from 1941 to 1960. The second of $63,000 is dated May 1, 1921, and has maturities from 1933 to 1942. The third of $100,000, not yet sold, is dated June 1, 1925, and has maturities from 1941 to 1960. Defaults in interest payments on the bonds amounted to $66,750 on January 1, 1928. According to latest advices, it is not intended to sell the third bond issue, it being stated that if delinquent taxes are paid up, the district will have sufficient funds to improve the diversion canal. The total unredeemed tax-sale certificates December

31, 1927, amounted to $58,358.83. These do not include delinquencies for 1926, for which year no tax sales were made owing to the failure of the directors to pass the proper resolution when the tax levy was made. In that year a total district assessed valuation of $354,088.23 escaped taxation as a result of this failure. This, however, was added to the assessments for 1926–27.

The estimated bond obligations other than irrigation district bonds total $54,600; $400 are general county bonds, $48,300 are highway bonds, $3,100 are Palmdale elementary school bonds, and $2,800 are Antelope Valley Union High School bonds.

Assessments and water tolls.—Land is valued for purposes of district assessment at $100 per acre and town lots 25 feet by 125 feet at $40 each. For each year from 1921–22 to 1925–26, the total assessed valuation in the district was $477,514. For 1926–27, owing to the carryover from 1925–26, the total was raised to $827,410; in 1927–28 it was $479,812. The annual assessment rate for each $100 valuation was $7.75 for each of the years 1922–23 to 1925–26, and for 1926–27 and 1927–28 it has been $9.25. The total assessment levy in 1927–28 was $44,382. No water tolls are charged, except for domestic connections. The rate for each connection, per month, inside the town of Palmdale is $3 and outside is $3.25. The total domestic water tolls collected in 1927 was $3,914.

LITTLEROCK CREEK

Location: along southern edge of Antelope Valley, southeast of Palmdale, in Los Angeles County. (Pl. XXVIII.)
Date of organization election: March 19, 1892.
Gross area: 3073 acres; **area assessed 1926:** 3040 acres.
Principal town: none.
Post office: Littlerock.
Railroad transportation: main line of Southern Pacific railroad nine miles west at Palmdale.

History.—This is the sole surviving district of six districts organized in the southern and western portion of Mojave Desert under the original Wright act between 1890 and 1895.* The early history of these districts is given in another publication.†

The principal development work in this district since it was financially reorganized subsequent to 1910 has been the improvement of its distribution system and the construction of Littlerock Dam jointly with Palmdale Irrigation District. An agreement with Palmdale District regarding the construction of this dam was made in 1919. The joint storage plan was approved by the Bond Certification Commission November 29, 1919, and in January, 1920, a $200,000 bond bond issues by Littlerock Creek District of $48,000 and $60,000, issue was voted to carry out the Littlerock Creek District portion of plans and unexpected construction costs necessitated two additional June, 1922, and was completed in the spring of 1924. Changes in the contract for the construction. Work on the dam commenced in respectively.

* The others were Neenach, Amargosa, Palmdale, Manzana, and Big Rock Creek.
† State Dept of Eng., Bul. 2, 10, 37-38, 91-93. See also statement regarding Palmdale Irrigation District above.

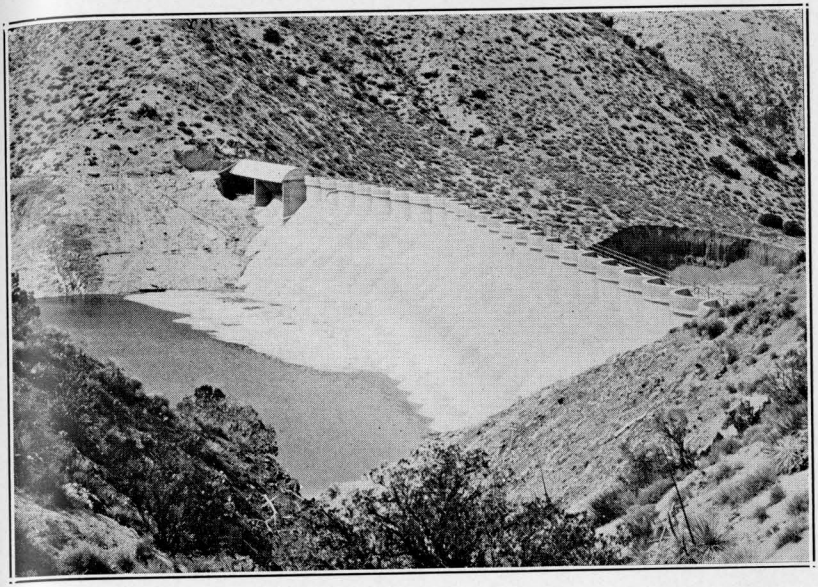


FIG. 1. Littlerock Dam, Littlerock Creek and Palmdale irrigation districts.

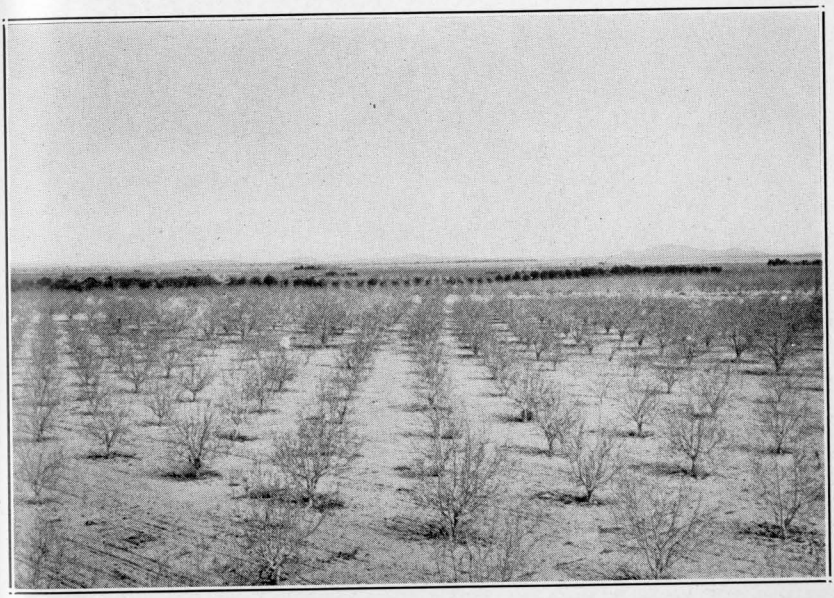


FIG. 2. Across Littlerock Creek Irrigation District from Littlerock.

During the dry period following the completion of the dam development within the district was retarded and some of the large unimproved holdings went delinquent in their assessments. In spite of this handicap, however, the district has been able to meet its payments on bond interest and principal. Steps are now being taken to bring about redemption of delinquent lands. For the years 1919 to 1924, the delinquent assessments on the largest land holding totaled $52,820.52, including interest to August 20, 1925. On August 11, 1925, an agreement was entered into with the representative of this company that if the district made certain improvements this land would be redeemed. On September 1, 1928, a balance of $11,285.49 on account of this agreement was still due. Other assessments on this land went delinquent in 1925, 1926, and 1927. The adjustment of these assessments is part of the present reorganization plan under way.

Soils and topography.—Soils are classified mainly as Cajon sandy loams and loamy sands and Hesperia sandy loam.* The area comprises a gently sloping alluvial fan lying east of Littlerock Creek. The average elevation is about 2800 feet. No drainage has been found necessary.

Development.—Practically the entire 2000 acres planted and irrigated is in Bartlett pears. There are 85 holdings averaging about 32 acres. There is one large holding, however, of 1000 acres, another of 160 acres, and a third of 80 acres. Eliminating the 1000-acre holding, the average is about 20 acres. The assessed value of land for county purposes is about $125,000, the improved land being taken at about $50 per acre and the unimproved land at about $25 per acre. The estimated population within the district is 250. Good paved highways connect the district with Los Angeles by way of Mint Canyon and San Fernando Valley.

Water supply.—Water rights of the district date back to the nineties and came to the district from Alpine Springs Land and Water Company by conveyance June 1, 1894. In order to safeguard its rights the district later brought suit against Palmdale Water Company. By stipulation entered in this suit, Littlerock Creek District is entitled to the first 13 cu. ft. per sec. flow in Littlerock Creek, measured at point of inflow into Littlerock Reservoir. The natural flow above that amount is shared in the proportion of one-quarter for Littlerock Creek District and three-quarters for Palmdale District. The districts share equally in the storage in Littlerock Reservoir, the total capacity being 5500 acre-feet. Studies of the water supply for the 27-year period ending in 1922 indicate that about 4000 acre-feet has been available in 24 of the 27 years. However, there was a deficiency both in 1924 and in 1925. The estimated diversion for 1926 amounted to 4200 acre-feet, and in 1927, 5500 acre-feet. Storage rights on Littlerock Creek are covered by permit 476, with a priority of February 7, 1918, issued by the Division of Water Rights jointly to Littlerock Creek and Palmdale districts.

Works.—Littlerock Dam, the principal feature of the works of Littlerock Creek District, is described above in connection with Palmdale District.

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Lancaster Area, California.

The district operates 3.5 miles of lined main canal with a capacity of 13 cu. ft. per sec., 1 mile of 18-inch and 1 mile of 20-inch main concrete pipes, and 19.5 miles of concrete lateral pipe lines 8 inches to 12 inches in diameter. A domestic system is also operated, including 3 miles of 8-inch concrete pipe and 11.5 miles of steel pipe 2 inches to 6 inches in diameter. There is a distribution reservoir with a capacity of 2.5 acre-feet. A domestic supply is obtained through a separate pipe line heading in the cienega in the creek bed about one mile below Littlerock Dam. Three wells were drilled in 1926, but these have not been equipped for pumping. Two pumping plants were installed in the cienega above the district several years ago, and there is also a small booster pump. These are used only in dry seasons and were not operated in 1927 or in 1928. Four private pumping plants within the district serve an estimated area of 370 acres, although only a small acreage receives a full supply from this source. No records are available as to the amounts of water delivered to users.

The total investment in works to December 31, 1927, was $387,157, of which $362,143 was obtained from bond issues, $3,014 from special assessments, and $12,000 from general assessments.

Use and delivery of water.—No information is available as to the amount of water delivered to irrigators. Deliveries are not measured.

Bonds.—Shortly after organization in 1892, the district issued bonds in the amount of $88,000. These were later refunded with $25,000 of an issue of $60,000 voted in 1910, the remainder being used for working over the irrigation system. These bonds bear interest at 5 per cent and have maturities from 1935 to 1954. The fourth issue was for $200,000, with maturities from 1941 to 1960, the fifth for $48,000, with maturities from 1925 to 1942, and the sixth for $60,000, with maturities from 1941 to 1960. All of the last three issues bear 6 per cent interest. Bonds retired to January 1, 1928, amounted to $6,000, leaving $362,000 outstanding. Bond retirements commenced January 1, 1925, and are being made at the rate of $2,000 per year. Other bonds against lands in the district are estimated at $32,400, of which $560 are Los Angeles County flood-control bonds, $29,800 highway bonds, $1,800 school bonds, and $240 other county bonds.

Assessments and water tolls.—Since 1916 the district has valued land for assessment purposes at the flat rate of $100 per acre, the total district assessed valuation in 1927–28 being $310,462. From the years 1922–23 to 1925–26, the annual assessment rate for each $100 of valuation was $8.75; for 1926–27 and 1927–28, it has been $9.50. The total amount of the levy in 1927–28 was $29,500. No water tolls are charged.

MOJAVE RIVER

Location: east of Mojave River and south and east of Victorville, in San Bernardino County. (Pl. XXX.)
Date of organization election: April 9, 1917.
Gross area: 27,665 acres; **area assessed 1927:** 27,665 acres.
Principal town: none; **nearest town:** Victorville.
Post office: Victorville.
Railroad transportation: main line of Santa Fe railway.

History.—The early history of attempts to irrigate and settle lands along Mojave River north of the Sierra Madre is very fully given in a

report on the Utilization of Mojave River for Irrigation in Victor Valley.* More recent activity began in 1913 when settlers and landentrymen on both sides of Mojave River formed Victor Valley Mutual Water and Power District Association in the hope of obtaining government aid in a reclamation project. Efforts to do this were unsuccessful.

After passage by Congress of the 'Smith Act,' which made possible the inclusion of government lands in irrigation districts organized under state laws, petitions were presented to the supervisors of San Bernardino County for the organization of Mojave River Irrigation District, on November 20, 1916, and Victory Valley Irrigation District, on May 28, 1917. Because of uncertainty as to the feasibility of the projects, action by the supervisors was delayed, and a commission was organized to make a thorough study of the water supply and its utilization.

This commission found a total average annual discharge in Mojave River of approximately 90,000 acre-feet and suggested the use of the water supply on two projects—one for the west mesa of 18,400 acres, and an ultimate project of 29,000 acres; another on the east mesa with a total area of 23,000 acres. This report was filed April 3, 1918.

Prior to the filing of this report the promoters of both districts took advantage of the provision of the irrigation district act allowing proposed districts reported on unfavorably by the state engineer to organize on a second petition signed by three-fourths of the landowners, and the formation of both of these districts was completed.

Victor Valley Irrigation District has not been active for some time, but Mojave River District has worked out a plan of construction and has been seeking to establish its rights to water. A bond issue of $5,600,000 was voted May 3, 1920, without the approval of the Bond Certification Commission. On August 31, 1922, however, the Bond Certification Commission approved a request of the district to issue $25,000 in bonds for conducting surveys, and on February 11, 1924, after the filing of revised construction plans calling for the expenditure of $2,175,025, the Bond Certification Commission reported for certification the remaining $2,150,025 required by the estimate. The district has been unable to dispose of any of these bonds, either for cash or through contractors, and no part of the project has been built.

During the eleven-year period since Mojave River Irrigation District was formed, with the exception of the first year, district assessments have been regularly levied, but difficulty has been experienced in collecting them. There has been litigation with riparian owners along the river below the point of proposed storage, and because of this litigation it has been possible to keep alive the district water filing with the state Division of Water Rights, and also to keep alive its reservoir right-of-way filing with the government.

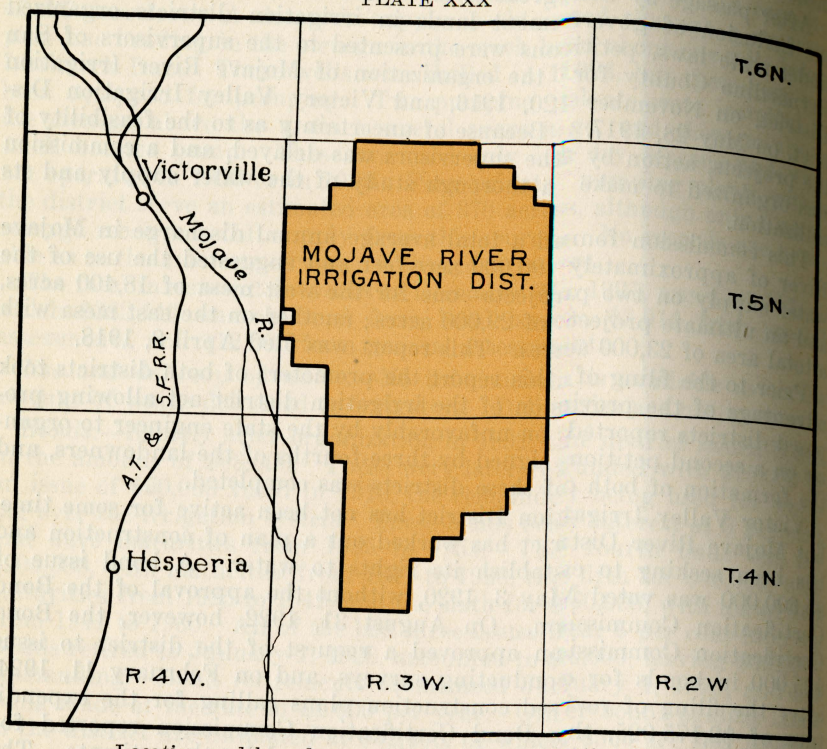
Soils and topography.—The district comprises a desert mesa extending from the base of the Sierra Madre northerly for about 10 miles. The soils are classified mainly as Hesperia loamy sand, Adelanto sandy loam, Adelanto sand, Cajon coarse sand, and Adelanto gravelly sandy loam.† In composition the soils are relatively uniform, varying mainly

* State Dept. of Eng., Bul. 5, 12-30. Report on the Utilization of Mojave River for Irrigation in Victor Valley, California, by Mojave River Commission. (Reprinted in 6th Biennial Report of the California State Dept. of Eng., 1916-18.)

† U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Victorville Area, California.

in their proportion of sand and clay. They have the usual organic-matter deficiency of desert soils. Elevations range from 3100 feet down to 2900 feet, with a slope toward the northwest. Ground water stands at about the elevation of Mojave River. General drainage is provided by the natural slope of the land.

PLATE XXX



Location and boundary map of Mojave Irrigation District, San Bernardino County.

Development.—Little progress has been made in development since the district was organized. Except for scattered areas, totaling about 1000 acres, irrigated by 35 pumping plants lifting from private wells, the region still remains in its native desert state, with a sparse covering of brush and giant yucca. The lift of existing wells varies from 75 to 260 feet. Most of the planted area is in orchards in small tracts. The largest land holding is that of Southern Pacific Land Company, which controls 7128 acres in odd-numbered sections in the northern part of the district. The next largest holding is 1030 acres. The total number of holdings is given as 150, and the estimated population as 100. The estimated county assessed valuation in 1927–28 was $150,000, including real estate and improvements.

Water supply.—On August 21, 1916, those promoting Mojave River Irrigation District filed application 439 with the Division of Water Rights, seeking appropriations from West Fork and Deep Creek, tributaries of Mojave River. Permit 2298 was granted October 28, 1925, allowing the storage and diversion of 30,000 acre-feet annually at the

Forks reservoir site. As previously indicated, this permit has been kept in good standing by extensions granted by the Division of Water Rights. According to the engineer who has prepared the plans for the district, the average seasonal flow of West Fork of Mojave River is 36,783 acre-feet. In the 23-year period which was studied, 30,000 acre-feet could have been supplied in 17 years, with a deficiency of 5 per cent in 3 years, and of 50 per cent in 3 years.

Works.—The revised plan of works provides for the construction of a masonry dam on West Fork of Mojave River near its junction with Deep Creek. At this point it is proposed to construct a constant-angle arched structure about 150 feet high above streambed. In addition, an auxiliary earth-fill dam about 50 feet high will be required. The reservoir is to have a total capacity of 85,000 acre-feet. This will equate the flow to give 30,000 acre-feet annually. The reservoir outlet is to be placed 50 feet above streambed, in order to increase the area that can be reached by gravity. Even then, 3,000 acres will require a 46-foot lift and 2800 acres about a 120-foot lift. Water is to be conveyed from the reservoir to the southeasterly corner of the district by a conduit 6.25 miles in length. Mojave River will be crossed by a steel siphon 33 inches in diameter. The distribution system is to reach each 40 acres.

The items of estimated cost of this proposed plan of works are as follows: payment to Arrowhead Lake Company for West Fork Reservoir, $250,000; real estate, rights of way and water rights, $100,000; construction of West Fork Dam, $596,158; main canal and distribution system, $1,018,867; interest for three years, $300,000; total, $2,175,025.

Bonds.—Data relative to bond issues have already been given, these indicating that $5,600,000 were voted May 3, 1920, and that $2,175,000 have been reported favorably by the Bond Certification Commission. None have been sold. The other bonds prorated to lands in the district are estimated at $16,400, as follows: general county bonds, $3,500; elementary school bonds, $12,700; union high school bonds, $200.

Assessments and water tolls.—Most of the land in the district is valued for district assessment at $20 per acre, a small portion being valued at $15. The total district assessed valuation for each of the last nine years has been $539,327. The assessment rate in 1918–19 was $3.20 per $100 valuation; in 1919–20, $1.75; from 1920–21 to 1922–23, $1.80; in 1923–24, $1.50; in 1924–25 and from 1925–26 to 1927–28, $1.00. The total levy in 1927–28 was $5,393.

LA CANADA

Location: 5 miles north of Glendale, in Los Angeles County. (Pl. XXXII.)
Date of organization election: April 5, 1924.
Gross area: 1294 acres; **area assessed 1927:** 1239 acres.
Principal town: none; **nearest town:** La Canada.
Post office: La Canada.
Railroad transportation: Glendale and Montrose railway.

History.—This district covers a suburban area overlooking Pasadena in which development was initiated subsequent to 1882 by two purchasers of a portion of Rancho la Canada, within the original boundaries of which the district is situated. Water was developed in

nearby canyons and piped to their lands, a proportionate interest in the supply being sold with the land. In 1902 La Canada Water Company was formed to take over the water distribution system and 3600 shares of stock were issued with a par value of $10 each. The company developed the supply in Pickens Canyon and ran several tunnels to increase the summer flow. Water shortages continued to occur, these shortages finally leading a group holding about one-third of the water stock to form Valley Water Company which developed a supplemental supply for their holdings through the drilling of several wells.

The demand for water grew as settlement increased, but La Canada Water Company was not in a position to finance new water development or needed pipe line extensions. In 1923, following a study by a group of citizens and an engineering investigation and report, decision was reached to form an irrigation district that would include the lands of most of the shareholders in La Canada Water Company other than those interested in Valley Water Company. A petition presented to the board of supervisors of Los Angeles County May 7, 1923, received a favorable report by the state engineer February 19, 1924, organization carrying unanimously by vote taken April 5.

The district did not immediately proceed to acquire an irrigation system, instead entering into a lease contract by which it took over the La Canada Water Company distribution system for a 10-year period, agreeing to keep this system in repair. The water company was to maintain the collecting pipe system in Pickens Canyon and deliver water to a reservoir from which it would be purchased by the district at $0.075 per 100 cu. ft. and then be distributed by the district.

In July, 1925, the district issued bonds in the amount of $154,000 for increasing the water supply and extending the distribution system. A well near the southeast corner of the district yielding 80.5 inches was developed and a second well was drilled near the northwestern extremity of the district to increase the supply for the west-side area. Rights to the yield of two tunnels in Snover Canyon, together with 40 acres of land, were purchased and an agreement was made for the use of surplus water developed in Hall and Beckley canyons by Alta Canada Corporation.

A second bond issue, of $174,000, was unanimously authorized June 16, 1928. The district has used part of the proceeds of these bonds to buy up additional stock of La Canada Water Company, of which it now owns 3543.5 of the 3600 shares issued. Thus the district now controls most of the water from Pickens Canyon, only 13 shares of the stock of La Canada Water Company now being held by parties outside of the present boundaries.

Soils and topography.—The district lies in two watersheds, the easterly and westerly slopes containing 559 and 680 acres, respectively. The soils are light and porous and are classified mainly as Hanford gravelly sandy loam and Ramona loam.* Elevations range from 1350 to 1825 feet. No artificial drainage has been found necessary.

Development.—About half of the district is settled, the remainder being held for speculation. About 700 acres is developed primarily for suburban homes. There are, however, several small citrus and avocado groves and vineyards, estimated to cover about 400 acres,

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Pasadena Area, California.

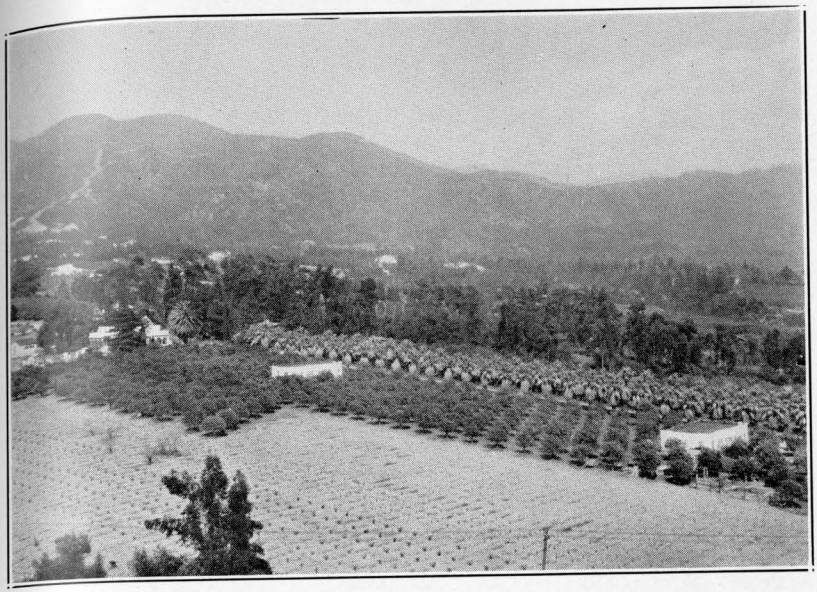


FIG. 1. Central portion of La Canada Irrigation District.

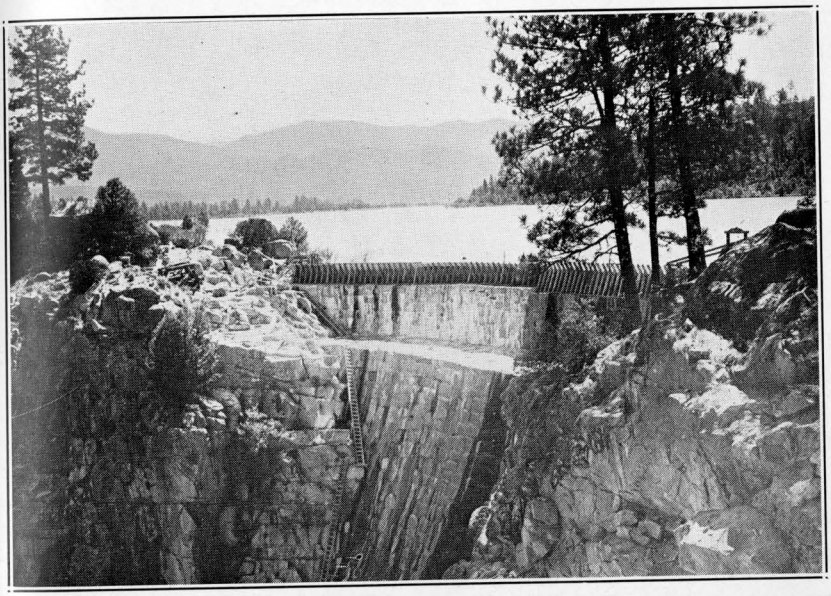


FIG. 2. Hemet Dam and Reservoir, principal source of water for lands in recently organized Hemet Irrigation District.

scattered throughout the district. The assessment roll for 1927–28 showed 492 holdings, averaging 2.5 acres. One holding contains 180 acres, the remainder ranging from 20 acres down. The estimated population is 700. The estimated assessed value of real estate in the district on the county assessment roll is $1,372,750. Transportation to surrounding cities is furnished by well-paved highways.

Water supply—As indicated under "History," the water supply comes from Pickens, Snover, Hall, and Beckley canyons and from wells. The supply from Pickens and Snover canyons has ranged over a period of years between four million and nine million cu. ft., the average flow being about 10 miners inches. During the summer months the Pickens Canyon tunnels yield about 8 inches, the Snover tunnels 0.76 inch, the Hall and Beckley tunnels about 1.80 inches, and Well No. 2 about 2 inches—a total of 12.56 for the west-side area. This supply, with the 80.5 inches from Well No. 1, gives a total average supply of about 93 inches. Four private pumping plants irrigate approximately 10 acres each. The ultimate total water requirement of the district is estimated at 2500 acre-feet, the present developed supply being about 45 per cent deficient for the ultimate area.

Works.—Well No. 1 is equipped with a centrifugal pump operated by a 40 h. p. electric motor and Well No. 2 by a double-acting plunger pump, with cylinder 6 inches by 110 inches, operated by a 10 h.p. electric motor. Three booster plants are used, one a 4-inch 2-stage centrifugal, operated by a 60 h.p. motor; one a 4-inch 5-stage centrifugal, also operated by a 60-h.p. motor; and the third by a 2-inch split-case centrifugal direct-connected to a 25 h.p. motor. There are four reservoirs owned by the district—No. 4, 180,000 gallons; No. 7, 1,000,000 gallons; No. 8, 185,000 gallons; and Seright, 200,000 gallons. Pipe lines have been laid as follows: 8-inch, 6421 feet; 6-inch, 16,112 feet; 4-inch, 28,236 feet. Besides the Snover Canyon tunnels and water rights and the 40 acres acquired when they were purchased, eight lots outside and four lots inside the district boundaries are now owned by the district. Of the 3600 shares in La Canada Water Company, 3543.5 shares, as previously indicated, are held by the district.

The constructed works and related rights and properties purchased by the district have cost approximately $115,300. The total investment from proceeds of the first bond issue to December 31, 1927, was $154,000.

Use and delivery of water.—A skeleton pipe line over the entire district delivers water to each 5 acres. Deliveries are measured through displacement meters. Deliveries to consumers from all sources during 1926 and 1927 have been as follows: March 1 to December 31, 1926, 7,887,376 cu. ft.; January 1 to December 31, 1927, 8,140,100 cu. ft. During winter months but little water is used and the gravity flow is distributed over the entire district.

Bonds.—The first bond issue, of $154,000, is dated July 1, 1925, bears interest at 5 per cent, and matures from 1936 to 1960. The second, of $174,000, is dated July 1, 1928, also bears interest at 5 per cent, and matures from 1949 to 1968. The estimated pro rata of other bonds against lands in the district is $21,800 divided as follows: general county, $2,700; Los Angeles County Flood Control District, $6,200; special road issues, $3,500; school, $9,400.

Assessments and water tolls.—Accurate maps for district assessment purposes have been used beginning with 1927. At present all acreage is valued for district assessments at $1,000 per acre and land subdivided into lots at $1,500 per acre. The total district assessed valuation for 1927–28 was $1,366,355. The assessment rate for each $100 of valuation for the past four years has been as follows: 1924–25 and 1925–26, $0.61; 1926–27, $1.35; 1927–28, $1.25. In 1927–28 the total levy was $17,080.

A water toll is charged for both irrigation and domestic service, in addition to the assessments. The rate is $2 per month per 800 cu. ft. or less and $0.10 for each additional 100 cu. ft.

In the contract under which the district purchased the site at Well No. 1, which is outside of the district, there is a stipulation that 42 acres adjoining the site will be served with water at the rates charged within the district, not including district assessments.

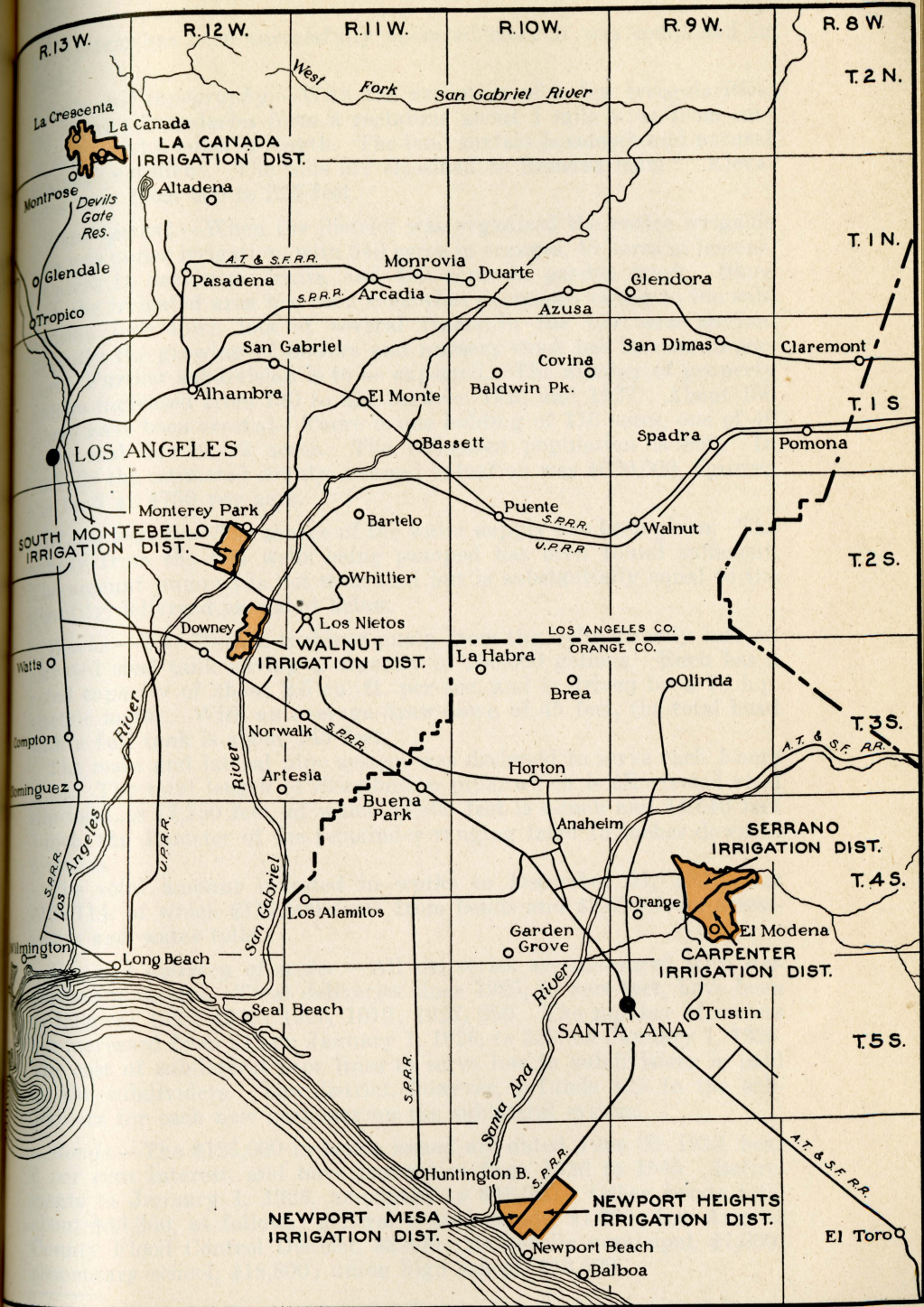
SOUTH MONTEBELLO

Location: within the town of Montebello, in Los Angeles County. (Pl. XXXII.)
Date of organization election: November 14, 1922.
Gross area: 901 acres; **area assessed 1927:** 828.54 acres.
Post office: Montebello.
Railroad transportation: Union Pacific and Santa Fe railroads.

History.—This small district occupies a unique position among irrigation districts in that it is located entirely within an incorporated city. When organized, however, the area lay largely outside of the residential portion of the city, and agriculture is still of primary importance. The land was subdivided in 1905 and four shares of Carmel Water Company were issued with and made appurtenant to each acre of land sold. Water was pumped by Carmel Water Company from wells east of Rio Hondo, a tributary of Los Angeles River, the bluff above the west bank of the Rio Hondo forming the east boundary of the district. Owing to repeated damage by floods in the Rio Hondo to the pipe line leading from the wells to the subdivision, the water company, in 1921, drilled four wells on the west side of that channel. At the same time the irrigation district was promoted to finance the construction of a new pumping plant and distribution system. Up to this time the water company had spent about $45,000 on its water system.

Organization of the district was authorized by the unanimous vote of 82 electors. An agreement was made for the district to pay the water company $19,500 for its system, the Bond Certification Commission requiring the company to include an option on the four east-side wells because the sufficiency of the new west-side wells had not then been established. This option was made to expire August 11, 1924.

An engineer estimated the needed expenditures, including purchase of the Carmel Water Company system, at $125,000, and bonds in this amount were unanimously authorized May 15, 1923. The new system was completed at a cost of $126,113.98, including purchase of the Carmel Water Company system, the slight increased cost over the estimate resulting from an increase in the length of pipe installed. It was found necessary to equip only two of the west-side wells with pumps.



Location and boundary map of irrigation districts on coastal plain of Los Angeles and Orange counties.

The system has been successfully operated since it was completed in 1924.

Soils and topography.—With the exception of a few irregularities, the district boundaries form a rectangle about 1 mile wide from east to west and 1.5 miles in length. The land surface is smooth and natural drainage excellent. The soils are classified as Ramona loam.* Elevations vary from 200 to 225 feet.

Development.—When the district was organized the entire irrigable area was under irrigation, with 340 acres in oranges, 40 acres in lemons, 20 acres in deciduous fruits, and 430 acres in garden truck. Since then the irrigated area has been somewhat decreased owing to the subdivision into town lots of several tracts in the northern section. Recently the growing of flowers and nursery stock has become important. Further subdivision is to be expected. The number of property owners increased from 130 to 214 between 1922 and 1927. About 150 homes have been erected. There is one holding of 116 acres, one of 40 acres, and one of 33 acres. The estimated population is 850. In 1927–28 the estimated county assessed valuation was $620,000, figuring the land at $750 per acre.

Water supply.—The source of the water supply has been given. The supply from the two wells being pumped has been found sufficient. The amount pumped is not measured but is substantially equal to the quantity delivered as stated below.

Works.—Two 10-inch turbines pump from the wells directly into an elevated steel tank having a capacity of 250,000 gallons. Each has a rated capacity of about 2.5 cu. ft. per sec. and is driven by a 75 h.p. electric motor. With an average draw-down of 45 feet, the total head with a full tank is about 145 feet.

The main and lateral pipe system was designed to serve each 5-acre tract. The total length of distribution pipe, which is all riveted steel slip-joint, is 77,750 feet, of which 34,800 feet is 4-inch and 14,640 feet 5-inch, the diameter of the remainder ranging from 18 inches down to 6 inches.

The total amount invested in works to December 31, 1927, was $126,114, of which $117,500 came from bonds and $8,614 from assessments and water tolls.

Use and delivery of water.—All deliveries are measured with displacement meters. Total deliveries since 1925, in acre-feet, have been as follows: 1925, 1040; 1926, 1010; 1927, 950. The number of meters has increased from 212 on January 1, 1926, to 258, on January 1, 1928. The cost of sub-lateral pipe lines to serve lots in subdivisions is paid by the subdividers. The district, however, refunds $25 to the subdividers for each new customer on the sublateral system.

Bonds.—The $125,000 in bonds issued are dated June 30, 1923, bear 6 per cent interest, and have maturities from 1926 to 1945. Retirements to January 1, 1928, amounted to $18,500. Other bonds total about $43,300, as follows: general county bonds, $1,200; Los Angeles County Flood Control District, $2,800; Montebello municipal, $7,000; elementary school, $18,800; union high school, $13,500.

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Los Angeles Area, California.

Assessments and water tolls.—All land is valued for district assessment at $850 per acre, and has been so valued since 1924–25. In 1927–28 the total district assessed valuation was $704,259. For each of the past five years the assessment rate for each $100 of valuation has been $2, the levy for 1927–28 having been $14,085. Since 1924 the water toll for both irrigation and domestic service has been $1 per month with a minimum use of 800 cu. ft.; $0.05 per 100 cu. ft. for the next 2200 cu. ft.; and $0.01½ per 100 cu. ft. for all water used over 3000 cu. ft.

WALNUT

Location: near Rivera, 10 miles southeast of Los Angeles, in Los Angeles County. (Pl. XXXII.)
Date of organization election: August 7, 1893.
Gross area: 911 acres; **area assessed 1927:** 911 acres.
Principal town: none; **nearest town:** Rivera.
Post office: Rivera.
Railroad transportation: Pacific Electric railway.

History.—The history of this district to 1915 is given in another publication.* It was one of the original Wright act districts, and never ceased to operate, never issued any bonds, and has always been successful. The purpose of the organization of an irrigation district was to condemn a right of way through Standifer Ditch and to provide a convenient means of operating an irrigation system. The right of way in question was in due time acquired and a system covering the entire area with water from San Gabriel River was constructed. The method of operation up to 1915 is described in the publication referred to. No important change in either the system or method was made until after the dry years from 1916 to 1921, during which time the shortage of water made it seem desirable to develop an additional supply from wells. The result obtained from the initial well development was so satisfactory that a second well was leased and a third drilled and equipped in 1926. During this period about $28,000 was spent on improvements to the distribution system, 3.5 miles of concrete pipe being laid.

From the first, Walnut Irrigation District has financed its construction by levying special assessments after authorization by the voters. Between September 10, 1920, and April 15, 1926, four of these were levied, amounting respectively to $10,000, $12,000, $20,000, and $7,000. After receiving authority to levy special assessments to be distributed over a period of years, it has been the practice of the district to borrow money on 7 per cent notes to finance immediate construction. These notes and the interest on them have always been paid as due and the district has never been forced to sell a single tax certificate.

Soils and topography.—The district occupies a portion of the alluvial plain west of San Gabriel River, a few miles west of Whittier and directly southeast of Rivera. The maximum width from east to west is about one mile, and the length from north to south about two miles. The soil classifications are Hanford fine sandy loams and Hanford sand.† Elevations range from about 155 feet to about 120 feet. Ground water stands about 20 feet from the surface. No drainage has been found necessary.

* State Dept. of Eng., Bul. 2, 30-32 and 94.
† U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Los Angeles, Area, California.

Development.—Mature orange and walnut groves and other minor plantings cover the entire district. While residential subdivisions are encroaching from the west, the district has continued to retain its agricultural character. Practically all of the landowners reside within the district. The 1927–28 assessment roll shows 59 ownerships, the largest of which is 72 acres. About 50 homesites have been established in the district for many years past. The county assessed valuation within the district is estimated at $365,000, figured at the rate of about $400 per acre, which is but a fraction of the actual cash value. The estimated population is 250.

Water supply.—The district made a filing in 1893 for 200 inches of the flow of San Gabriel River, and it is water obtained under that filing that has been carried through Standifer Ditch. While the rights to gravity flow through Standifer Ditch have not been sacrificed, there has been a reduction in use from that source due to installation of wells and pumping equipment. In 1927, when the San Gabriel run-off was about 15 per cent below normal, the district pumped about 90 per cent of the water used. No record is available of the amount of water diverted or pumped, but it is estimated that about 1200 acre-feet was pumped in 1927. The two wells owned by the district produce about 200 inches each, and the leased well about 100 inches. The draw-down when pumping a full head is about 10 feet below the standing water level, which is about 30 feet from the ground surface.

Works.—The district owns a two-fifths interest in Standifer Ditch. This ditch is concrete lined and has a capacity of 1500 inches. The distribution system is composed of concrete pipe and ditch. The pipe ranges in size from 36 inches down to 24 and has a total length of about 3.5 miles. Landowners are required to build and maintain their own sub-laterals. Wells 1 and 2 are equipped with deep-well turbines with capacities of 212 and 225 inches, respectively. Each is operated by a 30 h. p. motor. Well 3, which is leased, is pumped with a deep-well turbine of 100-inch capacity and is operated by a 25 h. p. motor. The usual pump lift, including draw-down, is about 40 feet. The supply has been sufficient since pumping from wells began. The wells owned by the district are inside its boundaries. The district owns a two-fifths interest in 17 acres of water-bearing gravels at the head of Standifer Ditch, which was purchased in 1903 for $2,000. The value of fixed properties, as shown by the annual statement on December 31, 1927, was $57,247.84, divided as follows: land, $5,000; concrete ditch and pipe, $36,079.44; pumping plants, $16,168.40.

Use and delivery of water.—Water is delivered in 'heads' of either 200 or 100 inches, depending on the capacity of the pump making the delivery. No meters are used, but the water is rotated from one user to another.

Bonds.—As previously stated, Walnut District has never issued any bonds, but has adopted the expedient of borrowing money on 7 per cent notes pending collection of assessments. The total borrowed during the years 1916 to 1927 has been $88,750, of which $45,750 had been paid back December 31, 1927, leaving outstanding on that date $44,000. Interest payments on these notes from 1916 to 1927 amounted to $10,359.48. Other bonds prorated to lands in the district amount to

approximately $16,500, made up of general county bonds, Los Angeles County flood-control bonds, and elementary and high-school bonds.

Assessments and water tolls.—No assessments are levied without authorization at a special election. All land is valued for district assessment purposes at $1,000 per acre. For the past five years, the total assessed valuation has been slightly over $900,000, the maximum being $911,900 in 1923–24, the valuation in 1927–28 being $910,930. The maximum assessment rate for each $100 of valuation has been $4, in 1922–23, and in three of the past twelve years it has been $2, in four years $0.50, and in one year, 1927–28, $1. The total levy in 1927–28 was $9,109. Water tolls are $0.50 for a total of 100 inches for one hour, or $1 for 200 inches for one hour, which is equivalent to $3 per acre foot.

SERRANO AND CARPENTER DISTRICTS

Location: along Santiago Creek 5 miles northeast of Orange, in Orange County. (Pl. XXXII.)
Date of organization elections: (both districts) July 12, 1927.
Gross areas: Serrano, 1505 acres; Carpenter, 1328 acres; **areas assessed 1927:** (both districts) none.
Principal town: (in Carpenter District) El Modeno.
Post office: (both districts) Orange.
Railroad transportation: Santa Fe railway at Orange and Southern Pacific railroad at El Modeno.

History.—These districts were organized on the same day, with the intention of participating, if possible, with the Irvine Ranch in the construction of a storage reservoir on Santiago Creek. Irrigation has been practiced on the cone of Santiago Creek since the seventies. Carpenter District includes all of the lands served by John T. Carpenter Water Company, which was incorporated April 6, 1900, and Serrano District includes lands served by Serrano Water Association. These two interests have equal rights to the natural flow of Santiago Creek, and jointly maintain a diversion dam and canal. In both districts the gravity flow from Santiago Creek is supplemented by pumping from wells.

The Serrano and Carpenter interests have been negotiating with the Irvine interests for several years with reference to the proposed storage on Santiago Creek. The basis of negotiations has been that each district would pay one-fourth and the Irvine interests one-half of the construction cost, and share stored water in the same proportion. The desire of the Serrano and Carpenter interests to retain their natural-flow rights and to confine the agreement with the Irvine interests to the stored water delayed agreement, but a contract between these interests has recently been signed and it is reported that they are now in a position to proceed with plans for construction. Since the comprehensive plan of Orange County Flood Control District is soon to be presented, final negotiations with the Irvine interests have been delayed, because it is believed that cooperation with the flood control district may be of advantage to all interests.

Soils and topography.—The two districts are situated on the alluvial fan of Santiago Creek, Serrano District being to the north and Carpenter District to the south of the creek channel. The northern

boundary of Serrano District and the southern boundary of Carpenter District follow the foothill slopes generally below the 400-foot contour, and the west boundary of the two districts runs across the alluvial fan of Santiago Creek between the 275 and 300-foot contours. The principal soil classification is Ramona gravelly loam.* Yolo loam and fine sandy loam prevail along Santiago Creek. There are a few hundred acres of Montezuma clay adobe in the southwest corner of Carpenter District east of El Modeno.

Development.—Mature orange and lemon groves cover a total of about 2000 acres in the two districts, with about 200 acres of walnuts and 100 acres of miscellaneous trees. There are about 100 separate ownerships within Serrano District and 200 in Carpenter District, most of the landowners being residents. The combined population is about 1800. The districts are typical of the citrus belt of Orange County, ownerships being small and intensively cultivated. Paved concrete roads reach the neighboring towns and cities.

Water supply.—The water supply of the two areas comes from the natural flow of Santiago Creek and pumping from wells. The steady recession of the ground water has made the proposed storage of flood water increasingly important. Two wells are pumped by John T. Carpenter Water Company and four in the Serrano area, one of the Serrano group serving lands outside of the Serrano District boundary. The wells draw down from 250 to 300 feet below the surface. John T. Carpenter Water Company and Serrano Water Association claim the right to the natural flow of Santiago Creek during the irrigation season, with the exception of half the surplus flow from November 20 to June 20, which may be diverted by the Irvine interests under certain conditions outlined in a judgment rendered in 1909.

Application 4302, filed with the Division of Water Rights November 5, 1924, by three individuals for the benefit of the two districts and the Irvine interests, is pending. As amended June 21, 1927, this requests a permit for the storage of 20,000 acre-feet from October 1 to May 1.

A water-supply study made for the Irvine interests based on the years 1895 to 1924, inclusive, and on storage at upper and middle sites on Santiago Creek, indicates that from 4800 to 6800 acre-feet would have been available with no shortage, and from 5000 to 8000 acre feet with a shortage in 15 months of the 30-year period. The upper site has a tributary drainage area of 62.9 square miles and the middle site of 73.5 square miles.

Works.—Neither district has yet acquired any works, water still being delivered by John T. Carpenter Water Company and Serrano Water Association. In connection with the water-supply studies referred to, hydraulic fill dams were recommended, the total estimated cost for the upper dam varying from $432,360, with spillway elevation of 770 feet, to $652,920, with a spillway elevation of 800 feet, and that of the middle dam varying from $662,500, with spillway elevation of 770 feet, to $736,152, with spillway elevation of 780 feet. These estimates represented costs per acre-foot of annual yield ranging from $90 to $108 with no shortage and of $79.50 to $94.50 with shortage of 15 months during the 30-year period.

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Anaheim Area, California.

Use and delivery of water.—Water is still delivered by John T. Carpenter Water Company and Serrano Water Association. One-third of the share of Serrano Water Association in the flow of Santiago Creek goes to the Gray tract and two-thirds to the Lotspeich tracts, these being subdivisions laid out some years ago.

Bonds.—No bonds have been voted or issued, and no indebtedness has been incurred by either district.

Assessments and water tolls.—No assessments have been levied and no water tolls collected.

NEWPORT MESA

Location: north of Newport Beach, in Orange County. (Pl. XXXII.)
Date of organization election: June 24, 1918.
Gross area: 694 acres; **area assessed 1927:** 694 acres.
Principal town: Costa Mesa.
Post office: Costa Mesa.
Railroad transportation: Southern Pacific and Pacific Electric railways.

History.—The area included within Newport Mesa District was subdivided and put on the market as irrigated farm land, an irrigation distribution system having been constructed by the subdivider. Water was supplied by La Habra Water Company. The water service was not satisfactory, so the subdivider agreed to give the system he had constructed to the settlers if they would form an irrigation district and develop a new supply by pumping from the bed of Santa Ana River, which lies a short distance west of the district. The organization of the district was carried unanimously, although there were only eight votes cast.

On March 31, 1919, the district voted a bond issue of $50,000. The sale of these bonds was held up by the Capital Issues Committee, but as the water supply was insufficient, the subdivider agreed to install a pump in the bed of Santa Ana River and construct a supply line to the district with the understanding that he would be reimbursed at a later date. The bonds were sold June 30, 1919, and the district paid to the subdivider $23,144.89, and used the remaining funds to build a concrete reservoir and to extend the distribution line.

Soils and topography.—The district is located on the mesa which rises about 100 feet above sea level between the channel of Santa Ana River and Newport harbor. The area is dome-shaped and surrounded on the south and west by steep bluffs which follow the Santa Ana River flood plain and the beach line. Soils are classified as Ramona fine sandy loams.* They are usually underlain within a few feet of the surface by a partially disintegrated sandstone. No artificial drainage has been found necessary.

Development.—In 1929 about 350 acres was planted to truck crops and about 40 acres to deciduous orchards, the latter having been partially abandoned. About 400 acres is under an oil lease, which has many years to run, and the landowners hestitate to make improvements until the lease expires. About 100 houses and business structures have been erected. The assessment roll for 1927–28 shows 170 owners, and on March 1, 1928, there were 110 water users. The average holding is

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Anaheim Area, California.

3.3 acres, based on the net irrigable area. One owner holds 154 acres and 40 lots, and another 28 acres. About 25 houses are located along the Pacific Electric right of way, facing Costa Mesa. The total population is about 350. Part of the town of Costa Mesa is in the district. Obviously, agriculture in the district is of secondary importance.

Water supply.—The district is pumping water from a 5-acre tract located over water-bearing gravels along Santa Ana River about 1 mile from the district boundary. The first well was drilled to a depth of 335 feet and a good supply of water developed. During 1920–21, the water became salty and the well casing had to be plugged below the 100-foot level. A new well was drilled to a depth of 100 feet and a good supply again developed. The water supply has since been satisfactory for irrigation, although it contains a considerable amount of gas and is discolored at times. Before a pump was purchased for the new well, the latter developed a flow of 1100 g. p. m. with a drawdown of 47 feet. Another 5-acre tract of water-bearing land, adjoining the first 5-acre tract purchased, has recently been acquired.

Works.—The present pump is a deep-well turbine with a capacity of 1000 g. p. m., operated by a 75 h.p. motor. The maximum lift is 120 feet. Water is pumped to a concrete equalizing reservoir containing 1,750,000 gallons, equivalent to 5.5 acre-feet.

Water is distributed from the reservoir under pressure to all consumers. The supply and distribution system includes 1320 feet of 14-inch redwood pipe, 9700 feet of 12–inch redwood pipe, and 2600 feet of 12-inch riveted steel pipe, .05 mile of 6-inch redwood lateral pipe, 5 miles of 6-inch riveted steel lateral pipe, and 850 feet of 4-inch steel lateral pipe.

The total investment in works to December 31, 1927, is given as $64,362, of which $51,578 has come from bond issues and $12,784 from assessments and water tolls.

Use and delivery of water.—Records of water delivered date from July 17, 1927, 214 acre-feet having been delivered from that date to December 31, 1927, or at the approximate rate of 400 acre-feet per year. Service connections increased from 88 in 1927 to 110 in 1928, most of the new connections being for domestic consumers. The district undertakes to make irrigation deliveries to each 5 acres.

Bonds.—Only the one bond issue, of $50,000, has been issued. This is dated June 8, 1919, bears 6 per cent interest, and matures from 1940 to 1959. Other bonds are estimated at $16,500, as follows: general county bonds, $1,000; street bonds, $8,000; school bonds, $7,500.

Assessments and water tolls.—Acreage property is assessed for district purposes at $600 per acre, and lots at from $225 to $665 each, these having been assessment valuations since 1923–24. Assessment valuations prior to that date on acreage property ranged from $345 to $400 per acre, and on lots from $160 to $500 each. The total district assessed valuation for 1927–28 was $421,707, which was approximately the same as for the two preceding years. The assessment rate for each $100 of valuation for 1923–24 and 1924–25 was $2.15, for 1925–26, $1.60, and for 1926–27 and 1927–28, $2. The total levy for 1927–28 was $8,434, which was practically the same as for 1926–27.

Water tolls are charged at flat rates since deliveries are not measured. Commercial truck land pays $0.75 per acre per month in advance,

orchards and miscellaneous field crops, $0.75 per acre per irrigation; alfalfa or other flooding, $1 per acre per irrigation; and commercial dairies with 5 cows or less, not including water for dwelling, $1 per month, plus $0.05 per month for each additional head of stock. Charges for domestic water are $0.50 to $1 per month, minimum, for each service. Family orchards and garden patches in lots are charged $0.25 for each one-quarter acre or fraction thereof per month, in advance. The district also supplies water for oil drilling, pumping plants, and steam plants, at rates ranging from $2 to $50 per month. Water tolls collected in 1927 amounted to $2,014.

NEWPORT HEIGHTS

Location: directly north of Newport Beach, in Orange County. (Pl. XXXII.)
Date of organization election: July 23, 1918.
Gross area: 1503 acres; **area assessed 1927:** 1503 acres.
Principal town: Costa Mesa.
Post office: Costa Mesa.
Railroad transportation: Southern Pacific and Pacific Electric railways.

History.—As in the case of Newport Mesa Irrigation District, Newport Heights District was organized to supplement the inadequate water supply and extend and improve the irrigation system provided by the land subdivider who put the property on the market. La Habra Land and Water Company furnished the water but was unwilling to extend the pipe line and the landowners were forced to install a new system to obtain adequate service.

A bond issue of $160,000 was voted October 28, 1919. Prior to this, the engineer of the district had laid out a plan which was to involve an expenditure of less than that amount. Subsequently he revised his plans and increased his cost estimates to $246,939. The new plans were in turn revised by a consulting engineer who estimated the cost of a completed system at $177,538, and the cost of required immediate construction as $149,637. The district went ahead on the latter basis, but the expenditures to December 31, 1924, amounted to $154,368.16.

The district constructed a distribution system of riveted steel pipe, protected with 'soil-proof' wrapping. The pipes, however, showed some leakage, and in 1927 the contractor paid the district $5,000 for release from further liability.

Soils and topography.—The district area is an undulating, dome-shaped mesa, ranging in elevation from 130 to 200 feet. High bluffs to the south and east separate the mesa lands from the tidal flats which extend inland about two miles. Soils are classified as Ramona sand and Ramona fine sandy loam.* No artificial drainage has been found necessary.

Development.—Although well adapted to agriculture, the district has developed mainly as a residential area. Possibilities of oil and proximity to Newport harbor have given the land a speculative value. There are about 200 acres of apples and pears and about 45 acres in citrus groves, the irrigated area having remained more or less constant during the last few years. About 350 homes and business buildings have been

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Anaheim Area, California.

erected. Over 500 separate ownerships are recorded on the 1927–28 assessment roll, the largest of these being 180 acres. Lands are largely subdivided into lots and half-acre and acre tracts. The estimated county assessed valuation for 1927–28 was $420,000. Costa Mesa, unincorporated, which lies partly in the district, has an estimated population of 400, and the remainder of the district a population of 1000 to 1100.

Water supply.—Water is pumped from three wells located on a 20-acre tract situated 1.25 miles northwest of the district boundaries. The tract was purchased from La Habra Land and Water Company. The deed to the property limits maximum diversion to 6 cu. ft. per sec. The wells draw down to about 25 feet below the surface. The supply has always been sufficient. As in the case of Newport Mesa District, considerable gas is evolved in the wells. Although the water is warm and somewhat discolored, it is used for domestic purposes without treatment.

Works.—One 5-inch, one 6-inch, and one 10-inch deep-well turbine are used at the well tract, these having an aggregate capacity, as reported by the district, of about 4000 g. p. m. These turbines are operated by 15, 20, and 75 h.p. direct-connected motors. Water is lifted from the wells into a concrete sump with a capacity of 100,000 gallons. One 4-inch and one 6-inch direct-connected centrifugal pump, the two having a combined capacity of 1300 g. p. m., lift water from the sump against a maximum head of 120 feet into the main supply line which feeds the distribution system. A steel standpipe 50 feet in diameter and 50 feet high, with capacity of 734,000 gallons, is situated near the southwest corner of the district. Irrigation water is not pumped through the standpipe but is delivered under an average head of 65 to 75 feet.

The distribution system consists of 8300 feet of 18-inch and 800 feet of 14-inch riveted steel main pipe line, and about 13 miles of riveted steel lateral pipe line, ranging in diameter from 12 inches to 2 inches. The main riveted steel laterals follow the roads through 40-acre blocks, and the distribution system is so arranged that each 5-acre tract may be served. The total invested in works to December 31, 1927, was $163,702.19, of which $156,000 was obtained from bonds and $7,702.19 from tolls and assessments. The district paid $5,635 to La Habra Land and Water Company for the water-bearing land and system purchased.

Use and delivery of water.—Water deliveries are not measured. About 400 irrigation and domestic connections are in service, most of these being domestic.

Bonds.—The bond issue of $160,000 previously referred to is dated January 1, 1920, bears interest at 6 per cent, and carries maturities from 1941 to 1960. Other bonds are estimated to amount to $88,300, divided as follows: school bonds, $24,000; bonds of Road Improvement District No. 4, $16,000; general county bonds, $3,300; County Improvement District No. 12, $45,000.

Assessments and water tolls.—District valuations for assessment purposes are estimated at about 50 per cent of selling price, the location being the most important influence on value. The district valuation is about three times the county valuation. Acreage property was assessed

for district purposes for the year 1928–29 at $700 to $1,100 per acre, residence lots at about $250, and business lots up to $2,640 each. From 1924–25 to 1927–28 acreage was assessed at $300 to $1,500 and lots at $250 to $1,800 each. The total district assessed valuation for 1927–28 was $1,349,028, and for 1928–29, $1,428,845. In 1923–24 and 1925–26 the assessment rate for each $100 of valuation was $1 and in 1924–25, 1926–27, and 1927–28 it was $1.25. The total assessment levy for 1927–28 was $16,862, and for 1928–29, $17,860.

Water tolls are charged at a flat rate. The domestic rate is $1 per month per service. Irrigation rates from May 1 to November 1 are $1 per month for lots up to one-fourth of an acre, $1.50 per month for half-acre lots, and $2 per month for acre lots, these rates in each case including domestic service. Irrigation water for larger lots is charged for at the rate of $0.20 per hour for a head of 25 inches.

BEAUMONT

Location: in San Gorgonio Pass, about 30 miles southeast of Riverside, in Riverside County. (Pl. XXXIII.)
Date of organization election: March 4, 1919.
Gross area: 4141 acres; **area assessed 1927:** 3161 acres.
Principal town: Beaumont.
Post office: Beaumont.
Railroad transportation: main Sunset route of Southern Pacific railroad.

History.—This district was organized to acquire and improve the water systems of Beaumont Land and Water Company and San Gorgonio Water Company, and if possible to augment the water supply for Beaumont and adjacent land.

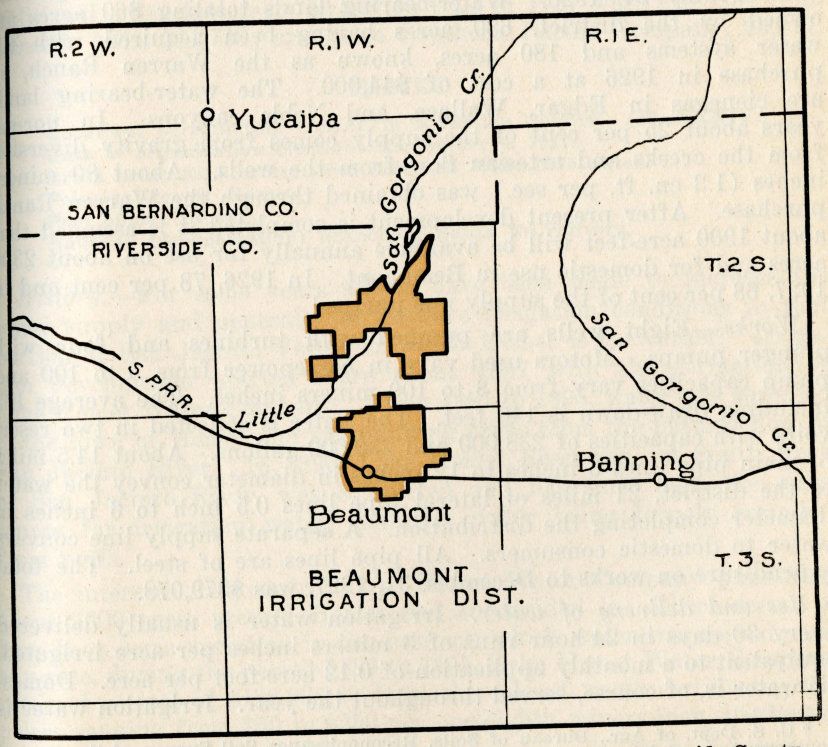
Settlement in the Beaumont area was begun during the speculative period of the late eighties and early nineties. The townsite of Beaumont was staked out in 1887 by Southern California Investment Company. A hotel was built and several miles of shade trees were planted. Some land was sold but in 1889 title passed by foreclosure to a San Francisco bank. The investment company had brought a small supply of water to the townsite from Noble Canyon. The land was leased to grain growers until about 1907 when the property was purchased by a Chicago firm. Land now within the district was then subdivided and a water supply was developed in Edgar Canyon. The acreage property was subdivided and sold as irrigated farm land suitable for deciduous fruit. Beaumont Land and Water Company and San Gorgonio Water Company, organized by the new owners, controlled the water supply and furnished it to the settlers. Both were public utilities and subsequently came under the jurisdiction of the California Railroad Commission, which issued several decisions regarding their affairs.*

When organization of the irrigation district was proposed, in 1918, the lands were in need of an increased water supply, but the existing companies were unwilling to make the investment necessary to attempt

* Opinions and Orders of the Railroad Commission of California, vol. 2, p. 706; vol. 3, p. 410; vol. 5, p. 131; vol. 10, p. 686. See also Report of the Railroad Commission of California, July 1, 1915, to June 30, 1916, pp. 326, 378, 428; Report of the Railroad Commission of California, July 1, 1916, to June 30, 1917, pp. 468, 517, 569, 614.

to develop it. Data furnished to the state engineer in 1920, when a district bond issue came up for consideration, indicated a planted area of 2020 acres, mostly apples, it being stated that the trees had been set out during the years 1908 to 1917. Beaumont Land and Water Company was supplying the water used outside of Beaumont and San Gorgonio Water Company all of that used within Beaumont. The two companies, however, were operated as a single system. The gross water production during the years 1916 to 1919 ranged from 840 to 1010 acre-feet per annum. The companies claimed that a substantially increased supply could be obtained by further development in Edgar and adjacent canyons, but the amount of such increased supply was recognized by all as being problematical. However, the district was formed by a vote of 307 to 114, and application was made to the Bond Certification Commission for authority to issue bonds amounting to $230,000, of which $170,000 was to be paid for the Beaumont Land and Water Company and San Gorgonio Water Company systems, and $60,000 for improving those systems and developing additional water according to the plans of an engineer employed by the district. This authority was not at first given, owing to doubt as to sufficiency of the water supply. Later the bonds were authorized and were voted September 9, 1920. A second issue, of $70,000, was authorized and voted in 1926, to be used for further water development. The district has operated the systems from 1921 on.

PLATE XXXIII



Location and boundary map of Beaumont Irrigation District, Riverside County.

Soils and topography.—The District is situated on the alluvial fan of Edgar, or San Gorgonio Creek, and slopes toward the south, falling from about elevation 3200 feet at the apex of the alluvial cone to about elevation 2550 feet at the southern section of the townsite, a distance of about 5 miles, or an average of 130 feet to the mile. The soils are deep and are classified as Placentia and Hanford sandy loams.* Natural drainage is ample.

Development.—The irrigated area has remained about the same since the district was organized—2268 acres from 1921 to 1926 and 2046 acres in 1927. Almost the entire area is in deciduous fruits, including cherries, pears, peaches, prunes, plums, apricots, and almonds, arranged in order of decreasing acreage. Farm holdings average 8 acres. In 1928 there were 1177 assessment payers, including over 360 in the town of Beaumont. There is one acreage of 100 acres and another of 60 acres. In 1927–28 the city and county assessed valuation in Beaumont was about $162,000 and the estimated county valuation of the entire district was about $350,000. The area in Beaumont is about 373 acres. The estimated population of Beaumont is 1500 and of the remainder of the district, 500.

Water supply.—Water rights are based on riparian ownership, use, and permit 1037 from the Division of Water Rights, the latter allowing the diversion of 8 cu. ft. per sec. from 10 wells in Edgar and Noble creeks for use from February to November, with a priority date of May 24, 1920. Water-bearing lands totaling 860 acres are owned by the district, 680 acres having been acquired with the water systems and 180 acres, known as the Warren Ranch, by purchase in 1926 at a cost of $44,000. The water-bearing lands are cienegas in Edgar, Wallace, and Noble canyons. In normal years about 25 per cent of the supply comes from gravity diversion from the creeks and artesian flow from the wells. About 80 miners inches (1.3 cu. ft. per sec.) was obtained through the Warren Ranch purchase. After present development is completed it is assumed that about 1900 acre-feet will be available annually for use on about 2300 acres and for domestic use in Beaumont. In 1926, 78 per cent and in 1927, 68 per cent of the supply was pumped.

Works.—Eight wells are pumped with turbines and four with plunger pumps. Motors used vary in horsepower from 5 to 100 and pump capacities vary from 8 to 100 miners inches. The average lift including draw-down is 140 feet. The water is collected in two reservoirs with capacities of 238,000 and 230,000 gallons. About 14.5 miles of main pipe lines 6 inches to 12 inches in diameter convey the water to the district, 21 miles of lateral pipe lines 0.5 inch to 6 inches in diameter completing the distribution. A separate supply line conveys water to domestic consumers. All pipe lines are of steel. The total expenditure on works to December 31, 1927, was $379,078.

Use and delivery of water.—Irrigation water is usually delivered every 30 days in 24-hour runs of 3 miners inches per acre irrigated, equivalent to a monthly application of 0.12 acre-foot per acre. Domestic water is, of course, served throughout the year. Irrigation water is

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Central Southern Area, California.

measured by weirs, miners-inch boxes, and displacement meters, domestic water by displacement meters. Deliveries of irrigation water are made to 10-acre units. In 1927, 127 acre-feet was delivered for domestic use and 1232 acre-feet for irrigation. Some water is delivered for locomotive use to Southern Pacific Company, deliveries ranging from 51 to 99 acre-feet per year from 1921 to 1927. Deliveries other than for domestic, irrigation, and railroad use have ranged during the same period from 18 to 37 acre-feet per year.

Bonds.—The first bond issue, of $230,000, is dated November 1, 1920, bears 6 per cent interest, and has maturities 1926 to 1944. The second issue, of $70,000, is dated July 1, 1926, also bears 6 per cent interest, and matures 1931 to 1950. Up to January 1, 1928, $20,700 of the first issue had been paid.

Assessments and water tolls.—Farm lands are valued for district assessment at from $45 to $100 per acre, the usual valuation being $100. Lots in Beaumont are assessed at $20 to $1120 each. The total district assessed valuation in 1927–28 was $264,820 on farm lands and $116,800 on town lands. In 1923–24 and 1924–25 the assessment rate for each $100 of valuation was $7.50; in 1925–26 it was $10; in 1926–27 and 1927–28 it was $9.50. The total assessment levy in 1927–28 was $36,266. Irrigation tolls, in addition to assessments, are at the rate of $7 per acre per year. The domestic rate is $1.25 per month, minimum, for the first 650 cu. ft., and $0.10 per 100 cu. ft. for all additional. Receipts from irrigation tolls in 1927 were $13,895; from domestic tolls, $11,736; and from Southern Pacific Company, $3,177.

HEMET

Location: surrounding Hemet, in Riverside County. (Pl. XXXIV.)
Date of organization election: September 6, 1927.
Gross area: 9815 acres; **area assessed 1928:** 9775 acres.
Principal town: Hemet.
Post office: Hemet.
Railroad transportation: branch of Santa Fe railway.

History.—For some years efforts have been made to increase the water supply and generally to improve irrigation conditions in that portion of San Jacinto Valley of which Hemet is the center. Irrigation development started there about 1887 with the formation of Lake Hemet Water Company. From 1887 to 1895, water was supplied to the town of Hemet and surrounding areas from the natural flow of San Jacinto River. In 1895, Lake Hemet Reservoir, on South Fork of San Jacinto River, was completed and has since been the main source for irrigation water, domestic water being largely supplied from wells.

The interests that control Lake Hemet Water Company purchased about 5000 acres around Hemet and subdivided it. There seems to have been some variation in the basis on which water was served. At any rate, during the period 1889 to 1915, Lake Hemet Water Company received a total of $438,938.60 from the sale of water certificates, the prices ranging from $50 to $250 per one-eighth miners inch, the larger number being sold for $75.

The obligations of Lake Hemet Water Company to the holders of these certificates have been the subject of extensive litigation and hearing before the Railroad Commission.*

At the time of an investigation for the state engineer in 1927, 2873.88 acres of land was being served under old contracts which were recognized, and 3071.13 acres under contested contracts, 600 acres of this total being owned by the interests which control Lake Hemet Water Company. In the case of some lands, the company is serving as a public utility under rates fixed by the Railroad Commission. The difference in the status of the various lands with reference to the basis on which water service is given has been a constant source of discord. Besides Lake Hemet Water Company, Fairview Land and Water Company and Hemet Town Water Company supply water, the latter mainly for domestic purposes.

As the orchards in Hemet Valley have been extended and have become older, the need for more water has been felt. Some of the landowners have drilled wells and thus obtained a supplemental supply. Conflicts with other users from San Jacinto River, principally Fruitvale Mutual Water Company, have caused further concern. For some years the general feeling has been that the best solution can only be found through unifying the various water interests in the valley, and from time to time, different ways of doing this have been proposed, but none put into effect. The organization of Hemet Irrigation District is a step in this general direction which is confined to those obtaining water from Lake Hemet Water Company, Fairview Land and Water Company, and Hemet Town Water Company. Some areas have been omitted which it has been thought should have been included.

Soils and topography.—The soil classifications are Hanford sands and Hanford sandy and fine sandy loams.† With the exception of a hill area, known as Park Hill, the lands are mainly flat valley floor, although with sufficient slope to provide natural drainage. Ground water stands from 75 to 190 feet below the surface.

Development.—Practically the entire district is in planted orchards, largely citrus, walnuts, and apricots. Some of the orchards are young and will increase in their irrigation requirement. The city and county assessment roll for 1927–28 showed a valuation within the district of $1,034,795. The estimated population of Hemet is about 3000, and for the remainder of the district about 2500. Paved highways communicate with other important towns and cities within the county.

Water supply.—The investigation of the state engineer in 1927 showed that 7500 acres was served with irrigation water during 1926 by Lake Hemet Water Company and Fairview Land and Water Company, equivalent approximately to 1 acre-foot per acre, net, on the land. The amount delivered was 185,578.60 miners-inch days, equivalent to about 7424 acre-feet. In addition to this, during the year 1927, Lake Hemet Water Company delivered approximately 278 acre-feet, Fairview Land and Water Company, approximately 98 acre-

* See particularly Decision 3804, Railroad Commission of California, in Vol. 11 of Opinions and Orders of the Railroad Commission of California.
† U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Central Southern Area, California.

feet, and Hemet Town Water Company approximately 78 acre-feet for domestic, industrial, and other public purposes. This is said to represent about a normal use in the area, exclusive of that supplied by the pumping plants. Lake Hemet has a claimed storage capacity of 15,000 acre-feet and there is an artesian area above the reservoir, owned by Lake Hemet Water Company, which it is assumed could be made to yield an additional supply. Lake Hemet Water Company also owns water-bearing lands along San Jacinto River, some of which are now being pumped by Fruitvale Mutual Water Company, and with reference to which litigation is pending. Private wells and wells put in and operated by small mutual water companies are said to supply about as much water for irrigation within the district as does Lake Hemet Water Company.

Works.—The district has not yet acquired any works. As previously indicated, it has been proposed that the district should purchase the existing systems of Lake Hemet Water Company, Fairview Land and Water Company, and Hemet Town Water Company. Lake Hemet Reservoir has been referred to. The existing supply and distribution works consist of lined canals, concrete and steel flumes, and pipes. These carry water to all portions of the district. The capital investments of the three companies, according to a report filed with the Railroad Commission December 31, 1926, totaled $840,421 of which $755,101 was for Lake Hemet Water Company.

Bonds.—The district has issued no bonds.

Assessments and water tolls.—The district levied an assessment for 1928–29, totaling $7,916. This was based on a rate of $0.90 on each $100 of valuation applied to the county assessment within the district.

LADERA

Location: south and east of Lake Elsinore, in Riverside County. (Pl. XXXIV.)
Date of organization election: October 30, 1922.
Gross area: 1632 acres; **area assessed 1927:** 1632 acres.
Principal town: none; **nearest town:** Elsinore.
Post office: Elsinore.
Railroad transportation: branch of Santa Fe railway.

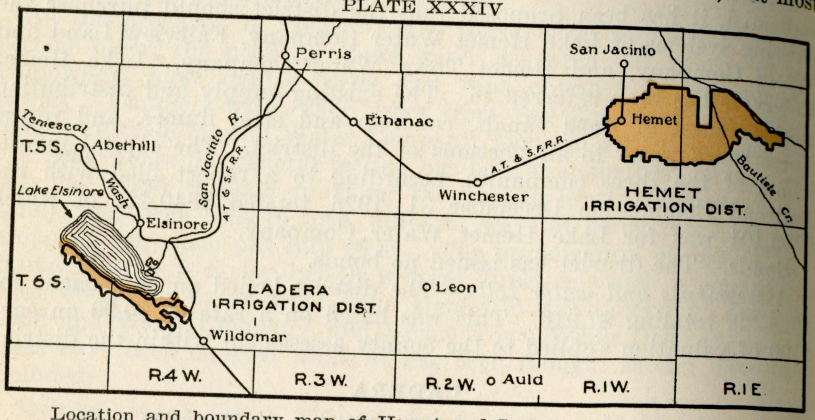
History.—Ladera Irrigation District was first proposed with an area of 7600 acres. The report of the state engineer recommended an area not exceeding 2000 acres, but his report was not received within the 90-day period specified by the irrigation district act, and organization was approved independently of the report of the state engineer, although the area was reduced to about 4000 acres on petition of certain landowners. The Bond Certification Commission was requested to approve a bond issue of $475,000, but this request was not granted. At that time the district included about 1200 acres southeast of Lake Elsinore, largely owned by South Elsinore Development Company. In 1926 the South Elsinore Development Company lands were excluded on petition of their owners, and since then efforts have been made to insure a water supply for the remaining 1632 acres. These efforts are still in progress. A request for authority to issue $250,000 was filed with the Bond Certification Commission April 3, 1928.

Soils and topography.—Lake Elsinore, to which the district is adjacent, has an average surface elevation of 1250 feet. The lands of

the district are located between elevations 1246 and 1650 feet, 1450 acres of the total being between elevations 1266 and 1380. The surface is generally smooth and the slopes are within limits which permit cultivation and provide surface drainage. With the exception of about 150 acres of Ramona stony and sandy loams in the southeast corner, the soils are classified as Hanford sandy loam.*

Development.—An appraisal for the Bond Certification Commission in 1927 showed a planted area of 575 acres, of which 349 acres was in deciduous fruits and nuts, 57 acres in citrus fruits, and 185 acres in olives. Only a small portion of the planted area was being irrigated. Eight subdivisions, comprising 149.63 acres, and containing 1047 residential lots, have been laid out in the portion of the district which faces Lake Elsinore. Several houses have been built on three or four of these tracts. A few of the buildings are permanent, but most

PLATE XXXIV



Location and boundary map of Hemet and Ladera irrigation districts, Riverside County.

of them were constructed for summer camping. Homes outside of the subdivisions are generally more substantially constructed.

The 1927–28 assessment roll carried 214 landowners and 69 owners of acreage. The three largest holdings contain 313, 207, and 75 acres, the largest being owned by an athletic and country club which has made extensive improvements. The county assessment roll for 1927–28 gave an estimated value for land within the district of $100,000. The estimated present population is 300.

Water supply.—At this writing nothing definite can be stated regarding the water supply other than that the only available source is an underground basin, which in the main lies outside of the district. The district owns 240 acres from which it proposes to pump water, but there has not been agreement as to the sufficiency of that source. The district is preparing to include these lands within its boundaries by petition. Interests outside of the district which are assumed to have rights to the underlying water have an acreage which, if developed, would demand an annual draft of 3200 acre-feet, and the annual demand of Ladera District has been estimated at 2300 acre-feet, making a total of 5500 acre-feet.

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the Central Southern Area, California.

Works.—Various plans for works have been proposed, but reference to them is omitted because final design of the system must await settlement of the pending water supply problem.

Bonds.—No bonds have been issued, nor is there a request for authority to issue any before the Bond Certification Commission, the request to issue $250,000 having been withdrawn pending termination of water-supply matters.

Assessments and water tolls.—Agricultural land below the 1380-foot contour is valued for purposes of district assessment at $400 per acre, and that above that contour at $200 per acre. This distinction has been made because the district has not proposed to pump at its own expense above the 1380-foot level. A basic valuation of $150 is placed on all lots below the 1380-foot contour and of $50 above that contour. The valuation of lots fronting on Lake Elsinore is increased $0.03 per square foot above the base with an additional $0.03 per square foot on corner lots. Above Grand Avenue, the main road which divides the portion of the district lying south of the lake into two sections, base valuations on lots are increased $0.01 per square foot, with an additional $0.01 per square foot on corner lots.

The district has levied assessments since 1923–24, the total assessed valuations ranging between $1,072,826 and $1,137,103 prior to the withdrawals in 1926; for 1927–28 the total assessed valuation was $771,976. The assessment rates for each $100 valuation during the past five years have been as follows: 1923–24, $0.7750; 1924–25, $0.1667; 1925–26 and 1926–27, $0.3333; 1927–28, $1.00. The total of the levies for the five-year period has been $25,386; for 1927–28 the levy was $7,719.

FALLBROOK

Location: surrounding Fallbrook, in San Diego County. (Pl. XXXV.)
Date of organization election: April 28, 1925.
Gross area: 10,216 acres; **area assessed 1927:** 9903 acres.
Principal town: Fallbrook.
Post office: Fallbrook.
Railroad transportation: branch of Santa Fe railway.

History.—The present Fallbrook Irrigation District represents the second effort to develop a project in the Fallbrook area under the irrigation district act. The first was made in 1891, when on April 6, a district also known as Fallbrook Irrigation District, with an area of 12,000 acres, was organized under the original Wright act. The main crops in the area then were wheat, oats, and barley. The landholdings ranged from a few acres to 2500 acres, with several tracts of 1000 acres each. Alternative proposed plans for a water supply were the construction of a dam on Santa Margarita River near Fallbrook and a dam on Temecula Creek above Fallbrook. Bonds in the amount of $400,000 were voted for the purpose of carrying out construction. Opposition, however, soon developed. Although in a judgment rendered February 27, 1893, organization of the district was held valid, contestants appealed to the supreme court, and the final outcome was that both the district organization and the bond issue were held void, principally on the ground that the petition for the formation of the district was not signed by the required number of freeholders.

There was other litigation, however, which has carried the name of Fallbrook Irrigation District down through irrigation district history. This was the case of *Maria K. Bradley* vs. *Fallbrook Irrigation District*. The purpose of the suit was to quiet title against sales of land made by the district for delinquent assessments, but the result was a declaration by the United States Supreme Court that the Wright act was constitutional. In a decision rendered July 22, 1895, Judge Erskine M. Ross of the United States Circuit Court had held the act unconstitutional and void as depriving landowners of their property without due process of law. On appeal to the United States Supreme Court, however, the judgment of the circuit court was reversed and the act was sustained.*

The recently formed irrigation district bears no organic relation to the previous district. In the time intervening between the invalidation of the previous district and the formation of the present one, development has gone ahead in the Fallbrook area largely on the basis of a limited water supply obtained by pumping from under ground. A census in 1926 showed a total of 1581 acres of planted land, with 712 acres irrigated from wells. Valuations have increased and an attractive community has been built up, but more water is needed, and that the effort to secure it is locally considered justified is shown by the fact that all of the 186 votes cast at the organization election were favorable to the district.

No final plan of obtaining a water supply has yet been worked out. The proposed source is Santa Margarita River and twelve different schemes of development have been investigated. These contemplate the delivery of from 8500 to 20,000 acre-feet per annum, with an estimated bonded debt ranging from $161 to $200 per acre, and a water cost ranging from $18 to $29.50 per acre-foot. Since the completion of these investigations, the district has been awaiting the outcome of a suit pending between the two principal riparian owners on Santa Margarita River, namely, Rancho Santa Margarita y las Flores, known as the O'Neill land and comprising most of the area between Fallbrook, and the Pacific Ocean, and the Vail land, situated about 10 miles northeast of Fallbrook.

Soils and topography.—With the exception of a small area along the northern boundary which slopes toward Santa Margarita River, the district lies within the drainage basin of San Luis Rey River. Numerous tributary arroyos provide excellent surface drainage. Elevations range from about 1000 feet east of Fallbrook to 475 feet on the creek channel, the terrain being rolling. There are some rock outcrops within the exterior boundaries but most of the lands on which these occur and some other areas have been excluded. The principal soil classifications are Sierra and Holland sandy loam, with several narrow tongues of Hanford sandy loam.† Ground water, during pumping, stands from 50 to 100 feet below the surface.

Development.—This has already in part been referred to. Of the 1581 acres planted, 678 acres is in olives, 485 acres in lemons, 148 acres in oranges, and the remainder in various deciduous and subtropical fruits. The 1927–28 assessment roll showed 299 assessment payers.

* *Fallbrook Irrigation District* vs. *Bradley*, 164 U. S. 112.

† U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the San Diego Region, California.

Location and boundary map of irrigation districts in San Diego County.

There are 5 large landholdings containing 1486, 575, 345, 290, and 235 acres. About 335 acres within the non-incorporated subdivision of Fallbrook is included in the district. The total population is estimated at 900, not including 600 living in the portion of Fallbrook which is outside the district boundaries. In 1927–28 the county assessment roll gave an assessed valuation of approximately $150,000. Fallbrook is located on the paved inland highway between San Diego and Riverside and is connected by a branch paved highway with Oceanside on the coast.

Water supply.—Application 3846, dated February 14, 1924, has been filed with the Division of Water Rights on behalf of the district. This requests 45,000 acre-feet of storage and 15,000 acre-feet annual use from Santa Margarita River. A permit has not yet been granted on this application owing to the pending litigation between the riparian owners already referred to. The tentative plan is to build a 150-foot dam on Santa Margarita River about two miles north of Fallbrook. This would impound 29,000 acre-feet of water, but at an elevation which would necessitate pumping to the district. The elevation of the streambed at the proposed dam site is 163 feet below the lowest point in the district and 663 feet below the highest point. Another proposal is to build a dam at Nigger Canyon, on Santa Margarita River about 15 miles above Fallbrook, from which point water could be conveyed to the district by gravity. Agreement has not been reached as to the amount of the mean annual run-off of the Santa Margarita.

The contending riparian owners on the Santa Margarita have had litigation pending since August 22, 1924, when the O'Neill interests protested an application of the Vail interests for a permit to appropriate water of Temecula Creek, a principal tributary of the Santa Margarita. The application of the Vail interests is numbered 1423 and was filed October 22, 1919. The pending litigation seeks to restrain the diversion of Temecula Creek by the Vail interests and to bring about a determination of the relative rights of the two parties. The lands of both the O'Neill and the Vail interests are riparian to the Santa Margarita, while, as previously indicated, most of Fallbrook District is outside of that drainage basin. On December 6, 1928, the district filed a condemnation on the unused riparian rights of Rancho Santa Margarita and on the lands in their proposed reservoir site.

Works.—Final plans for irrigation district works must, of course, await a satisfactory consummation of water-supply plans. In 1926, about 90, and in 1927, about 100, private pumping plants were being operated, the water supply being deficient in August and September. The only capital investment by the district is $1,700 for a small office building.

Bonds.—The district has issued no bonds. Other bonds against lands in the district, however, are estimated to total $52,500 as follows: elementary school bonds, $2,000; union high school bonds, $2,500; West Fallbrook public utility bonds, $3,000; general county bonds, $45,000.

Assessments and water tolls.—Acreage property bordering the inland highway is valued for district assessment purposes at from $100 to $125 per acre, and that removed from the highway at about $80 per acre. Town lots near Fallbrook are assessed at $165 per acre. The total district assessed valuation for 1927–28 was $895,787. The assessment

rate for each $100 of valuation for the last three years has been as follows: 1925–26, $1.33, 1926–27, $1.20, and 1927–28, $0.60. These three assessments totaled $21,285. Since the district is not an operating enterprise, no water tolls are charged.

VISTA

Location: around Vista about 10 miles inland from Oceanside, in San Diego County. (Pl. XXXV.)
Date of organization election: August 28, 1923.
Gross area: 18,161 acres; **area assessed 1927:** 18,141 acres.
Principal town: Vista.
Post office: Vista.
Railroad transportation: branch of Santa Fe railway.

History.—This district embraces the largest area that has been included within a single irrigation project in the coastal area of southern California for a good many years, with the exception of the area in San Fernando Valley which receives water from the Los Angeles aqueduct. Outside of an area of about 135 acres at Vista developed subsequent to 1912 by a private company known as Vista Water Company, and about 85 acres irrigated from three private pumping plants, the land within the district has for many years been dry-farmed. Crops grown have been mainly grain, with a few acres of truck and orchards about Vista and some vineyards in the easterly portion of the area. Construction of a reservoir at Warner Ranch on San Luis Rey River by San Diego County Water Company offered an opportunity for the Vista area to obtain a water supply, and it was this opportunity that stimulated the formation of the district.

This irrigation district embraces an irregular area extending from within one mile of San Luis Rey River on the northwest to within about one mile of Escondido on the southeast. Vista occupies an approximately central position in the main body of the district. When the district boundaries were being drawn, the owners of a large area extending to the southwest of Vista toward Oceanside desired to be included, but the water supply was found insufficient. The water supply, in fact, is insufficient for the entire area now included. When presented to the state engineer for his consideration at the time of organization he stipulated that the area should not exceed one acre for each of the 13,000 acre-feet of water then available to the district, but as the boundaries had already been drawn, assignments to the district of the right to receive water were made on a sufficient area to reduce the land entitled to water to meet the requirements of the state engineer. The method of doing this is explained in a later paragraph.

An agreement was made with San Diego County Water Company on October 2, 1924, providing for an annual supply of 13,000 acre-feet of water from Lake Henshaw, the name of the reservoir on Warner Ranch. On October 10, 1924, by a vote of 96 to 0, a bond issue of $1,700,000 was authorized. Construction work was commenced early in 1925 and the first water was delivered February 27, 1926. In 1926 the district arranged with San Diego County Water Company for an additional 600 acre-feet annually, and at a still later date 1000 acre-feet annually was arranged for on release by Escondido Mutual Water Company of an option it held on that amount.

After the district had constructed the main conduit and distribution system to each 40 acres, about $200,000 remained in the bond fund. In order to stimulate the development and settlement of district lands, the district entered into agreements with landowners whereby the district would extend the distribution system to 10-acre tracts, provided the landowners would contribute a portion of the cost and do certain development work as detailed below. The work of making extensions commenced in 1926, and during that year 25.21 miles of extension laterals were built, an additional 21.48 miles being added in 1927. Up to December 31, 1927, 103 applications for lateral extensions to serve 10-acre tracts, covering 8642 acres, had been received by the district and deposits of $106,074.97 made by the landowners. The allowance made by the district amounted to $15 per acre for extensions approved in 1926, $11 per acre for extensions approved in 1927, and $7.50 per acre in 1928. No allowances are provided for 1929. All construction work is done by the district.

With the exception mainly of some repairs to a distributing reservoir and some cracking of concrete pipes, the system constructed has given satisfactory results.

Soils and topography.—Rolling hills are a distinctive feature of the topography east of Vista. West of Vista toward the coastal plain and easterly toward Escondido the slopes become flatter. Sierra loam, Holland loam and sandy loam, Montezuma adobe, and Placentia loam constitute the main soil classifications.* Shallow arroyos furnish natural drainage into Loma Alta, Buena Vista, Agua Hedionda, and San Marcos creeks, all of which flow westerly toward the ocean. Maximum elevations are about 800 feet, the lowest elevation being around 300 feet. Practically all of the soils in the Vista District are shallow and underlain by decomposed granite and tight subsoils.

Development.—Vista Water Company, referred to above, was started in connection with a proposed irrigation development of about 1800 acres. Between 700 and 800 shares of stock were sold, each representing one acre of land. Seven wells and a small distributing system were constructed, but only about 25 miners inches of water was obtained, and that supply gradually decreased until it could not maintain the area planted. Since the district system has been completed, however, there has been marked increase in the planted area, the crop censuses of October, 1926, December, 1927, and August, 1928, showing planted and irrigated areas of 941, 2691, and 3019 acres, respectively. Many real estate firms have made subdivisions and have sought to stimulate settlement. Orchard plantings, largely citrus and avocados, total 1250 acres. The largest planted area, however, is in berries and truck, 1665 acres having been in these crops in 1927 and 1437 acres in 1928. Vista Development Company still owns 1850 acres, four other large holdings containing 980, 800, 597, and 550 acres. A census of the district taken by the district zanjeros January 1, 1928, showed a total population of 1067, of which 250 were within Vista. The county assessment roll for 1927–28 gave an estimated assessed valuation within the district of $350,000.

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the San Diego Region, California.

Water supply.—As previously indicated, the district has contracted with San Diego County Water Company for an annual water supply of 14,600 acre-feet from Lake Henshaw. This reservoir has a total storage capacity of 203,581 acre-feet. The water is impounded by a semi-hydraulic fill dam 123 feet high located at elevation 2620, the dam being across the bed of San Luis Rey River. Water released from the reservoir passes down San Luis Rey River and through Escondido Ditch into Lake Wohlford, formerly known as Escondido Reservoir, owned by Escondido Mutual Water Company. After going through the power plant of Escondido Mutual Water Company below Lake Wohlford, the water enters the main supply conduit of the district, which conveys it 12.5 miles to Pechstein Reservoir, constructed by the district.

The net safe yield of Lake Henshaw for irrigation purposes has been estimated at 28,000 acre-feet per annum, the study on which this estimate was based including the seven-year dry period of the nineties. During the last three years of such a dry period a 50 per cent supply would have been available.

The contract between the district and San Diego County Water Company provides that the 13,600 acre-feet of water covered by the first contracts shall be delivered in amounts beginning with 1360 acre-feet for the period March 1 to November 30, 1926, and increasing by that amount each year until 1936, when delivery of the full 13,600 will be reached, delivery of this amount to continue perpetually thereafter. The contract provides that the district shall pay for this water at the rate of $17.50 per acre-foot in accordance with the above delivery schedule, and regardless of the quantity used. Payment for all of the additional 1000 acre-feet obtained under the later agreement is made annually at the same rate. The contract carries a provision which permits the water company to carry 2000 acre-feet per year through the district system for delivery to outside lands.

Reference was made to the capacity and estimated safe yield of Lake Henshaw. This was given as 28,000 acre-feet per annum for irrigation. Since much of the water is now and will ultimately be used for domestic purposes, which has priority over irrigation, it should be noted that the estimated safe yield for domestic purposes is 24,750 acre-feet. Besides the 14,600 acre-feet sold to Vista Irrigation District, the company has disposed of 300 acre-feet to Bennett Mutual Water Company, 4000 acre-feet to Escondido Mutual Water Company, and 1,000 acre-feet is under option to Rancho Santa Fe, making a total of 19,900 acre-feet.

The amount of water used by Vista Irrigation District between February 1 and December 31, 1926, was 1894 acre-feet and in 1927 was 3199 acre-feet.

Works.—The main supply conduit from Escondido Power Plant to Pechstein Reservoir includes 6.7 miles of concrete flume, of a capacity of 44 cu. ft. per sec., 0.39 mile of tunnel, and 5.45 miles of concrete and steel pipe. The concrete flume was constructed of gunite upon excavated side-hill benches. Several laterals divert directly from the supply conduit, but most of the water is conveyed to Pechstein Reservoir, located about four miles east and one mile south of Vista, which has a capacity of 200 acre-feet. Pechstein dam is an earth-fill embank-

ment 52 feet high and 500 feet long. The main lateral pipe lines follow the ridges of the district. Seven circular concrete equalizing reservoirs with capacities ranging from 30,900 to 102,100 cu. ft. are located at strategic delivery points. Altogether, 82.97 miles of steel and concrete pipe are included in the distribution system to 40-acre tracts, and 46.7 miles are included in the 10-acre extension laterals.

The total capital investment to December 1, 1927, was $1,431,534.05. This includes $83,447.87 paid for interest on bonds during construction. The only works purchased were those of Vista Water Company, for which the district paid $5,500.

Use and delivery of water.—As previously indicated, the district formerly undertook to deliver water to each 40-acre tract, but has since participated in the construction of extensions to 10-acre units on 8642 acres. Where such extensions are made, all necessary easements and rights of way are granted to the district, and all laterals and pipe lines so extended are the property of the district. A further condition is that each owner applying for lateral extensions must either have already expended or must agree to expend in improvements upon the land to be served an amount equivalent to $15 per irrrigable acre. The term 'improvements' is construed to mean leveling or preparing land for irrigation or planting, proper preparation for cultivation of the soil, and the planting of trees, laying out of pipe lines or distribution lines, or such other improvements as render the land to be served "susceptible of beneficial irrigation and utilization of irrigation waters"; or improvements shall be construed to mean the "subdivision and platting of said land and filing of said plat of record and the approval thereof by the county engineer and the board of supervisors of San Diego County," together with necessary laying out and construction of roads and highways.

Management of the district is under the control of an engineer-manager. The amount delivered to irrigators for the period February 1 to December 31, 1926, was 834 acre-feet, 200 acre-feet having been lost by draining Pechstein Reservoir for repairs. In 1927 the total deliveries amounted to 2093 acre-feet.

Water is measured by displacement and propeller-type meters. Service connections are made on written application to the district approved by the engineer-manager, with advance deposits varying from $20 for a 5/8-inch disc meter to $85 for a 2-inch disc meter, for pressure use, or a 4-inch propeller-type meter, for gravity use.

Irrigation and domestic water is supplied only on written application, it being necessary to file application for irrigation water two days before water is required. The minimum irrigation head delivered is 10 inches. The rules provide that at the peak of the irrigation season water shall be served according to a rotation schedule furnished to the irrigators 48 hours in advance of service.

Reference has been made to the assignment to the district of rights to receive water in order to reduce the irrigable area from the gross area of 18,161 acres, included within the district, to 14,600 acres. This method of reducing the area to be irrigated was approved by the Bond Certification Commission and the area to be eliminated from service through such assignments was worked out by committees of landowners. These 'waived' lands generally constitute the least valuable and least

easily irrigated lands. They are definitely platted on the irrigation district map and assignments by the various landowners are of record. Whether any of the 'waived' areas will receive water in the future will depend upon the use of water and requirements as the district develops.

The net economic water requirement of land in Vista District was under investigation in 1926 and 1927 by the Division of Irrigation Investigations and Practice of the College of Agriculture and the Division of Agricultural Engineering of the U. S. Department of Agriculture, cooperating with the State Department of Public Works, and a report has been prepared for publication. It was found that the normal rainfall when normally distributed is sufficient to meet winter needs of groves and cover crops, and that from one to two winter irrigations will be needed in 5 out of 10 years; also that mature groves will require about 1.25 acre-feet of water per acre per year during the irrigation season.

Bonds.—The district has voted but the one bond issue, of $1,700,000. This is dated January 1, 1925, bears interest at 6 per cent, and matures from 1946 to 1965. Other bonds against lands in the district are estimated to total $230,000, as follows: Elementary school bonds, $24,000; Oceanside High School bonds, $6,000; road district bonds, $45,000; sanitary district bonds, $70,000; street improvement bonds, $20,000; and general county bonds, $65,000.

Assessments and water tolls.—The district values land for purpose of assessment at rates ranging from $130 to $200 per acre, with a normal assessment of $160 per acre. 'Waived' lands are assessed at from $5 to $10 per acre. The 'normal' assessment for three years previous to 1927–28 was $150 per acre. The total district assessed valuation for 1927–28 was $2,246,184. The assessment rate for each $100 valuation during the past four years has been as follows: 1924–25, $1.25; 1925–26, $1.35; 1926–27, $5.30; 1927–28, $7.85. The total levy in 1927–28 was $176,323. In addition to these assessments water tolls are charged on each acre entitled to receive water, the rate having been $1.75 per acre in 1926, $4.50 per acre in 1927, and $6.25 per acre in 1928.

The payment of the toll gives the landowners the right to receive without additional charge a proportionate share of the minimum amount of water which the district must purchase each year from San Diego County Water Company. In the year 1926–27 the toll of $4.50 per acre gave the landowners the right to receive 0.26 acre-foot of water, and the toll of $6.25 in 1928 gave the right to receive 0.36 acre-foot.

Landowners desiring more than their pro rata share of the water are permitted to purchase an assignment of water toll 'credits' from some other landowner, or they may purchase additional water from the district at $0.04 per 100 cu. ft.

Water rates for domestic service are as follows: first 500 cu. ft. per month, $0.20 per 100 cu. ft.; for the next 1500 cu. ft. per month, $0.15; for the next 3000 cu. ft. per month, $0.10; for all over 5000 cu. ft. per month, $0.07 per 100 cu. ft. Minimum monthly charges vary from $1 to $2 depending on size of meter. Combined irrigation and domestic service may be received through one meter if the area irrigated is three acres or less. The combination rate is $0.10 per 100 cu. ft. for the first 1500 cu. ft. per month and $0.05 per 100 cu. ft. for use over 1500 cu. ft.

FIG. 1. Contour irrigation in Vista Irrigation District.

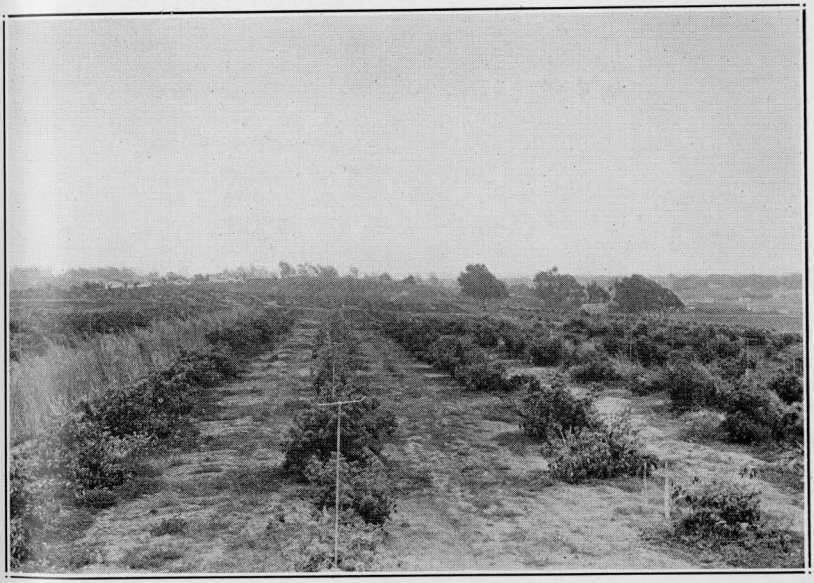


FIG. 2. A typical section of San Dieguito Irrigation District.

per month. With the exception of the flat rate irrigation toll, charges are required to be paid before the tenth of the month following delivery, or service is discontinued.

Landowners who have waived the right to receive water on a portion of their holdings may still use their pro rata of water on those lands if they desire to do so, as long as there is a surplus, although in no case is the quantity delivered to be increased, excepting as above indicated.

SAN DIEGUITO

Location: on coastal plain, about 30 miles north of San Diego, in San Diego County. (Pl. XXXV.)
Date of organization election: March 18, 1922.
Gross area: 3900 acres; **area assessed 1927:** 3850 acres.
Principal towns: Cardiff and Encinitas.
Post office: Encinitas.
Railroad transportation: Santa Fe railway.

History.—In 1918 and 1919, when Hodges Dam on San Dieguito River was nearing completion, steps were taken by landowners holding property from Del Mar to Oceanside to organize an irrigation project to make use of some of the water that was being made available by storage at Lake Hodges. A district containing about 25,000 acres was proposed and some steps were taken towards organizing it. In 1916, Cardiff Irrigation District, located a few miles north of Del Mar, had been formed, this containing only about 700 acres. It was first proposed to include 4000 acres in Cardiff District, but an adverse report by the state engineer caused reduction to the smaller area. Nothing was done in Cardiff District and the project remained dormant pending the consideration of plans for the larger district. At one time it was proposed to form the larger district by increasing the area of Cardiff District to take in lands up to Oceanside, but this was not deemed feasible and the plan was abandoned.

When San Dieguito Irrigation District was formed, it included only 2300 acres, but it was later increased to its present area by the inclusion of the townsite of Encinitas, and by consolidation with Cardiff District, this consolidation being effected at an election held September 26, 1922. By that time, Hodges Dam had been completed, as well as a conduit leading from Lake Hodges to a small reservoir known as San Dieguito Reservoir. These properties were owned by Santa Fe Land Improvement Company, a subsidiary of the Santa Fe railway. On January 18, 1923, San Dieguito District entered into a contract with this company for an annual water supply of 3200 acre-feet. A plan of construction was prepared calling for an expenditure of $400,000, and at an election February 27, 1923, bonds in that amount were unanimously voted. The San Dieguito District system was completed in February, 1924, at a cost exceeding the bond sales by about $60,000, the excess being covered by district warrants.

Under date of November 1, 1925, the contract between San Dieguito Irrigation District and Santa Fe Land Improvement Company was superseded by a contract with San Dieguito Mutual Water Company, which had in the meantime acquired Lake Hodges, San Dieguito Reservoir, and the connecting conduit. Later, the interests of San

Dieguito Mutual Water Company were acquired by the city of San Diego.

Soils and topography.—The coastal plain in the vicinity of San Dieguito Irrigation District rises abruptly about 80 feet above the shore line of the Pacific Ocean. The land slopes inland for a short distance from the bluff and then merges into a rolling plateau, of which the higher elevations range from 100 to 300 feet. This plateau is crossed by numerous arroyos. The principal soil classification is Kimball sandy loam, with some San Joaquin sandy loams in the western portion.* There are no wells in the district and natural drainage is supplied by the arroyos.

Development.—While there is important agricultural development in the district, it has been largely subdivided and residential development is going forward. The irrigated land has increased from 470 acres in 1924 to 1700 acres in 1928. The principal permanent plantings are avocados, of which the 1928 crop census shows 533 acres. The crop census of 1928 also shows 1167 acres in potatoes, beans, vegetables, and other truck crops, 200 acres in bulbs and flowers, and 33 acres in trees other than avocados. An area of about 80 acres is double-cropped. In 1927, there were 200 irrigated farms, 241 irrigation meters, and 351 domestic meters. On July 1, 1928, irrigation meters had increased to 305, and domestic meters to 442. The extent of subdivision is indicated by the fact that the 1927–28 assessment roll showed 1650 property owners, the average holding being about 2 acres. At that time, there was one holding of 400 acres, with 200 acres in crop and 200 acres about to be subdivided, one of 250 acres, and one of 240 acres, both of the latter being largely cropped. The 1927–28 county assessed valuation, as estimated from school district assessments, was $320,000. There are about 450 inhabitants in Cardiff, about 450 in Encinitas, and about 700 outside of these two unincorporated towns. The coast highway runs through the district close to the coast line.

Water supply.—The 'safe yield' of Lake Hodges for irrigation purposes has been estimated at 10,500 acre-feet. Of this amount, as already indicated, San Dieguito District has contracted for 3200 acre-feet. Water-supply studies show that during dry years, such as occurred between 1894 and 1904, it will be necessary to draw upon other sources to maintain the district supply at 75 per cent of the maximum of 3200 acre-feet per annum. A supplemental contract between San Dieguito Water Company and San Diego County Water Company, owners of Lake Henshaw, for delivering, under certain conditions, sufficient water from the San Luis Rey River watershed during periods of drought to insure a 75 per cent supply to San Dieguito District. A second possible alternative for the district during drought is pumping from the gravel basin along San Dieguito River.

Water is delivered to the district at San Dieguito Reservoir, situated on Santa Fe Rancho five miles east of the district. The contracts with San Dieguito Mutual Water Company provide minimum annual payments beginning with $17,829, on October 31, 1926, and increasing to $41,600, on October 31, 1930, the latter being the amount to be paid

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the San Diego Region, California.

each year thereafter. The district is required to pay $0.03 per 100 cu. ft., equivalent to $13.07 per acre-foot, for water used for irrigation, and $0.075 per 100 cu. ft., equivalent to $32.67 per acre-foot for domestic water, the district being obligated to provide meters and segregate the service.

Works.—The district has built a skeleton water distribution system for 3200 acres and a complete system covering 2900 acres. Lake Hodges, the source of supply, is located on San Dieguito River about ten miles inland from the coast, and is formed by a multiple-arch dam, 130 feet high, which impounds 37,700 acre-feet of water. The spillway is at elevation 315. Carroll Conduit, which conveys water to the delivery point at San Dieguito Reservoir, is for the most part a concrete open canal, although in many places the section is changed to concrete pipe or steel flume supported by concrete trestle. The conduit is about four miles long and has a capacity of about 30 cu. ft. per sec. San Dieguito Reservoir has a capacity of 1120 acre-feet. Water from this reservoir is conveyed to the district by 10 miles of continuous wood stave pipe, 7 miles of which is 26 inches in diameter, the remainder being 24, 22, 20, 16, and 14 inches in diameter. The capacity of this line is slightly in excess of 10 cu. ft. per sec. At intervals of about 0.5 mile, after the pipe line enters the district, it is tapped by riveted steel lateral pipes from 12 inches down to 4 inches in diameter. The original system was designed for distribution to each ownership, but extensions to subdivided areas are made by the district at the cost of the subdividers, a deposit by the subdividers being required in advance, the actual cost being adjusted after the work is completed. Many extensions have been made according to this procedure. Within the townsites of Cardiff and Encinitas all laterals are usually of 4-inch riveted steel or 2½-inch standard screw pipes. The lateral pipe system is about 45 miles in length.

About 1400 acres in the district is above the gravity distribution system and receives water by means of three booster pumps lifting water 105, 150, and 170 feet, respectively. The booster pumps are all centrifugals with capacities of 450, 1220, and 900 g.p.m., respectively, the former being operated by a 20-h.p. motor and the two latter by 60-h.p. motors.

The total investment in works to December 31, 1927, was $490,347.55, not including depreciation.

Use and delivery of water.—All water delivered is measured by displacement-type meters, service being continuous and meters being installed at the cost of the consumers. Service pipes and fittings from the district laterals to the property lines are furnished at the expense of the district, it having already been noted that extensions necessary for supplying subdivided areas must be paid by the landowners. These latter extensions are maintained by the irrigation district but are to remain the property of the landowners until the cost has been repaid by the district.

In case of water shortage, the district reserves the right to give preference to domestic use. During the years 1924 to 1927, the district diverted water from San Dieguito Reservoir as follows: 1924, 378 acre-feet, 1925, 681 acre-feet, 1926, 1115 acre-feet, and 1927, 1280

acre-feet. During the same years the total deliveries were: 1924, 299 acre-feet, 1925, 580 acre-feet, 1926, 1012 acre-feet, and 1927, 1162 acre-feet. Of the 1162 acre-feet delivered in 1927, 111 acre-feet was for domestic use and 1050 acre-feet for irrigation. Small quantities of water were sold outside of the district in 1925 and 1926 for duck clubs, the amounts being included under irrigation. All water is delivered under pressure.

The superintendent of the district compiled from meter readings the net duty of water on 181 acres in 1925 and 1926. In 1925, 40 acres of avocados 4 years old used from 1.78 to 3.12 acre-feet per acre; 21.5 acres of bulbs used 1.57 acre-feet per acre; and 80 acres of potatoes used 0.463 acre-foot per acre. In 1926, the use on avocados ranged from 1.80 to 2.64 acre-feet per acre; on bulbs, from 1.30 to 1.42 acre-feet per acre; and for truck and poultry, 1.75 acre-feet per acre. In 1925, the rainfall was 10.14 inches and in 1926, 13.25 inches.

Bonds.—The $400,000 bond issue of the district is dated April 1, 1923, bears 6 per cent interest, and matures from 1931 to 1950. Other outstanding bonds are estimated to amount to about $300,000, of which $1,000 are high school bonds, $3,000 elementary school district bonds, $20,000 bonds of Encinitas Lighting District No. 1, $125,000 general county bonds, and $150,000 are Improvement District No. 14 bonds, issued January 1, 1928. A new road improvement district is being formed for the construction of a highway joining Encinitas and Cardiff with Rancho Santa Fe, and this will add a substantial amount to the above total.

Assessments and water tolls.—The district assessor undertakes to assess all land at about 50 per cent of its cash value. The district assessment along the ocean front outside of Encinitas and Cardiff is at the rate of $650 to $900 per acre. Higher lands east of the highway are assessed at from $100 to $600 per acre, the usual valuation being about $400 per acre. The highest valuation is on lots in the business district of Encinitas, where the maximum rate is $15 per front foot, which is slightly in excess of $5,000 per acre. The total district assessed valuation for 1927–28 was $1,796,462, which is slightly lower than it was for each of the preceding three years. The assessment rates for each $100 of valuation for the past five years have been as follows: 1923–24, $8; 1924–25, $3.50; 1925–26 and 1926–27, $4; and 1927–28, $2.75. The total levy in 1927–28 was $49,402.71. This was the smallest levy since 1922–23, it having been about $73,500 in each of the two preceding years. This reduction in 1927 was due to the retirement of all construction warrants in 1926. The retirement of these warrants was made possible by the sale of tax sale certificates mainly covering land in the old Cardiff District which was delinquent when the two districts were consolidated. The purchaser of the tax sale certificates paid to the district $13,424.10, this including the face value and interest at 7 per cent to purchase date.

In addition to the annual assessments, the district charges tolls on all water delivered. Up to 1927, water delivered for irrigation was charged at $0.03 per 100 cu. ft. under the gravity system; $0.045 per 100 cu. ft. under booster pump No. 1, which has a lift of 150 feet; $0.05 per 100 cu. ft. under booster pump No. 3, which has a lift of 105 feet; and $0.06 per 100 cu. ft. under booster pump No. 2, which has

a lift of 170 feet. Up to 1927, the rate for domestic water was $0.075 for each 100 cu. ft. under the gravity system and $0.09 for each 100 cu. ft. under booster pump No. 1, $0.105 under booster pump No. 2, and $0.095 under booster pump No. 3. Collections are made monthly. The total tolls collected in 1927 were $21,352. New tolls went into effect July 1, 1928, as follows: irrigation water, $0.03 for each 100 cu. ft. over the entire district; for domestic use, $0.075 for each 100 cu. ft. over the entire district.

SANTA FE

Location: on the coastal plain directly north of Del Mar, in San Diego County. (Pl. XXXV.)
Date of organization election: February 14, 1923.
Gross area: 9258 acres; **area assessed 1927:** 9258 acres.
Principal towns: Rancho Santa Fe and Solana Beach.
Post office: Rancho Santa Fe.
Railroad transportation: Santa Fe railway.

History.—The area included in this district was embraced within the area of about 25,000 acres which several years ago it was proposed to include within a single project.* It embraces practically all of the high lands between San Dieguito River and San Elijo Creek, extending from the Pacific Ocean on the west to the eastern boundaries of the old Rancho San Dieguito, about six miles inland.

Santa Fe District is intended primarily as a suburban area, the eastern portion, embracing Rancho Santa Fe, being a district of restricted rural homes. Rancho Santa Fe was acquired about twenty years ago by Santa Fe Land and Improvement Company, a subsidiary of Atchison, Topeka, and Santa Fe Railway Company. At the time of organizing the district the lands lying between Rancho Santa Fe and the ocean were held almost entirely by two interests.

Soils and topography.—Surveys by the engineers of the district have segregated 2892 acres as nonirrigable. Large portions of the nonirrigable lands are rough, cut by arroyos, and covered with chaparral, and contain many attractive homesites. The topography of the district, in fact, is generally rolling, with elevations varying from about 40 to about 360 feet.

The soil survey classifies the land generally as Los Flores and Kimball sandy loams, San Joaquin sandy loams, and Montezuma adobes.† The larger agricultural areas are Los Flores and Kimball loams and sandy loams, undifferentiated. General natural drainage is supplied by the arroyos, a few low places requiring small drainage works.

Development.—The district is composed of three main areas, namely, Rancho Santa Fe on the east, Solana Beach on the coast, and the intervening property, known as the 'syndicate' lands. In recent years in the development of Rancho Santa Fe emphasis has been placed on private homesites for people of ample means not dependent on agriculture. A civic center has been built and about 45 homesites have been established. The population of the civic center and surrounding residences totals about 265. Along the seacoast in the vicinity of Solana Beach, land is largely subdivided into town lots. About 60 homes

* See statement regarding San Dieguito Irrigation District above.
† U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the San Diego Region, California.

and business structures have been erected and the present population is about 300. Approximately 1350 acres of the area between Solana Beach and Rancho Santa Fe has not been subdivided, and up to 1926 was leased to Japanese truck growers, since which time it has not been much used.

A corporation, known as 'Rancho Santa Fe Corporation,' has recently purchased the unsold lands in Rancho Santa Fe, comprising about 1500 acres, as well as the 'Syndicate' lands, comprising about 1400 acres. About 500 acres in the Solana Beach area is in another ownership. The approximate total number of holdings in 1927–28 was 345, which was an increase of 45 since the previous year. The portion of the county assessment for 1927–28 estimated to cover lands in the district amounted to $275,000.

While Santa Fe District is primarily suburban in character, 1085 acres was reported irrigated in 1926 and 1625 acres in 1927. Of the area reported irrigated in 1927, 575 acres was in avocados, 716 acres in oranges and lemons, 100 acres in deciduous fruits, 34 acres in walnuts, 160 acres in truck crops, and 40 acres in bulbs. Most of the citrus and avocado plantings are in Rancho Santa Fe, where they surround the rural homes.

Water supply.—Like San Dieguito Irrigation District, Santa Fe District obtains its water from the San Dieguito River drainage area after storage in Lake Hodges. On November 1, 1925, the district contracted with San Dieguito Mutual Water Company for the delivery to the district of 6576 acre-feet of water per annum, annual deliveries to increase from 1879 acre-feet, for the year ending November 1, 1926, to the full amount of 6576 acre-feet, for the year ending November 1, 1931. The contract provided for increase in payments from $24,552, November 1, 1926, to $85,935, November 1, 1931, annual payments in the latter amount to continue after 1931. The interests of San Dieguito Mutual Water Company were acquired late in 1925 under lease contract by the city of San Diego. The district has an option until 1931 to purchase an additional 1000 acre-feet annually from San Diego County Water Company, owner of Lake Henshaw on the San Luis Rey. Furthermore, the district has a contract with San Diego County Water Company under which the latter guarantees to the district a 75 per cent supply in case a period of extreme drought should cause a deficiency in the yield of Lake Hodges. When the district was organized the requirement of 1 acre-foot per acre on arable land and 0.25 acre-foot per acre on nonarable land was assumed as sufficient, it being further assumed that 10 per cent of the arable land and 25 per cent of the nonarable land would not require water each year.

Works.—Reference was made to Lake Hodges, San Dieguito Reservoir, and the conduit connecting them under San Dieguito Irrigation District. As in the case of San Dieguito District, Santa Fe District receives its supply from San Dieguito Reservoir. The distributing pipe lines leading to the district from San Dieguito Reservoir comprise 29 miles of steel and concrete mains, ranging from 27 inches down to 12 inches in diameter, and 42.5 miles of lateral pipes, from 10 inches down to 2 inches in diameter. Nineteen small concrete distributing reservoirs are located at convenient points along the distribution system. Nine booster pumping plants lift water to the higher areas

FIG. 1. Irrigating young avocados in Santa Fe Irrigation District.

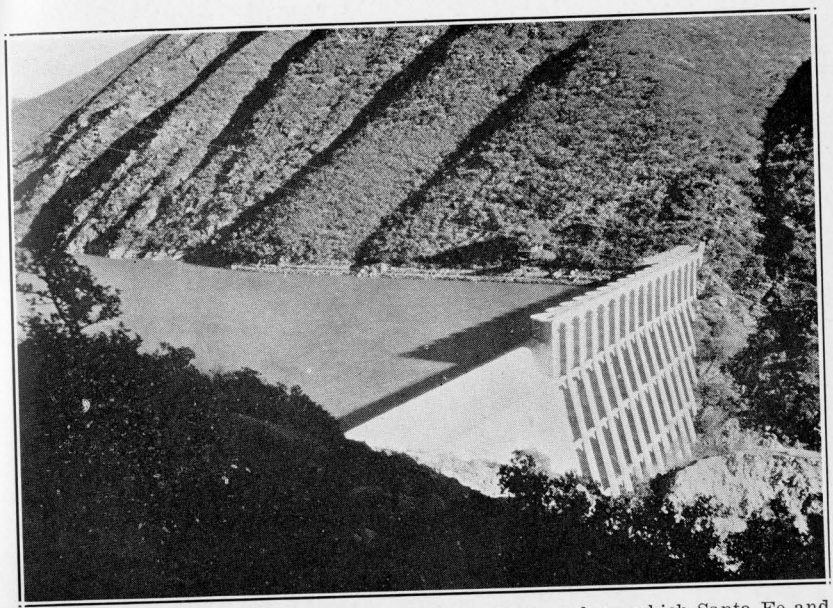


FIG. 2. Hodges Dam and lower portion of Lake Hodges, from which Santa Fe and San Dieguito irrigation districts obtain their water.

in the district. These have capacities ranging from 225 to 1100 g.p.m. At the present time about 500 acres is served, the lift ranging from 50 to 150 feet.

The total investment in works to December 31, 1927, was $630,651.83. This included $423,708.84 paid to Santa Fe Land and Improvement Company for pipe lines and equipment and $35,519.52 paid to San Dieguito Mutual Water Company for pipe lines installed after the voting of bonds but prior to their sale. The largest items in the construction expenditures of the district have been $472,237.87 for pipe lines and $101,488.66 for reservoirs.

Use and delivery of water.—All water for either irrigation or domestic use is measured by displacement meters, deliveries being to units of about 10 acres. Water delivery began in 1924, the estimated diversions and deliveries since that being as follows: 1924, diversions 800 acre-feet, deliveries 635 acre-feet; 1925, diversions 1150 acre-feet, deliveries 920 acre-feet; 1926, diversions 1000 acre-feet, deliveries 800 acre-feet; 1927, diversions 1330 acre-feet, deliveries 1154 acre-feet. Of the deliveries in 1927, 1030 acre-feet was for irrigation and 124 acre-feet for domestic use. The diversion of 1330 acre-feet in 1927 was less than 50 per cent of the minimum quantity for which the district was required to pay under its contract with San Dieguito Mutual Water Company.

The manager of Santa Fe District reports that on Rancho Santa Fe in 1926 the average use on orchard plantings two and three years old was 0.06 acre-foot per acre, the highest consumption being 1.65 acre-feet on an orchard planting intercropped with vegetables. The use of water in the Lockwood Mesa and Solana Beach areas averaged 1.7 acre-feet per acre, the plantings consisting almost entirely of vegetables or orchards intercropped with vegetables. The rules of the district require that written applications for water service must be made, and that water must be used continuously for at least 24 hours in heads of not less than 5 inches, unless otherwise arranged. Irrigation and domestic services are segregated by use of separate meters.

Bonds.—The district has one bond issue amounting to $700,000. It is dated November 1, 1923, bears interest at 6 per cent, and matures from 1933 to 1952. The issue was sold in two installments in June and July, 1924. Interest payments amount to $42,000 per annum until 1932, inclusive, and then begin to decrease. Payments on principal begin with $19,000 annually in 1933 and increase gradually to $58,000 in 1952. The maximum annual payment for interest and principal of bonds comes in 1938, when the required payment is $60,860.

Other bonds are estimated to amount to $70,000, including $6,000 high school bonds and $65,000 general county bonds. In August, 1928, a road improvement district was being formed which proposed to carry out construction estimated to cost about $300,000, a large portion of which would be assessed against lands in Santa Fe Irrigation District.

Assessments and water tolls.—District assessment valuations are stated to be from 25 to 50 per cent of selling price. Land in Rancho Santa Fe is assessed at about $180 per acre and lands lying between Rancho Santa Fe and the coast at $200 to $450 per acre. Nonarable acreage is assessed at about one-tenth of the assessment of arable land.

Town lots in Solana Beach and in Rancho Santa Fe Civic Center are assessed at $75 to $150. In general, valuation decreases as distance from the ocean increases. The total district assessed valuation for 1927–28 was $1,424,688. For the past five years the annual assessment rates on each $100 of valuation have been as follows: 1923–24, $8.80; 1924–25, $5.22; 1925–26, $5.88; 1926–27, $6.04; 1927–28, $6.27. The total levy for 1927–28 was $89,327.

Tolls are charged for all water delivered. There is a minimum monthly charge of $1 to $3, depending on the size of the meter, for each service connection. Domestic rates are charged at $0.15 per 100 cu. ft. for the first 1000 cu. ft. per month, $0.10 per 100 cu. ft. for the next 4000 cu. ft. per month, and $0.08 per 100 cu. ft. for all over 5000 cu. ft. per month. The irrigation rate is $0.03 per 100 cu. ft. throughout the system. Water sales collections have equalled required purchase payments only in 1924. They were less than required purchase payments by $886.84 in 1925, by $10,541.43 in 1926, and by $16,727.21 in 1927.

The district has entered into eight contracts for the sale of surplus water outside the district, in 1927 receiving a total revenue from this source of about $500. The total water tolls collected in 1927 amounted to $19,746.

RAMONA

Location: in Santa Maria Valley about 40 miles northeast of San Diego, in San Diego County. (Pl. XXXV.)
Date of organization election: July 27, 1925.
Gross area: 650 acres; **area assessed 1927:** 600 acres.
Principal town: Ramona.
Post office: Ramona.
Transportation: paved highway to San Diego.

History.—This is one of the smaller irrigation districts in California, and is thus far primarily a semimunicipal enterprise, its chief present purpose being to supply domestic and garden water for inhabitants of Ramona, which occupies the center of the district. Ramona was established in the eighties as a stage station and the surrounding area in Santa Maria Valley has since been devoted mainly to grain and diversified farming. Development of a small underground water supply at Ramona has, however, permitted growth of the settlement. A few orchards have been put out, some truck crops have been grown, and poultry raising has become an important local industry.

The underground water supplies within the town of Ramona have been brackish and not satisfactory for domestic consumption. The district was therefore organized to acquire water-bearing lands and an established pumping right directly adjacent to Santa Maria Creek, which bounds the district on the northwest. Bonds were voted shortly after organization and construction work was carried out in 1927, water being first delivered in August of that year. Both the organization election and the bond issue were carried by practically unanimous votes.

Soils and topography.—Soils are mainly classified as Placentia sandy loam, with some Sierra loam scattered along the eastern boundaries.*

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the San Diego Region, California.

With the exception of a small amount of hillside land, the topography is flat, with a gentle slope toward Santa Maria Creek. Elevations mainly range from 1440 feet to 1540 feet. The ground water level at Ramona is about 20 feet from the surface. No drainage has been found necessary and none has been provided.

Development.—This has been partially covered under "History." Besides the water furnished to Ramona, about 30 acres of alfalfa and corn was irrigated in 1928. The assessment roll for 1927–28 showed 160 landholdings, the two largest being 25 and 15 acres. The estimated county assessed valuation for 1927–28 was $55,000. The estimated population is 750, all living within the nonincorporated town of Ramona.

Water supply.—The district purchased 165 acres of water-bearing gravels along Santa Maria Creek, from which the engineer of the district estimates 560 acre-feet annually can be obtained. No filing has been made with the Division of Water Rights, the district having acquired a filing for 1000 inches of the water of Santa Maria Creek made under the old law by W. E. Woodward on March 4, 1912. Santa Maria Creek is a tributary of San Dieguito River. The city of San Diego is the principal claimant on the latter, but has taken no action to enjoin diversion by Ramona District.

Works.—There are 12 wells, about 35 feet deep, in the water-bearing area along Santa Maria Creek. These are pumped through a common branched suction line by a 6-inch centrifugal pump situated in a concrete pit about 7 feet below the surface. This pump is belt-connected to a 15-h.p. induction motor and under test has delivered a maximum of 320 g. p. m. Delivery is first made to a 350,000-gallon circular concrete sump, from which the water is boosted 130 feet into a 100,000-gallon redwood stave tank situated 1500 feet to the southeast. The booster pump is a 2½-inch, two-stage centrifugal, with a capacity of 250 g. p. m. and is directly connected to a 20-h.p. induction motor. The distribution system consists of 2013 feet of 10-inch, 4455 feet of 8-inch, 7171 feet of 6-inch, 14,391 feet of 4-inch, and 12,500 feet of 3-inch steel tubing.

The capital investment in works to December 31, 1927, amounted to $95,946.81, which included items for legal services and interest. This sum includes $10,000 paid for 55 acres and $35,000 paid for 110 acres along Santa Maria Creek, together with attached rights and equipment.

Use and delivery of water.—Water deliveries commenced in August, 1927. Monthly deliveries from January 1 to July 31, 1928, ranged from 60,275 cu. ft., in February, to 239,933 cu. ft., in July, the total having been 1,700,426, or 23.1 acre-feet. All deliveries are measured by displacement-type meters. Meter installations are paid for by consumers, the charge for a ⅝-inch by ¾-inch meter being $30 and for a 1-inch meter, $45. The district retains the ownership of both meters and the service pipes. The rules of the district give to the manager the right to place irrigators on any one line or conduit upon an irrigation schedule in case of necessity, this schedule to prorate the water according to the irrigated area.

Bonds.—A bond issue of $91,000 was voted May 4, 1926. The bonds are dated July 1, 1926, bear 6 per cent interest, and mature from 1947 to 1966. There are also outstanding approximately $875 in Ramona

Union High School bonds and $16,700 in general county bonds prorated against lands in the district. There is also an annual tax of Ramona Lighting District amounting to $750.

Assessments and water tolls.—For district assessment purposes lands are valued at from $40 to $50 per acre, the higher figure being the usual valuation. The total assessed valuation in 1927-28 was $68,767. The annual assessment rate for each $100 valuation was $2 in 1926–27 and $8 in 1927–28. The total levy in 1927–28 was $6,301. In addition to assessments, a minimum monthly charge of $2 is made for each service connection, this entitling the consumer to 1000 cu. ft. of water. Tolls for water in excess of 1000 cu. ft. are at the rate of $0.08 per 100 cu.ft. The district collected $3,456.46 for service installations and water tolls to December 31, 1927, of which it is estimated that about $2,500 was paid for service installations.

LAKESIDE

Location: on south bank of San Diego River, about 20 miles northeast of San Diego, in San Diego County. (Pl. XXXV.)
Date of organization election: July 29, 1924.
Gross area: 320 acres; **area assessed 1927:** 320 acres.
Principal town: Lakeside.
Post office: Lakeside.
Railroad transportation: San Diego and Arizona railway.

History.—This is the smallest irrigation district in California. As first proposed, the district boundaries were to include about 800 acres, this area including several orange and lemon groves. Water was being received from Cuyamaca Flume, now owned by La Mesa, Lemon Grove and Spring Valley Irrigation District. Lakeside was the residential and business center. The area of the district was finally reduced to 320 acres and it was proposed to purchase 13⅜ shares of stock in Lakeside Heights Water League, which had been organized to construct a connecting pipe line to the Lakeside area from Cuyamaca Flume. Twenty-four shares of stock had been issued, the recognized sale price per share being $1,000. In December, following the organization of the district, a bond issue of $35,000 was reported on favorably by the Bond Certification Commission, after having been approved by a vote of 69 to 4 at an election June 6, 1924.

The district did not, however, carry out the plan to purchase 13⅜ shares of stock in Lakeside Heights Water League. Instead, it purchased 4 of these shares and developed a well in San Diego River basin, yielding 1000 g. p. m. when pumped with an 18-inch deep-well turbine. The construction of the system was completed in 1926.

Soils and topography.—The district surrounds Lindo Lake, a small lake of about 25 acres which is excluded from the district. West of the lake the land slopes rather evenly towards San Diego River, a portion of the low land along the river, with an elevation of about 400 feet, being subject to submergence by the floods in the river. East of Lindo Lake the land in the district is rolling and attains an elevation of about 500 feet along the south boundary. The soils are variable and, with the exception of those near the higher elevation, are deep and fertile, being composed of recent alluvial deposits of San

Diego River and Los Coches Creek. The principal soil classification is Placentia loam.* No drainage has been found necessary.

Development.—Lakeside District is essentially residential, the entire district being subdivided into town lots and small tracts. About 95 separate ownerships appeared on the 1927–28 assessment roll, the largest ownership being 60 acres. Irrigation is confined to about 50 acres of alfalfa on the low lands along the river. The district has an estimated population of 500. A substantial business center is located in Lakeside. The county assessment roll showed an estimated assessed valuation within the district of $35,000.

Water supply.—The district is assumed to be entitled to a flow of four miners inches from the Cuyamaca system by virtue of its ownership of four shares of stock in Lakeside Heights Water League. This and the supply obtainable from the well in the river basin exceeds the estimated ultimate requirement of the district. The right of Lakeside District to pump from the gravels along San Diego River presumably is involved in pending litigation in which the city of San Diego is seeking to establish its paramount right to the waters of San Diego River by virtue of the fact that the city is the successor of a Spanish pueblo. This suit, referred to more fully in the statement regarding La Mesa, Lemon Grove, and Spring Valley Irrigation District below, is now on appeal to the supreme court. In 1928, Lakeside District acquired a 50 per cent interest in the riparian right of a large tract on San Diego River.

Works.—The district has installed a deep-well turbine with a capacity of 300 g. p. m. in its well near San Diego River. The pump, operated by a 10-h.p. motor, delivers water into a sump near Lindo Lake. At this point it is boosted 120 feet into a 200,000-gallon redwood stave tank situated on the hillside south of the lake. The booster pump has a capacity of 350 g.p.m. and is driven by a 35-h.p. motor. Storage tanks supply water under pressure to all parts of the district through 24,364 feet of steel pipe ranging from 8 inches down to 2½ inches in diameter.

The capital investment in works to December 31, 1927, was $42,794, of which $34,125 was obtained from bonds and $8,669 from annual assessments. This investment includes $1,500 paid for 6 acres of riverbed land and $4,000 paid for the right to 4 inches continuous flow from Cuyamaca Flume delivered through the Lakeside Heights League water system.

Use and delivery of water.—All water delivered is measured by displacement-type meters. A consumption of 437,700 cu. ft., or approximately 10 acre-feet, was recorded in 1926. In 1927, after the well supply became available, the consumption increased to about 78 acre-feet, about 50 per cent of which is sold outside of the district. While the above figures give a general idea of consumption requirements, the system has not yet been operated sufficiently long to draw definite conclusions regarding the amounts that will be needed. The number of water consumers in 1927 was 83, being an increase of 13 over 1926.

Bonds.—By vote of 69 to 4, on January 6, 1925, the district authorized a bond issue of $35,000. The issue is dated January 1, 1925,

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the San Diego Region, California.

bears 6 per cent interest, and matures from 1946 to 1965. Lakeside Union School bonds prorated to the district approximate $3,100; Grossmont Union High School bonds approximate $2,000; and general county bonds approximate $1,900; a total of $7,000. There is an annual tax against lands in the district, levied by Lakeside Lighting District, amounting to $206.

Assessments and water tolls.—In 1925, the district used county valuations for assessment purposes. In 1926, they used the same valuations multiplied by three. In 1927, the estimated actual full cash value was used as the basis for district assessments. The assessed valuation on acreage ranges from $25 to $150 per acre and on lots from $40 to $600, the usual valuation on acreage being $100 per acre and on lots, $220 each. The total district assessed valuation for 1927–28 was $118,608. The annual assessments for each $100 of valuation for the past three years have been $8 for 1925–26, $3.50 for 1926–27, and $4.25 for 1927–28. The total levy in 1927–28 was $5,041.

Water tolls, in addition to assessments, are $2 per month, minimum, within the district, with an allowance of 1000 cu. ft., and $0.05 per 100 cu. ft. for consumption over 1000 cu. ft. per month. Water toll collections increased from $1,284 in 1926 to $3,616 in 1927, the increase resulting largely from outside sales made in 1927. Consumers outside of the district pay a minimum charge of $3 per month, with an allowance of 1000 cu. ft., and $0.06 for each 100 cu. ft. over 1000 cu. ft.

Water consumers pay the cost of meter installation. Service charges for meters range from $15 for a $\frac{5}{8}$-inch by $\frac{3}{4}$-inch meter to $85 for a 2-inch meter. Ownership of meters and service is retained by the district. The district installs at its expense service of suitable capacity from water mains to curb or property lines abutting upon public streets, highways, alleys, lanes, or roads in which water mains of the district are installed. No service longer than 20 feet, except across a street, is installed at the expense of the district. All water bills are payable monthly, and become delinquent on the fifteenth day of the month following consumption, when 10 per cent is added. The usual provision is made for placing irrigators on any one line or conduit upon an irrigation schedule in case of necessity.

LA MESA, LEMON GROVE, AND SPRING VALLEY

Location: adjoining San Diego, in San Diego County. (Pl. XXXV.)
Date of organization election: October 17, 1913.
Gross area: 18,000 acres; **area assessed 1927:** 18,000 acres.
Principal towns: El Cajon and La Mesa.
Post office: La Mesa.
Railroad transportation: branch of San Diego and Arizona railway.

History.—This is the largest of the irrigation districts in southern California in which residential development predominates over agriculture. The early history of the district is given in a previous publication.* When organized in 1913 it was assumed that irrigation would be important on some 12,000 acres out of the 14,794 acres then included in the district, although the increasing importance of residential development and domestic use of water was recognized. During the fifteen years since organization, the population of San Diego and

* State Dept. of Eng., Bul. 2, 94-98.

surrounding areas has increased so rapidly that the change to residential use then anticipated as something to occur sometime in the future has already taken place.

The early activity of La Mesa, Lemon Grove, and Spring Valley Irrigation District was in the direction of perfecting rights to the use of water from San Diego River. The original engineer's report filed in January, 1914, proposed storage on San Diego River in Mission Valley, with a dam a short distance below the old Mission Dam. Water was to be pumped from there to the district, which lies directly south of the old Mission Dam. Instead of storing water in Mission Valley, it was decided to acquire the water system of Cuyamaca Water Company, successors to the old San Diego Flume Company, which had been organized in 1886, and had built the well-known Cuyamaca flume system. The district agreed with Cuyamaca Water Company to purchase the property of the latter at a price to be fixed by the Railroad Commission. That body set a price at $745,000. A disagreement arose regarding the adequacy of this price, and because of this, together with the adverse attitude of the city of San Diego, transfer of the system to the district was not made. The district had voted a bond issue of $1,232,500 when it was proposed to construct storage in Mission Valley. Bonds of this issue in the amount of $66,000 were exchanged for various parcels of lands in Mission Valley, but after failure of the plan to take over the Cuyamaca system, $10,000 of these were retired. The remainder were withdrawn from sale and held by the district, later, on March 5, 1923, being burned.

From 1915 to 1924 the district remained inactive, merely levying annual assessments sufficient to pay interest on outstanding bonds and carry the small maintenance expenses of the district organization. During this period the principal concern of the district was to prevent the city of San Diego from acquiring the water supply on which the district was dependent. In 1921 the city of San Diego had brought an action against Cuyamaca Water Company to enforce what it claimed was its paramount right to use of all of the water of San Diego River, by virtue of the fact that the city was successor to a Spanish pueblo. This right had been claimed by the city for some time but no definite action was taken to enforce it until filing of the suit mentioned. This suit was dismissed at the request of the city, owing to an expression by the presiding judge considered by the city as adverse to its claims.

A few months later a new suit was filed in which the district, as well as the cities of La Mesa and El Cajon and other neighboring communities which were actually using the water of San Diego River, intervened. A decision was rendered December 7, 1926, in which it was held that the city of San Diego had a paramount right but had lost it to the extent of adverse beneficial use by the defendants, the amount of this adverse use being fixed at a continuous flow of 27 cu. ft. per sec. This included both surface diversions from San Diego River through storage in Cuyamaca Lake on Boulder Creek, a tributary of San Diego River, and in Grossmont, Eucalyptus, and Murray reservoirs in the district; also through pumping from the El Monte wells situated in the gravel basin of San Diego River about one mile east of Lakeside. The decision of the lower court enjoined Cuyamaca Water Company and other defendants from increasing their diversions over the 27 cu. ft. per

sec. specified. Both sides were dissatisfied with this decision and appeal has been taken to the supreme court, where it is now pending.

Prior to the action of the city of San Diego to enforce its claim to a paramount right to the waters of San Diego River, that is, in 1918, La Mesa, Lemon Grove, and Spring Valley Irrigation District had resumed negotiations with reference to the purchase of the Cuyamaca system. A report submitted to the state engineer on April 28, 1919, set the value of the Cuyamaca system at $1,440,000, and estimated the cost of necessary additions at $893,000, and the cost of lateral extensions and pumps required to serve the entire district at $251,000 more. Nothing finally resulted from the negotiations begun in 1918, but in December, 1923, a committee of citizens, who feared that their lands might be left without water if the city of San Diego should either acquire the Cuyamaca system or be successful in its claim of a paramount right to the waters of San Diego River, requested the directors of the irrigation district to obtain an option on the Cuyamaca system immediately. Early in 1924 the directors of the district initiated proceedings for the calling of a bond election, employed an engineer to lay out a plan of development, and resolved to resist by all lawful means the attempt of San Diego to acquire a paramount right to San Diego River.

The plan of development outlined by the district engineer called for the purchase of the Cuyamaca system, construction of a dam at the Fletcher reservoir site on San Diego River below its junction with Boulder Creek, and enlargement of the existing supply and distribution system. His estimates called for an expenditure of $2,500,000, of which the largest items were the purchase of the Cuyamaca system for $1,100,000, construction of Fletcher Dam at a cost of $500,000, purchase of the main distribution system within the district at a cost of $390,000, and additions to the distribution line to cost $231,000. After receiving a favorable report from the Bond Certification Commission, the district authorized a bond issue of $2,500,000 by a vote of 770 to 241 at an election November 7, 1924. Approval of the purchase of the Cuyamaca system was in due time given by the Railroad Commission and the district assumed control September 1, 1925. Owing to increased expenditures on the Cuyamaca system made subsequent to the estimate and prior to the passing of title to the district, the price paid by the district for the Cuyamaca system was $1,226,529.92.

Obviously the acquirement of the Cuyamaca system by La Mesa, Lemon Grove, and Spring Valley District has not solved all of the water problems before the district, owing to the pending litigation over water rights with the city of San Diego. With certain changes and eliminations, the district has gone ahead with the construction plans outlined by its engineer, and to December 31, 1927, had expended a total of $2,159,283.11. Regardless of the outcome of the pending litigation with San Diego over water rights, that city has a very definite interest in the Cuyamaca water system. In 1927 the city appointed a committee of two engineers and one accountant to report upon a plan whereby the city and the district might jointly utilize the system, to their mutual advantage. This committee submitted its report in May, 1928, and recommended the purchase by the city of the Cuyamaca supply system, with guarantee to the irrigation district of sufficient water for its ultimate needs at the cost of production. Some such

agreement between the city and the district has been looked upon as probable, since both the city and the district, particularly the city, will require additional water in the near future. Flood waters are being wasted into the ocean while litigation remains undecided. In the meantime, neither the city nor the district is in a position to build storage to restrain them.

Soils and topography.—Since La Mesa, Lemon Grove, and Spring Valley Irrigation District is already largely on a residential basis, although some 3000 acres of citrus trees and truck and other crops is being irrigated, soil classifications do not have the significance they have in districts in which agricultural development is paramount. The principal classifications given in the soil survey are Redding gravelly loams and sandy loams, Montezuma adobes, Placentia sandy loams, and Olympic loams.* The topography is fairly rolling, with many steep hillsides. Elevations vary from about 300 feet to about 800 feet. Natural drainage is supplied by the rolling topography and only local artificial drainage will be necessary.

Development.—As previously stated, about 3000 acres is being irrigated, half of this being in citrus plantings. About 1000 acres of this area is double-cropped to truck crops. New land is going into cultivation as supply and distribution facilities are extended, but it is expected that residential use of water will show a more rapid increase than agricultural use. The 1927–28 assessment roll showed 4386 assessment payers, which is approximately the number of separate ownerships. Five ownerships embrace 3004 acres, ranging from 326 to 850 acres each.

The 1927–28 county assessment as prorated to lands in the district is estimated at $1,200,000 on land, the assessment valuations on lands within the cities of La Mesa and El Cajon amounting to $1,656,645. The locally estimated values of land within the district, however, greatly exceed these assessment valuations, $8,000,000 being the figure for 'farm' lands and $3,600,000 for lands within the cities and towns, the estimated total being $11,600,000. The locally estimated value of improvements adds $4,500,000 to this figure.

The population within the district is estimated at 9500, of which 1500 is for El Cajon, 2500 for La Mesa, and 500 for the nonincorporated town of Lemon Grove. San Diego, which adjoins the district on the west, has an estimated population of 140,000.

Water supply.—The situation with reference to water rights has already been outlined. Briefly, the supply comes from Cuyamaca Reservoir on Boulder Creek, by diversion from San Diego River below the mouth of Boulder Creek, and by pumping from the gravel beds of San Diego River at El Monte. First filings of San Diego Flume Company, predecessors to Cuyamaca Water Company, were made in 1886. On January 11, 1915, Cuyamaca Water Company filed application 8, under section 12 of the water commission act, seeking to perfect a claimed previous filing for 40 cu. ft. per sec. from San Diego River. This was rejected November 5, 1921, after hearing. On January 4, 1916, the company filed application 238 for 2500 cu. ft. per sec. of flood flow of San Diego River and 125 cu. ft. per sec. normal flow, including 34,000 acre-feet of storage, but this was canceled Septem-

* U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the San Diego Region, California.

ber 28, 1920. There are, however, three applications pending, namely, numbers 2013, filed September 20, 1920, 4089 filed July 14, 1921, and 4208, filed September 13, 1924. Permit 1474 was granted on application 2013 on June 30, 1923, and was assigned to the district April 9, 1926. The permittee proposed the generation of 9222 theoretical horsepower at a power plant on Boulder Creek which would utilize a flow of 50 cu. ft. per sec. through a head of about 1600 feet. The estimated construction cost is $390,000, and an extension of time to December 1, 1929, has been allowed. Action has not yet been taken on applications 4089 and 4208. The former is an application under section 12 of the water commission act to perfect a filing posted June 12, 1912, on water to be stored at the El Capitan reservoir site, this filing having been assigned to the district November 18, 1926. Application 4208 seeks permission to divert 10 cu. ft. per sec. by pumping from San Diego River near the district, and for supplemental storage in Murray Reservoir.

The mean annual discharge of San Diego River has been estimated at 48,000 acre-feet. The report to the city of San Diego made by its special committee in 1928 estimated the ultimate maximum requirement of the district at 3650 million gallons, equivalent to about 11,200 acre-feet, with a daily maximum of 15 million gallons. The latter estimates were based on the years 1901 to 1925 and would have required an increase in the capacity of Cuyamaca Flume to about 45 cu. ft. per sec. Using the years 1895 to 1919, a smaller average diversion would have been deduced. Based on the period 1901 to 1925, gravity diversions of 300 to 5000 or 7000 million gallons per year, the maximum depending upon flume capacity, would have been possible. Further, it was estimated that the El Monte gravels will yield 4000 million gallons per annum over a 5-year period of unusual drought, and that at least one-third of this amount can be pumped in a single year. It would have been necessary to augment the unregulated gravity and the storage supply of the system by pumping an average of 698 million gallons per year, amounts to be pumped annually ranging from nothing to 1300 million gallons. In some months of some of the years covered by the hydrographic study from which the above figures were derived, the ultimate requirement of the district exceeded the estimated possible gravity diversions and the water pumped.

From 1916 to 1927 the gravity diversions by the Cuyamaca system have ranged from 4453 acre-feet, in 1921, to 10,720 acre-feet, in 1922. During this period water was pumped in seven years, the annual amounts ranging from 272 acre-feet, in 1923, to 2740 acre-feet, in 1926. Deliveries by the Cuyamaca system during the period 1916 to 1927 have ranged between 3130 acre-feet, in 1917, and 5430 acre-feet, in 1916.

Works.—Cuyamaca flume and reservoir were constructed between 1886 and 1889. Cuyamaca Dam is an earth-fill, impounding 11,600 acre-feet. Water released from this reservoir passes down Boulder Creek for about 12 miles to San Diego River. Below the mouth of Boulder Creek a low rubble masonry dam diverts water into Cuyamaca Flume. This flume follows along the south slope of San Diego River canyon for about 15 miles, to within about two miles east of Lakeside, where it turns southwest and continues about 16 miles along the hillside south of El Cajon Valley to Grossmont and Eucalyptus reservoirs. These reservoirs have respective capacities of 127 and 31 acre-feet. The conduit includes 25 miles of wood flume which has been in service since

1889, 8 tunnels with a total length of 0.8 mile, a metal flume 0.5 mile long, a concrete flume 0.25 mile long, 3 siphons aggregating 4 miles in length under Chocolate Creek, South Fork of San Diego River, and Los Coches Creek, and 3.5 miles of canal. The conduit has a capacity of about 31 cu. ft. per sec. and the siphons a capacity of 45 cu. ft. per sec.

Some water is delivered directly to high-service areas from Grossmont and Eucalyptus reservoirs, the remainder being conveyed by La Mesa Ditch to Murray Reservoir located about 1.5 miles northwest of La Mesa. This reservoir has a capacity of 6085 acre-feet. Murray Dam is a multiple-arched structure 117 feet high with crest length of 900 feet. Most of the water impounded in Murray Reservoir is sold outside of the district.

The El Monte supply, situated in the gravel basin of San Diego River about 1 mile above Lakeside, is pumped by six wells drilled by Cuyamaca Water Company and five wells added by the district, 8 of the 11 being usable at present. Water from these wells is pumped into a sump by deep-well turbines and is lifted from the sump into Cuyamaca Flume by two high-head centrifugal pumps, the total head, including a maximum drawdown of 50 feet, being about 350 feet. At present the capacity of the pumps is 6 m. g. d.

The distributing system consists of 27 miles of pipe ranging from 24 inches down to 10 inches in diameter, and about 75 miles of pipe ranging from 8 inches to 0.5 inch in diameter. Eleven booster plants raise water from 125 to 400 feet above the gravity system to supply about 425 acres. The total installed horsepower for the booster pumps is 332.5.

The Cuyamaca wood flume, which as stated has been in service since 1889, must soon be replaced, at a cost roughly estimated at from $700,000 to $900,000. Several years ago it was lined with asphaltic roofing paper, which has been very effective in limiting leakage.

The total capital investment in works to December 31, 1927, is shown on the books of the district as $2,159,283.11, as previously indicated.

Use and delivery of water.—When La Mesa, Lemon Grove, and Spring Valley District took over the Cuyamaca water system it assumed liability for service to outside consumers or areas in the amounts they had been furnished with water from the Cuyamaca system during the 12-month period ending July 31, 1925. The district also often sells to the city of San Diego surplus water which accumulates in Murray Reservoir.

Records are available of water delivered from Cuyamaca system from 1912 to 1927. Since September 1, 1925, the service has been under the management of the district. Total deliveries to regular customers during this 16-year period have ranged from 1990 acre-feet, in 1913, to 4440 acre-feet, in 1924. Deliveries have been made to the city of San Diego in eight of the years, ranging in amount from 499 acre-feet, in 1927, to 2420 acre-feet, in 1921. The total deliveries to regular customers in 1927 amounted to 2793 acre-feet, of which 2234 acre-feet was delivered inside the district and 559 acre-feet outside the district. All deliveries are measured, usually with displacement-type meters. About 3500 meters are connected, most of them being for domestic service.

Bonds.—Reference has been made to the original bond issue of $1,232,500, of which $10,000 has been retired, $1,166,500 burned, and $56,000 is outstanding. The second issue amounted to $2,500,000, was voted November 7, 1924, is dated January 1, 1925, bears interest at 6 per cent, and matures from 1946 to 1965. Other bond obligations against lands in the district are difficult to state with accuracy. The best estimate that can be made shows $3,800,000, exclusive of irrigation district bonds. Of these, $2,650,000 are improvement district bonds, $676,290 are municipal and improvement district bonds within the city of La Mesa, $13,000 are municipal bonds within the city of El Cajon, $47,000 are bonds of Lemon Grove Mutual Water Company assumed by La Mesa, Lemon Grove, and Spring Valley Irrigation District, and $470,000 are general county and school district bonds.

Assessments and water tolls.—During the nonoperative period 1915–1925, the district assessment rate varied between $0.20 and $0.70 for each $100 of valuation, being constant at $0.20 for the years 1917–18 to 1923–24. Sufficient money was raised from these rates to pay bond interest, to retire $10,000 of the $66,000 of bonds disposed of, and to pay the administration expenses of the district. For the years 1926–27 and 1927–28 the annual levies were $140,399 and $153,706, respectively. The rate for each $100 of valuation in 1926–27 was $2.50 and in 1927–28, $2.45. For 1926–27 the total assessed valuation was $5,306,000, but this was raised to $6,274,841 for the year 1927–28. In addition to the latter amount, $316,927 was the assessed valuation on property excluded from the district but subject to assessment for bond interest, a portion of the excluded area being subject to assessment for interest and redemption of the first bond issue only.

For district assessment purposes, valuations are stated to be about 50 per cent of cash valuations. The high valuation on acreage suitable for subdivision into lots is $500 per acre, and on the best farm lands is $350 per acre. Some lands are assessed as low as $125 per acre, the most usual valuation in the district being $300 per acre.

Tolls are charged for all water deliveries. Inside the district the rates are $0.15 per 100 cu. ft. up to 1000 cu. ft. per month, $0.10 per 100 cu. ft. for the next 2000 cu. ft. per month, and $0.06 per 100 cu. ft. for all over 3000 cu. ft. per month. Minimum monthly charges vary from $1 for a $\frac{5}{8}$-inch by $\frac{3}{4}$-inch meter to $12 for a 4-inch or larger meter. Rates outside the district are $0.25 per 100 cu. ft. for the first 1000 cu. ft. per month, $0.15 per 100 cu. ft. for the next 2000 cu. ft. per month, and $0.08 per 100 cu. ft. for all over 3000 cu. ft. per month. Minimum charges are the same as for service inside the district. A surcharge of 30 per cent of the total monthly bill is added for water pumped above the gravity system. In 1927 the total charge for water tolls was $140,-150.60, this being for a total of 3292 acre-feet delivered. Inside the district the charge was at the average rate of $42.19 per acre-foot, outside the district at the rate of $47.14 per acre-foot, and the wholesale rate to the city of San Diego for the 499 acre-feet delivered was $39.14 per acre-foot.

TIA JUANA RIVER

Location: on the coastal plain directly north of the international boundary, in San Diego County. (Pl. XXXV.)
Date of organization election: August 5, 1924.
Gross area: 1511 acres; **area assessed 1927:** 1511 acres.
Principal town: Imperial Beach.
Post office: San Ysidro.
Railroad transportation: San Diego and Arizona railway.

History.—This district lies directly north of the flood plain of the lower portion of Tia Juana River. Its organization was stimulated by the efforts of Coronado Water Company to obtain the right to pump water from Tia Juana River for use in Coronado and vicinity. On May 15, 1924, the Division of Water Rights issued a permit to Coronado Water Company to divert a maximum of 6.65 cu. ft per sec. from Tia Juana River by pumping from underground gravels. On June 11 of the same year F. B. Beyer and others filed an action under section 1*b* of the water commission act asking for a review of the permit granted to Coronado Water Company. After the district was organized it intervened. The superior court of San Diego County, in case 42244, declared the Coronado Water Company permit invalid, on the ground that the basin from which the company proposed to pump was not an underground stream and therefore was not under the jurisdiction of the Division of Water Rights.

Prior to this decision, on December 12, 1925, the Division of Water Rights granted permit 2348 to Tia Juana River Irrigation District for the pumping of 1600 acre-feet per annum from Tia Juana Basin at a maximum rate of 4.12 cu. ft. per sec. An unsuccessful action to annul this permit was brought by Coronado Water Company. In the meantime a decision had been rendered by the supreme court in *Mojave River Irrigation District* vs. *Superior Court*,* holding section 1*b* of the water commission act unconstitutional, and since this section of the water commission act was the basis on which the permit of Coronado Water Company had been declared invalid, a motion was made in the superior court of San Diego County on June 18, 1928, seeking to vacate the superior court judgment in case 42244. Such action was taken by the superior court and the permit of Coronado Water Company which had been canceled by the Division of Water Rights was thereupon restored.

This cleared the situation with reference to water filings on Tia Juana River. In the meantime, however, namely in July, 1928, the Bond Certification Commission, which had delayed action on the request of Tia Juana River Irrigation District to issue bonds, reported favorably on the issuance of $170,000, which was the amount called for by revised plans of the district. The proposal to issue these bonds failed at an election held in the fall of 1928, but another election has been set for April 15, 1929.

Soils and topography.—The principal soil classification within the district is Kimball sandy loam.** The topography is rolling, with eleva-

* 74 Cal. Dec. 711.

** U. S. Dept. of Agr., Bureau of Soils, Reconnoissance Soil Survey of the San Diego Region, California.

tions ranging from 15 to 100 feet. Ground water stands at about 50 feet below the surface. No drainage has been considered necessary.

Development.—At present a small area is planted to truck crops which are irrigated from wells, a large part of the remaining area being dry-farmed to grain hay. The estimated population in the district is 150. The 1927–28 assessment roll showed 110 separate ownerships, a large number of the owners being nonresidents. There are 6 ownerships of 40 acres each. The estimated county assessed valuation of lands in the district for 1927–28 was $77,000.

Water supply.—The proposed water supply is referred to under "History." Rights to the underflow of Tia Juana River, from which Tia Juana River District has proposed to pump, are complicated by interests and claims of the city of San Diego and Coronado Water Company north of the international boundary, and by the rights of the Mexican government south of the boundary, the principal flow from the Tia Juana coming from the watershed in Mexico. The city of San Diego has already perfected filings on Cottonwood River, a tributary of the Tia Juana, by construction of storage at the Moreno and Barrett reservoirs. It also has filings on tributaries of Cottonwood River and a filing on the Cottonwood at the Marron site, on the international boundary. The quantity of water proposed to be stored by the Mexican government of its Garcia site, where a dam is now being built, and the extent of use of this water, are at this writing uncertain.

However, because of the large watershed of Tia Juana River, which is over 2000 square miles in area, and the extent of the underground basin of the lower Tia Juana, the Division of Water Rights has concluded that the supply desired by Tia Juana River Irrigation District will be available. In a report to the state engineer, dated June 17, 1927, the annual demand on the underground supply of the lower Tia Juana was estimated at 8405 acre-feet, this including 2600 acre-feet for lands directly overlying the water-bearing gravels, 590 acre-feet for San Ysidro Irrigation District, 3700 acre-feet for Coronado Water Company, and 1515 acre-feet for Tia Juana River Irrigation District. This did not take into consideration the later proposal of the city of San Diego to pump from the underground basin of the lower Tia Juana to the extent of 15.5 cu. ft. per sec., for which proposal they were, in the summer of 1928, obtaining options on 107 acres of land in the lower Tia Juana River basin.

Works.—The construction plan adopted by Tia Juana River District and reported on favorably by the Bond Certification Commission contemplates the purchase of 100 acres of water-bearing land in the lower Tia Juana River basin, the drilling of three wells with combined capacities of 6 cu. ft. per sec., and the installation of two pumps to lift water against a head of 175 feet to a 750,000-gallon reservoir. From this reservoir it is proposed to deliver water to each 40 acres through a welded steel pipe lateral system having an aggregate length of 59,599 feet, and ranging in diameter from 18 inches down to 4 inches. The estimated cost of construction is $166,372, which includes an allowance for bond discount and bond interest during six months. The engineers of the district estimate a total annual operating cost to the district of $11,616, and an annual cost per acre, including bond interest and

redemption on 20 to 40-year serial bonds, but not including cost of electric power, at $14.80 per acre for the first 20 years and $16.93 to $18.70 per acre during the next 20 years.

Bonds.—As previously indicated, no bonds have yet been issued. It is estimated that $15,000 of general county bonds are chargeable against lands in the district.

Assessments and water tolls.—District assessments are based on valuations at the flat rate of $300 per acre on unsubdivided areas and of $42 on lots. The total district assessed valuation for 1927–28 was $469,222 on 1511 acres, an average of about $310 per acre. For the past three years the annual assessment rates for each $100 valuation have been as follows: 1925–26, $2; 1926–27, $1; 1927–28, $0.67. No assessment was levied in 1928. The total levy in 1927–28 was $3,127.

The estimated annual cost per acre for bond interest and retirement and maintenance and operation other than the cost of power has been referred to under "Works." Under the plan as proposed this cost would be covered by annual assessments. To these assessments, however, it is estimated that it would be necessary to add water tolls of $0.01¼ per 1000 gallons, equivalent to $4.07 per acre-foot, and a domestic toll of $0.10 per 1000 gallons, it being estimated that the income from these tolls will carry power charges. Although the above estimates give a general idea of present proposals, it is obvious that the division of income between assessments and tolls, if the district plan is carried forward, can not be foretold at this time.

SAN YSIDRO

Location: directly north of the international boundary, about 15 miles south of San Diego, in San Diego County. (Pl. XXXV.)
Date of organization election: March 11, 1911.
Gross area: 497 acres; **area assessed 1927:** 467 acres.
Principal town: San Ysidro.
Post office: San Ysidro.
Railroad transportation: San Diego and Arizona railway.

History.—San Ysidro Irrigation District was organized to finance a water supply for the Little Landers Colony, a social experiment started by William E. Smythe in 1909. The history to 1915 is given in a previous publication.* The district is no longer a "Little Landers" project, but rather a small municipality of residential holdings occupied largely by people interested in affairs in the Mexican town of Tia Juana directly across the international boundary.

The original irrigation system of San Ysidro District was constructed at a cost of $28,000. A bond issue of $25,000, carrying interest at 5 per cent, was sold locally at a slight premium when the Little Landers Colony was in the height of its activity. A flood in Tia Juana River in 1916 destroyed the district pumping plant, which was located in the lowlands along Tia Juana River, and also a portion of the concrete distribution pipe system. This placed the district temporarily in financial difficulties, but a temporary pumping plant was installed and the enterprise carried on. Conditions improved slowly until 1920 when rapid settlement commenced following the growth of Tia Juana in Mexico. Within a few years over 100 new residences and business

* State Dept. of Eng., Bul. 2, 98-99.

structures were erected and the population has since grown to from 1000 to 1500.

Soils and topography.—About 100 acres of the district is on the alluvial flood plain of Tia Juana River, the remainder being rough sidehill land composed of various shallow soils of little agricultural value. The lowlands are subject to floods and were covered in 1916 and 1926, causing considerable damage. The water table stands about 20 feet below the surface.

Development.—As already indicated, San Ysidro District is mainly residential. In 1928, only about 15 acres was irrigated, this being in alfalfa along the river bottom. About 250 acres was served domestic water. In 1927, there were about 400 water users, the holdings averaging a little over one acre, the largest holding being 20 acres. The combined value of homes and business structures has been locally estimated at $750,000.

Water supply.—San Ysidro Irrigation District claims a prescriptive right to pump 1.356 cu. ft. per sec. continuous flow from the lower Tia Juana River underground basin, dating back to 1911. The district has received permit 1815, with a priority date of June 10, 1922, for 1 cu. ft. per sec. of underground waters of Tia Juana River. It is specified that the amount diverted under the permit, together with that received by the district under its previous vested rights, shall not exceed 1350 acre-feet in any one calendar year. The district owns 17 acres of water-bearing land in the Tia Juana River basin. The present and prospective draft on the underground basin and use and applications pertaining to the surface flow of Tia Juana River and tributaries are referred to in the statement regarding Tia Juana River Irrigation District above. No measurements of the annual pumping draft by San Ysidro District have been made.

Works.—The reconstructed system of San Ysidro Irrigation district embraces 5 new wells located in the water-bearing land along Tia Juana River, a 625,000-gallon concrete reservoir, and a distribution system, the latter including 1100 feet of 10-inch and 7000 feet of 4-inch cast-iron pipe and 100 feet of 10-inch riveted steel pipe. The five wells are connected to a single 5-inch centrifugal pump by a branched suction line. The pump has a capacity of 700 g.p.m. and is operated by a 50-h.p. electric motor. Water from the wells is pumped directly into the mains, the surplus being forced into the concrete reservoir which is located about one mile to the north near the district boundary line. The lift to the reservoir, including drawdown, is 220 feet. A 3-inch centrifugal pump is available for emergency service.

The reconstruction of the system was financed by 7 per cent construction warrants. The capital investment in works to December 31, 1927, was reported as $52,126, not including any depreciation. Of this amount, $25,000 represented the original bond issue and $27,126 was raised from annual assessments and sale of the interest-bearing warrants.

Use and delivery of water.—Water is delivered throughout the district under pressure, but is not metered. The approximate average unit to which deliveries are made is one acre. Consumers are required to pay the cost of water service connections, this ranging from $10 for 1-inch connections to $25 for 2½-inch connections.

Bonds.—The $25,000 bond issue of the district, bearing 5 per cent interest, was authorized December 12, 1912, by a unanimous vote of 90. It is dated January 1, 1913, and matures from 1934 to 1943.

General county bonds against lands in the district are estimated at $8,000, elementary school district bonds at $10,000, and high school bonds at $2,000, making a total of $20,000. There is also a special assessment for sidewalks and road work against property in the district amounting to about $40,000, and an annual lighting district tax amounting to $775.

Assessments and water tolls.—Acreage property is valued for district assessment purposes at a flat rate of $260 per acre, lots facing the highway at $250 each, and other lots $100 each. The total district assessed valuation for 1927–28 was $93,010. The annual assessment rate for each $100 of valuation for the past five years has been as follows: 1923–24, $5; 1924–25, $6; and from 1925–26 to 1927–28, $4. The total assessment levy in 1927–28 was $3,720.

Water tolls collected in 1927 amounted to $7,613 and in 1928 to $10,243. Beginning with 1927, the water tolls have been based on flat monthly rates as follows: house and lot, $2, or $3 with an extra house; for lot only, $1; for one-quarter acre, $1.25, or $2.25 with a house; one-half acre, $1.50, or $2.50 with a house; one acre, $2, or $3 with a house. Prior to 1927, the flat monthly rates were $1.40 for house and lot, with $1 extra with an additional house; $0.40 on a lot only; $0.55 on a one-half acre tract, or $1.55 with a house; and $1 for one acre, or $2 with a house.

PALO VERDE

Location: along Colorado River, mainly in southeastern Riverside County. (Pl. XXXVIII.)
Date of organization election: October 27, 1923.
Gross area: 88,693 acres; **area assessed 1927:** 78,504 acres.
Principal towns: Blythe and Ripley.
Post office: Blythe.
Railroad transportation: branch line of Santa Fe railway.

History.—The Palo Verde Irrigation District act, creating Palo Verde Irrigation District, was passed by the legislature in 1923 and amended in 1925 and 1927.* The organization of the district, however, was made subject to approval by a majority vote within the district at a special election to be called by the supervisors of Riverside County within sixty days after the act became effective, but only after being petitioned in writing by an owner of real property within the district. The act limited qualified voters within the district to owners of real property or improvements thereon assessed for taxation on the last preceding equalized county tax roll. Each property owner so qualified was given the privilege of casting one vote for each $100 of valuation or fraction thereof greater than $50, these qualifications holding also for subsequent elections within the district.

The boards of supervisors of Riverside and Imperial counties were charged with the duty of levying the annual taxes necessary for the maintenance of the district and the meeting of its obligations, these to be based on the county assessment rolls. All taxes so levied were to

* Statutes of 1923, Chap. 452, amended by Statutes of 1925, Chap. 353, and Statutes of 1927, Chap. 583.

be collected in the same manner as county taxes and be deposited in the office of the county treasurer of Riverside County in a special Palo Verde Irrigation District fund. Furthermore, all district funds in the hands of the county treasurer were to be drawn on warrants of the county auditor. Most other provisions of the act, with the exception of those relating to the taking over of the properties and functions of Palo Verde Joint Levee District, Palo Verde Drainage District, and the Palo Verde Mutual Water Company, followed generally the provisions of the California irrigation district act. There were, however, variations in the basis of levying assessments, due to the necessity for complying with the statutes under which the levee and drainage districts had been organized.

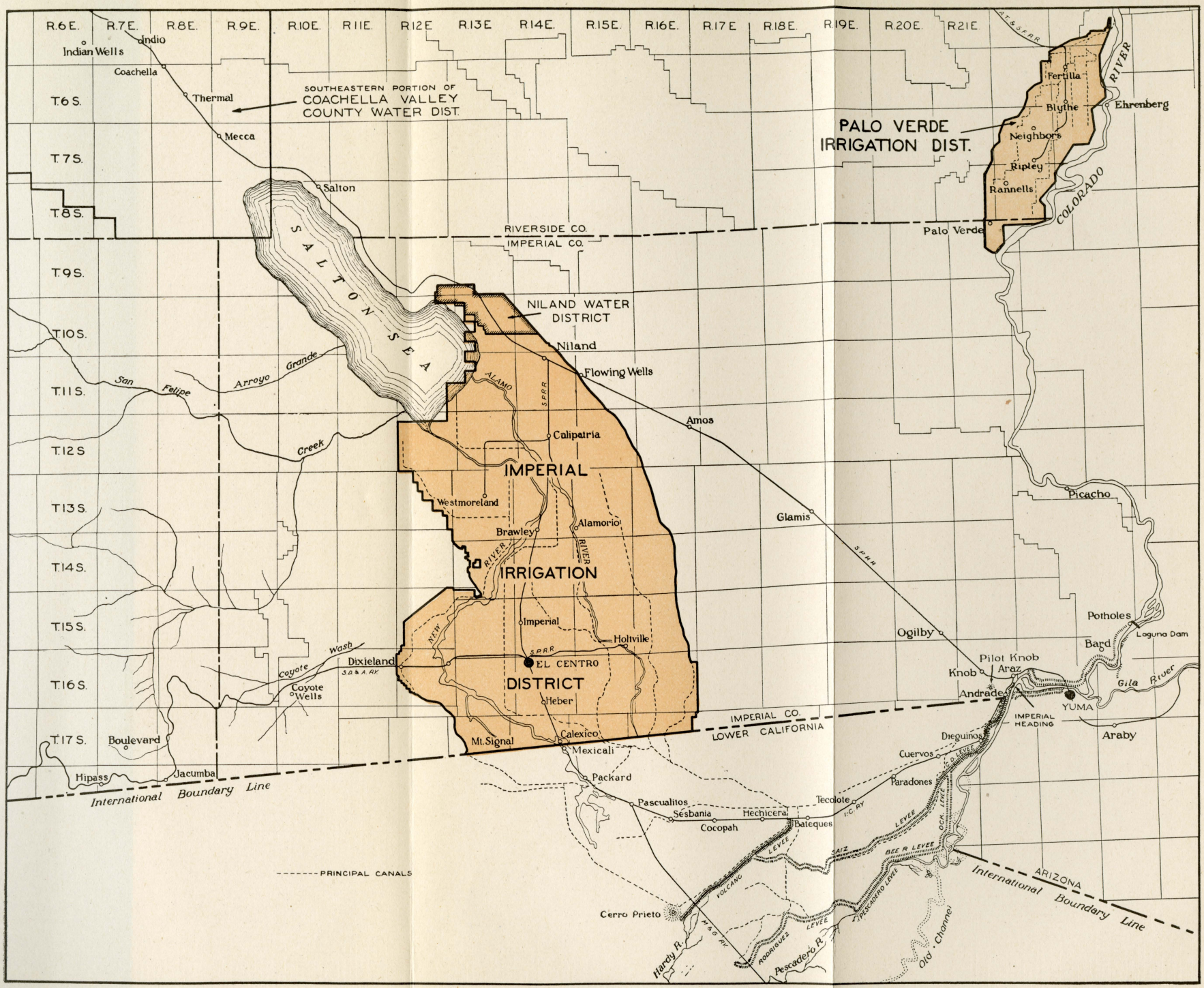
The provisions in the special act for the taking over of the properties and functions of Palo Verde Mutual Water Company, Palo Verde Joint Levee District, and Palo Verde Drainage District, specified in detail the procedure by which those enterprises should be absorbed. The district was given the option of acquiring the water rights and system of Palo Verde Mutual Water Company, subject to existing rights of stockholders or waterusers, or of acquiring the system through purchase of the outstanding stock; or, if purchase was found inadvisable, the district was authorized to take over the management, control, and operation of the system by lease or contract.

The act provided that on completion of the organization of the irrigation district all of the properties and functions of Palo Verde Joint Levee District and Palo Verde Drainage District should revert to, and become vested in, the irrigation district, subject to rights of holders of outstanding bonds or other indebtedness. When thus taken over, the irrigation district assumed outstanding bonds or other indebtedness, the collection of principal and interest to be enforced through the irrigation district as it might have been enforced through the joint levee and drainage districts.

The special Palo Verde irrigation district act was approved June 21, 1923, and organization was ratified by the landowners October 27, 1923. In December, 1924, the legality of the organization was sustained by the Supreme Court.

Palo Verde District took over the properties of Palo Verde Mutual Water Company by acquiring 41,795 shares of its capital stock at $27.50 a share, a lump cash sum payment of $125,000, and the assumption of bonds of Palo Verde Mutual Water Company in the amount of $350,000, a total of $1,624,362.50, this purchase having been ratified by the stockholders of the mutual water company December 17, 1925. Prior to this, on August 28, 1925, a special election had been held within the irrigation district at which the issuance of bonds to the amount of $3,287,000 had been authorized for the purpose of purchasing the mutual water company and extending its irrigation and drainage systems. At the same election the district authorized the issuance of bonds in the amount of $213,000 to refund the bonds of Palo Verde Mutual Water Company and Palo Verde Joint Levee District which were to mature in 1926, 1927, and 1928, and also authorized the sale below par of all of the bonds voted.

Prior to the formation of Palo Verde Irrigation District, bonds had been sold by Palo Verde Joint Levee District in the amount of $1,593,330.36, and by Palo Verde Drainage District in the amount of $850,000.



Map of Imperial and Palo Verde irrigation districts.

Under the terms of the special Palo Verde act, these bonds were assumed by the irrigation district.

Among other matters, the amendments to the Palo Verde Irrigation District act in 1925 and 1927 provided for the levying of irrigation district assessments by an assessor appointed by the trustees of the irrigation district, rather than by the supervisors of Riverside and Imperial counties; also for the appointment of a district collector, who should act in place of the tax collector of Riverside and Imperial counties. The county treasurer of Riverside County, however, was made the treasurer of the district. Some changes were made in the basis of assessments, not only in the irrigation district, but also in Palo Verde Joint Levee and Palo Verde Drainage Districts.

The amendments also covered a number of matters relating to the operation of the district and the levying and collection of assessments, not included in the original act.

Early development in Palo Verde Valley dates from about 1877 or 1878, when Samuel Blythe acquired about 40,000 acres in the valley under the swamp and overflow act. The first Blythe water filing was made at Black Point, July 17, 1877. Cattle raising was the chief activity, and very little development occurred until the Blythe land was sold in 1904 to Hobson and Murphy, who formed Palo Verde Land and Water Company. A few homesteads had been established before this in the southern end of the valley, but a disastrous flood in 1905 wiped out most of them. In 1908 the irrigation properties of Palo Verde Land and Water Company were taken over by Palo Verde Mutual Water Company, which made extensive improvements in the canal system, financing the work by the sale of about 30,000 shares of stock, each representing a water right for one acre of land. Unentered government land was rapidly filed on, but there was no marked increase in development until after the completion into the valley of the branch line of the Santa Fe railway in 1915.

Soils and topography.—Soils of Palo Verde Irrigation District are alluvial deposits of Colorado River, made as the river channel has shifted back and forth across the basin. The soil map shows many classifications, of which Holtville silty clay, Rositas fine sand, Holtville silty clay loam, Imperial very fine sand, and Gila very fine sand seem to predominate.* A considerable proportion of the Imperial series are of the shallow phase. About 80 per cent of the valley shows an average alkali content of less than 0.2 per cent within the 6-foot soil section, so distributed as to be noninjurious to crops. The remaining portion of the valley carries an alkali content ranging from 0.2 per cent to 3 per cent or more, the greater part, however, ranging between 0.4 and 2 per cent. The most numerous of the alkalies found in the valley are 'white.'

Practically the entire valley is included within Palo Verde Irrigation District, which has a maximum width of about 10 miles between the levees bordering Colorado River on the east and Palo Verde Mesa on the west. The length of the valley is about 30 miles along the eastern edge. Elevations range from 240 feet to 275 feet. The channel of Colorado River is higher than most of the valley lands, the river bank

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Palo Verde Area, California.

in places being about 10 feet above the valley lands immediately below Palo Verde Mesa on the west. The surface is generally smooth, with some areas covered with sandy hummocks, and with numerous old sloughs which serve to some extent as surface drains.

Development.—Palo Verde Valley is generally similar to Imperial Valley, although elevations range from 240 to 275 feet above sea level, instead of being below sea level, as in Imperial Valley, this resulting in some difference in winter temperature conditions. Crops are grown and irrigation is practised throughout the year. Thus far cotton ranks above all other crops in area, alfalfa hay raising being second, pasture and fallow lands third, and grain fourth. Neither truck growing nor dairying has yet reached much importance in the valley. A creamery, however, is now in operation and production of dairy products is reported to be increasing. The area irrigated in 1926 was 32,522 acres. Most of the uncultivated land is covered with brush. Blythe, the principal town, with a population of about 1500, and Ripley, with about 500, are included within the district. There are about 850 holdings, of which about two-thirds are owned by nonresidents. The largest holding is 1200 acres and the next, 960 acres.

Water supply.—The water rights of Palo Verde District are based on the oldest filings on Colorado River in California. The first filing is for 95,000 miners inches, dated July 17, 1877. Subsequent filings were made December 15, 1878, for 90,000 miners inches, February 20, 1883, for 100,000 miners inches, April 2, 1904, for 300,000 miners inches, September 14, 1908, for 200,000 miners inches, and August 5, 1911, for 200,000 miners inches. Obviously the filings are duplicate or enlarged filings, rather than cumulative. The first filings are prior to any others of which record has been found. There has never been a deficiency in the supply in the river, but it has been difficult to divert the required amount because of deposits of silt in the intake canal and the lowering of the river channel at the headgate caused by the shortening of the river below the intake and consequent scouring. This decrease in channel elevation at the intake has been in excess of 2 feet.

Formerly the intake of Palo Verde Canal was kept open by drag-line excavators, duplicate canals having been provided at the upper end of the valley so that one could be cleaned while the other was in service. A diversion weir across Colorado River similar to Laguna Dam of the Yuma Reclamation Project was recommended, but later studies indicated that the cost would be excessive until after the flood flow of Colorado River has been regulated. In lieu of alternate drag-line cleaning of the duplicate upper canals, a settling basin has been provided by removal of the earth between the duplicate canals at their upper ends, this basin as constructed being 2300 feet long and 150 feet wide on the bottom, and 12 feet to 18 feet deep directly below the intake. Attempts have been made in several years to construct a temporary weir across the river at the intake to raise the river elevation during the irrigation season, but these have been effective for only short periods. Silt accumulating in the settling basin is removed by a suction dredge having a rated capacity of 400 cu. yds. per hr., built since February, 1928. Power for operating this dredge

is supplied by a 500 k.w. generator driven by a 625 h.p. Diesel engine located near the settling basin and owned and operated by the district.

Monthly diversions between October 1, 1926, and February 27, 1927, ranged from 4000 to 8400 acre-feet, and between March 1 and September 30, 1927, from 20,800 acre-feet in March to a peak of 33,800 acre-feet in August. Assuming maintenance of present (January, 1929) conditions, the district estimates that diversions can be maintained ranging between 60 cu. ft. per sec., with the river at elevation 280 at the intake, and 500 cu. ft. per sec., with the river at elevation 283. Work is now in progress to regrade the upper portion of the canal to 9 inches per mile. This will lower the elevation at the intake 4 feet. When this work is completed it is estimated that the district can maintain diversions ranging from 30 cu. ft. per sec., with the river at elevation 276, to 650 cu. ft. per sec., with the river at elevation 281.

Gross diversions during the past three years, in acre-feet, have been as follows: 1925, 225,000; 1926, 203,000; 1927, 208,000. In spite of these large quantities, which amount to approximately 6 acre-feet per acre irrigated, there have been critical water shortages, due to inability to make diversions, as referred to above.

Works.—A concrete headgate about 50 feet wide is situated on a point of rock which extends into the river at the intake. This headgate has 8 bays equipped with vertical wooden slide gates behind which are slots for flashboards. The main canal flows southwesterly about 4 miles and feeds the main laterals which continue for about 20 miles to the south, the total length of the canal system being about 200 miles. Construction of about 27 miles of canals would extend the lateral system to each quarter-section in the district. The 1926 annual report of the district lists 150 canal headings, including the intake gate, 270 checks, 300 irrigation canal bridges, 700 delivery outlets, 25 flumes, and 1 spillway.

About 12,000 acres of high land is situated near the upper end of the valley. Water is lifted a maximum of approximately 5 feet to about 9000 acres of these lands by three booster pumps located at the control gate 4 miles below the heading. They are all screw pumps. The largest has a capacity of 115.50 cu. ft. per sec. and is operated by a 120 h.p. Deisel engine; the next has a capacity of 67 cu. ft. per sec. and is operated by a 75 h.p. engine; the third has a capacity of 15 cu. ft. per sec., and is operated by an 18 h.p. engine.

When the district organized, and the works of Palo Verde Drainage District reverted to it, about 68 miles of drains had been constructed. These drains discharge into Colorado River through Laguna Palo Verde at the extreme southern end of the valley. When the river is high it backs into the outlet and prevents discharge of the drainage water, but the adverse effect of this has not been felt, except in the lower end of the valley south of Ripley, which mostly has not been cleared. Proceeds of the bond issue of $850,000 were spent on drainage works in the valley by Palo Verde Drainage District. There has been practically no maintenance on the drainage system since its installation.

A levee 34.5 miles long protects the district from overflow, this and other protective work having been built by Palo Verde Joint Levee District prior to the formation of Palo Verde Irrigation District. The levee

district expended on the work the proceeds of bonds in the amount of $1,593,330.36. The river channel is trained away from the levee by means of jetties and cuts dredged across the natural river bends. The length of the river was shortened 14.6 miles by six of these cuts constructed between 1919 and 1926. Between 1917 and 1926 the length of the river channel from intake to drainage outlet was decreased from 47 to 38.8 miles.

A tripod type of jetty, locally developed, has been used in the protective work along the river. The tripod is a framework of old railroad rails bolted together in the form of a tetrahedron, the drift in the river lodging in the tripods and the cables connecting them.

Use and delivery of water.—Water is used extravagantly in Palo Verde District and reduction in applications is considered one of the important steps needed to be taken. This will not only lessen the difficulty and cost of diversion from the river through the lessening of the quantity required, but will also reduce the drainage problem. As previously indicated, the present use approximates 6 acre-feet per acre on the average and individual use is, in many cases, in excess of this.

Palo Verde Irrigation District has a problem of canal cleaning similar to that described in the report on Imperial Valley below, although the expenditures on cleaning are very much less in Palo Verde than in Imperial Valley. The settling basin just below the headgate has materially reduced the amount of sand and silt taken into the canals. Small canals are cleaned with Ruth dredgers. The district reports that, in 1926, 123 miles of canals were cleaned on both sides by these dredgers at an average cost per mile of $166.59. Water delivery is made entirely upon demand and land upon which assessments have been paid may call for water without limit.

Bonds.—Reference was made under "History" to the irrigation, levee, and drainage bonds outstanding against lands in Palo Verde Irrigation District. The bonds outstanding December 31, 1927, totaled $4,327,330.36, including $71,000 sold but not delivered, divided as follows: Palo Verde Mutual Water Company, $290,000; Palo Verde Joint Levee District, first and second issues, $1,324,330.36; Palo Verde Drainage District, $850,000; Palo Verde Irrigation District, first issue, $1,650,000, second issue (refunding) $213,000. The refunding issue of $213,000 was used to retire bonds of Palo Verde Mutual Water Company and Palo Verde Joint Levee District maturing during 1926, 1927, and 1928. The bonds of Palo Verde Joint Levee District carry 6½ per cent interest and all of the others 6 per cent.

Annual payments due on interest and principal of all outstanding issues reach their maximum in 1936, when the payments required will be $375,586.28. The maturities of the remaining bonds of Palo Verde Mutual Water Company extend from 1929 to 1936, those of Palo Verde Joint Levee District from 1929 to 1962, those of Palo Verde Drainage District from 1929 to 1942, and those of Palo Verde Irrigation District from 1929 to 1955. The total amount to be paid for bond interest and principal from 1928 to final maturities of all issues in 1962 will be $8,761,116.20.

Assessments and water tolls.—For the first two annual assessments in Palo Verde District a valuation of $40 per acre was placed on good farm land cleared, and of $15 per acre on good farm land uncleared.

These assessments were levied by the supervisors of Riverside and Imperial counties in accordance with the original Palo Verde District act. Separate assessment rates were applied to these valuations in each of the three organized districts. After the amendment of 1927, which placed the responsibility for the levying of assessments on the district assessor, the valuation of good farm land cleared was raised to $100 per acre, with proportional increase for the undeveloped acreage.

Under the amendment of 1927, the cost of all properties acquired by the district after its organization, and the cost of construction work and improvements for providing, maintaining, and operating protection and reclamation work in the district, is raised by taxation levied uniformly over the entire district in accordance with the assessed value of real estate and improvements. The cost of all construction and improvements for maintaining and operating the waterworks of the district, however, is raised by taxation levied uniformly over the entire district in accordance with the assessed valuation of the lands only. For raising money to pay the interest and principal of bonds of Palo Verde Mutual Water Company or Palo Verde Irrigation District, assessments are levied on both lands and improvements. For paying the principal and interest on outstanding bonds of Palo Verde Joint Levee District, and for the maintenance, repair, and operation of levees constructed by said levee district, assessments are levied upon all of the lands, improvements, and personal property within the boundaries of the levee district. For paying principal and interest of bonds of Palo Verde Drainage District, and the cost of maintenance, repair, and operation of the drainage and reclamation system installed by said drainage district, assessments are levied in accordance with the assessed value of all land within the drainage district.

It will be seen from the above that four different rates must be fixed by Palo Verde district for levying the annual assessments—one each for the joint levee and drainage districts and two for the irrigation district. The assessed valuation, annual assessment rate, and total levy for each of these purposes for 1927–28 were as follows:

District	*Assessed value*	*Tax rate for each $1 valuation*	*Total levy*
Joint levee	$5,061,863.00	$0.0288	$145,781.66
Drainage	3,905,930.00	0.0203	79,290.89
Irrigation operation and maintenance	4,084,358.00	0.0556	227,086.38
Bond and interest	4,787,831.00	0.0337	161,350.09
Total			$613,509.02

The assessments levied for 1925–26 and 1926–27 followed the original Palo Verde district act, with two separate rates in each of the three districts. The total levies in those years did not vary widely from that for 1927–28 under the amended plan. For 1925–26 the total levy was $685,081, and for 1926–27 it was $519,927.

The assessed valuation for 1928–29, as equalized, in Palo Verde Irrigation District was $4,974,780, and the total amount of the levy was $758,365.45. The total rate for bond interest and principal for 1928–29 was $9.04 for each $100 of assessed valuation. The total rate for maintenance of levees is $6.87, and the rate for equipment purchased is $1.43, making a total rate of $17.34 for each $100 of assessed valuation.

This total rate, of course, applies only to lands in the irrigation district which are also in the joint levee and drainage districts.

The last delinquent tax sale was made by the district June 30, 1928, when tax sale certificates sold, including penalties and costs, amounted to $175,162.20.

IMPERIAL

Location: Imperial Valley, in Imperial County. (Pl. XXXVIII.)
Date of organization election: July 25, 1911.
Gross area: 605,000 acres; **area assessed 1927:** 585,000 acres (approximate).
Principal cities and towns: El Centro, Brawley, Calexico, Imperial, Holtville, Calipatria, and Westmoreland.
Post office: El Centro.
Railroad transportation: main Sunset line and Imperial Valley Branch, Southern Pacific railroad, and San Diego and Arizona railway.

History.—The history of this irrigation district and its predecessor, the California Development Company, constitutes the history of the irrigation development of Imperial Valley. Many reports and articles relating to the valley have been published, some of these dealing with it prior to the formation of Imperial Irrigation District in 1911, and others, published since then, covering also Imperial Irrigation District.*

In briefly outlining the history of irrigation development in Imperial Valley, it might be said that the first effort to bring water from Colorado River to this desert area was made about the time of the Civil War. At that time Dr. O. M. Wozencraft, as principal promoter, and Ebenezer Hadley, county surveyor of San Diego County, worked out a development and colonization project to be financed largely by the sale of government land which it was proposed should be granted, in the amount of 3,000,000 acres, to the state of California. The legislature of California approved the proposed grant but it failed to pass Congress.

Later, in 1876, the Corps of Engineers of the United States Army made a study of the proposal and reported unfavorably upon a canal location entirely within the United States, but, as others had done previously, called attention to the physical feasibility of carrying water from Colorado River into Imperial Valley along the natural drainage lines through Mexico. The first important effort to do this was made by C. R. Rockwood and his associates, who, in 1892, organized Colorado River Irrigation Company. A canal was surveyed which would divert water north of the international boundary and carry it south of the boundary to Alamo River, a natural channel draining back into Cali-

* 60th Cong., 1st Sess., Senate Doc. 246, Irrigation in Imperial Valley, California, Its Problems and Possibilities, by C. E. Tait. 5-56.
Trans. Am. Soc. C. E. Vol. LXXVI, Irrigation and River Control in the Colorado River Delta, by H. T. Cory, 1204-1453.
Calif. State Dept. of Eng., Bul. 2, 100-104.
67th Cong., 2d Sess., Senate Doc. 142, Problems of Imperial Valley and Vicinity (Arthur P. Davis report), 1-98, particularly 71-92.
U. S. Dept. of the Interior, Report of the All-American Canal Board, July 22, 1919, 7-98, particularly 17-21.
Opinion of the Superior Court of Los Angeles County, California, in *Title Insurance and Trust Company* vs. *California Development Company et al.* (Case No. 81926), dated January 4, 1913, 1-44.
65th Cong., 1st Sess., Senate Doc. 103, The Colorado River in Its Relation to the Imperial Valley, California, by C. E. Grunsky, 3-39.
There are a large number of other reports and papers which make reference to the historical aspects of Imperial Valley. For bibliography of published data, see Senate Document 142 (referred to above), 223-233. Unpublished data have been collected in an important compilation entitled "Colorado River Basin," which is on file in the offices of the United States Bureau of Reclamation in Washington, Denver, and Yuma.

fornia and finally into Salton Sink, which lies below sea level at the northern end of Imperial Valley.

Efforts to finance Colorado River Irrigation Company were not successful, and it was succeeded in 1896 by the California Development Company, with Rockwood still in charge of engineering and construction. Between 1896 and 1902 this company laid out the Imperial canal system and began construction. The head of the canal was located at Hanlon's, about 500 feet north of the international boundary, where a wooden headgate, known as the Chaffey headgate, was built. A small amount of water was delivered to lands in Mexico in 1901 and water was made available to Imperial Valley the following year. By December, 1902, some 2000 people are said to have entered the valley.

On May 17, 1904, the California Development Company, through a Mexican subsidiary company, known as *La Sociedad de Riegos y Terrenos de la Baja California*, was granted the right by the Mexican government to divert 10,000 cu. ft. per sec. (284 cubic meters per second) below the international boundary, or receive that amount diverted in California, and to transport it through Mexican territory. Under the authority thus granted, but without yet having received specified permission therefor, two dredger cuts were made from Colorado River to Imperial Canal to facilitate diversion, the first just below and the second about four miles below the international boundary. Pending approval of application to the Mexican government for the right to construct a controlling gate at this cut, none was constructed. Unprecedented floods from Gila River in Arizona during the winter of 1905 indicated the necessity for closing the lower cut, but efforts to do so were unavailing. This cut, originally 60 feet wide, was greatly enlarged by the river, as was also Imperial Canal below. By August the entire river was running through the cut and canal and through Imperial Valley into Salton Sink.

In June, 1905, as a result of a loan of $200,000 to California Development Company by Southern Pacific Company, the latter company took over the management of the canal and other properties of the company. The Southern Pacific Company was interested not only in the development of Imperial Valley, but also in the protection of its railroad around the northern end of Salton Sea. Throughout the years 1906 and 1907 strenuous but unsuccessful efforts were made to turn Colorado River permanently back into its old channel toward the Gulf of California, and thus prevent its further continued flow down the channels of Alamo and New rivers and into Salton Sink. The river had been turned down its old channel on November 4, 1906, following the completion of Hind Dam, but on December 7, a second break occurred. On December 20, at the request of President Roosevelt, Southern Pacific Company started work on a second closure. This was accomplished February 10, 1907, by the completion of Clarke Dam. It has been estimated that the cost of twice turning the river back into its own channel exceeded $2,000,000.

This, however, was not to be the entire cost of protecting Imperial Valley from Colorado River. For a number of years no other agency than the government or Southern Pacific Company was financially able to carry the burden. The California Development Company was thrown into receivership in December, 1909, but the funds available to the receiver were inadequate. About the time of the beginning of the

receivership, Congress appropriated $1,000,000 for protective works, and this was mainly spent in unsuccessful endeavor to keep the river from flowing southwesterly down the channel of Bee River and into the old bed of Volcano Lake, which it was doing by the end of the flood season of 1909. In 1912 President Taft recommended an additional Congressional appropriation of $1,000,000 but this appropriation was not made. Since then the entire burden of controlling the river has been borne by the people of the valley, at first mainly through California Development Company, and in recent years mainly by Imperial Irrigation District, with some expenditures made directly by the Mexican government and by land interests in Mexico.

Throughout this period of efforts to control Colorado River, and in spite of the ever-present flood hazard, agricultural development has proceeded in Imperial Valley. In order to enable it to finance the construction of distributing canals within Imperial Valley, California Development Company had organized a number of mutual water companies. Whenever a mutual company was organized its ditch system was constructed by California Development Company, and in consideration of this, that company was given the right to sell the stock of the mutual water company and to retain the money received therefrom. One share of mutual water company stock was issued for each acre to be irrigated, and water was to be supplied by California Development Company at the rate of $0.50 per acre-foot. By 1906, 130,000 acres was under cultivation and water rights had been purchased through mutual water companies for over 200,000 acres. By 1910 the irrigated area exceeded 180,000 acres, exclusive of about 15,000 acres in Mexico which was being supplied from the Imperial system.

The crisis in the affairs of Imperial Valley created by the financial tangle into which California Development Company had been precipitated, largely through the disasters on the river that have been referred to, made it imperative that the settlers in Imperial Valley should find some way to acquire control of Imperial Canal. There was bitter controversy as to the most desirable procedure. Generally speaking, those who had purchased stock in some mutual water company believed that a holding company should be formed for the purpose of acquiring the properties of the old company from the receiver. On the other hand, those who had not purchased water stock, but who had made land entries in Imperial Valley, favored the formation of an irrigation district, and this step was finally taken July 25, 1911, by a vote of 1304 to 360. When formed, the district included 523,600 acres. Opposition to the district continued after its formation, the opponents, however, being unsuccessful in attacking the first district assessment in the courts.

Shortly after the district was organized, an engineering report was made and a bond issue of $3,500,000 was recommended, of which $3,000,000 was to be used for purchasing the works of California Development Company and $500,000 was to be used for betterments, particularly in connection with flood protection along Colorado River. On October 29, 1914, this bond issue was authorized by a vote of 3278 to 330. The Southern Pacific Company had acquired the entire system, including that portion lying within Mexico, at receiver's sale on February 8, 1916, but it was not until June 22, 1916, that the purchase of the California Development system by the district was finally con-

summated, the district at that time turning over to Southern Pacific Company for its interest in the system $3,000,000 in 5 per cent bonds at par. This purchase included the properties of a new subsidiary Mexican company, *Compania de Terrenos y Aguas de la Baja California, S. A.*, to which the works of the Imperial canal system in Mexico originally owned by California Development Company had passed.

Soils and topography.—Imperial Valley in California comprises the larger portion of the northern slope of the delta built by Colorado River as it has cut across the Gulf of California and separated Salton Sink from the sea. The soils are thus made up chiefly of the silts and sands brought into the valley by Colorado River and its tributaries from the six states comprising its principal drainage area. The character of the soils varies with the character of the material brought down. Locally the soils are classed as 'hard,' 'medium,' and 'soft,' these terms, of course, referring to their friability under cultivation. Soil surveys cover the entire area of the valley within the United States and extend beyond the boundaries of Imperial Irrigation District.* The soil variations are so numerous that no attempt will be made here to describe them in detail.

Through numerous additions since organization, the area in Imperial Irrigation District has been increased to 605,000 acres, of which 515,000 acres is generally classed by the district as being irrigable.†

Nonirrigable areas mainly comprise the lands along the channels of Alamo and New rivers, the lands within the cities and towns, and some sand hills in the southeastern corner of the district. Some lands bordering Salton Sea may be classed as irrigable or nonirrigable, as they are reclaimed by silting from the lower end of the Alamo and New rivers, or left in their present state. A considerable area of land near the eastern boundary of the district east from Brawley and Imperial, and other areas west of Imperial, and also west of New River northeast of Dixieland, are so heavily impregnated with alkali as to have doubtful value for agriculture. The great bulk of the valley is an even plain sloping northerly toward Salton Sea. The eastern half of the valley slopes toward Alamo River to the west.

The soils of Imperial Valley are free from hardpan and of great depth, and in early days it was thought that drainage would not be necessary. This impression has proven to be erroneous, and the district has found that it will be necessary to provide drainage for practically the entire area, although the lands requiring drainage are not continuous. This drainage is required not because of a general rise of the underground water table, as in most irrigated sections, but to remove seepage from canals and excess water applied to the land in irrigation, which, due to tightness of the soil, is unable to get away without artificial aid. About 100,000 acres is reported to have a local water table less than

* U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Brawley Area, California, and Soil Survey of the El Centro Area, California.

† In preparing a report for the Bureau of Reclamation in 1927, the writer undertook to check the area of nonirrigable lands within Imperial Irrigation District, planimetering this area from a map of irrigated, irrigable but not irrigated, and nonirrigable lands prepared with the assistance of the division superintendents of Imperial Irrigation District. This indicated, as of 1926, 462,237 acres irrigated, 88,320 acres irrigable but not irrigated, and 47,613 acres nonirrigable. While this method does not give the exact areas, the conclusion from it is that the area of irrigable land within the district is in excess of the 515,000 acres estimated by the district to be irrigable.

4 feet from the surface. The need for drainage in the valley is increased because a large portion of the land carries a high alkali content which led soil specialists in early days to express doubts as to the feasibility of reclamation. Under the conditions of this valley, however, it has been found possible to raise crops successfully on lands carrying a higher alkali content than elsewhere.

What has been said above regarding the irrigable and irrigated areas relates only to lands lying within Imperial Irrigation District. South of the international boundary, however, Imperial Irrigation District is supplying water to a large area, and is the potential source of supply for much additional land. Thus far the areas irrigated in Mexico are confined to the northern slope of the delta; that is, as far south as the old channel of the Bee and southwesterly from that channel along Pescadero Cut and Rodriguez Levee. The gross area from the international boundary to the southern limits thus described is approximately 500,000 acres, of which the best information available indicates 400,000 acres to be susceptible of cultivation. South of the Bee, Pescadero Cut, and Rodriguez Levee, the gross planimetered area is 315,000 acres. Of this, 220,000 acres is estimated to be irrigable if Colorado River is restored to its old channel between Sonora and Lower California, and 150,000 to 175,000 acres is estimated to be irrigable with Colorado River following its present course down the Bee and Pescadero channels. The soils in the developed portion of Colorado River delta in Mexico are generally of good to excellent quality, with relatively small areas showing alkali injury.

Development.—Lands of Imperial Valley have developed more rapidly than any other large area in western America. Where there was nothing but desert twenty-seven years ago, values have been created approximating $140,000,000, not including development in the valley in Mexico.* An incomplete tabulation of the value of agricultural products grown in 1925 gives a total of approximately $26,000,000, which does not include the return from such major crops as barley, milo maize, wheat, alfalfa hay, poultry and eggs, or from winter and spring pasturing of sheep and cattle shipped in for feeding en route to market. The principal returns were from cantaloupes, lettuce, milk fat, and cotton, but with very large income also from watermelons, peas, asparagus, tomatoes, and other truck crops, and from fruits, and pasturage.

The estimated population of Imperial Irrigation District is now approximately 50,000, of which about half live within incorporated cities. The Southern Pacific Company has built a branch line from Niland on the main Sunset line near Salton Sea southerly to Calexico on the border, and thence through Mexico back to Yuma. The San Diego and Arizona railway passing through El Centro and Calexico connects the valley with San Diego, and with the east through Yuma.

* In a study by the writer for the U. S. Bureau of Reclamation made in 1927, property values created in Imperial County through or incident to irrigation development from Colorado River were tabulated. The values found totaled $137,442,677. This tabulation included real estate, both operative and nonoperative, and improvements and personal property, both within and without incorporated cities. Improvements included roads and street improvements. Personal property included the physical property of Imperial Irrigation District. Values of real estate and improvements outside of incorporated cities were arrived at by applying ratios of assessed values to true values as found by the State Board of Equalization. Practically all of the developed lands in Imperial County are within Imperial Irrigation District, the principal exception being 15,035 acres in the reservation unit of the Yuma reclamation project.

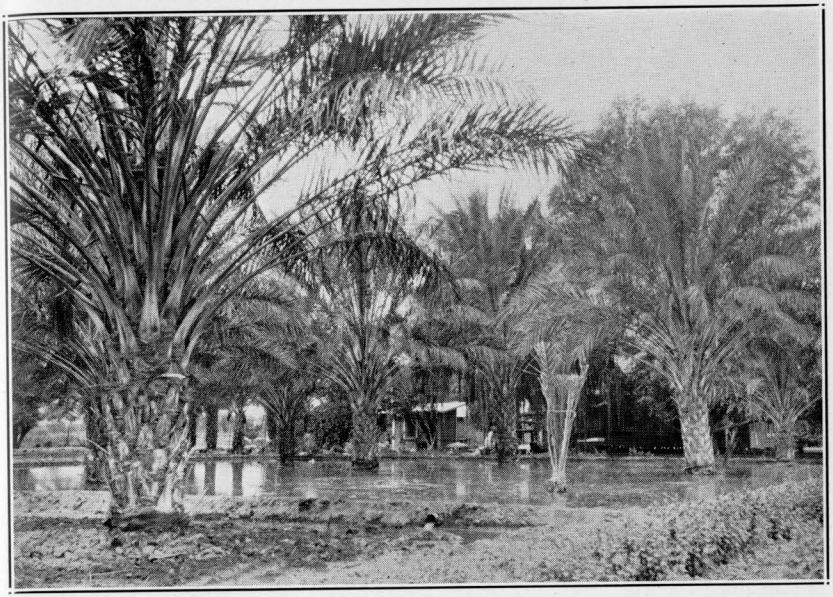


FIG. 1. Irrigating date palms in Coachella Valley County Water District.

FIG. 2. Typical branch canal, Imperial Irrigation District.

The transcontinental state highway traverses the valley, with alternate lines through San Diego and Redlands.

In 1927 there were 4769 separate farms in the district, of which 1812 were farmed by owners and 2957 by tenants. The large number of tenants is due not only to climatic conditions, but also to the extensive acreage devoted to truck crops. The Southern Pacific Company still owns about 38,000 acres of undeveloped land, and there are several holdings as large as 2000 to 3000 acres. The net area cropped in the district in 1927 was 389,048 acres, 30,252 acres of this being double cropped. Of the total area cropped, including that double cropped, 306,245 acres was in field crops, 96,576 was in garden crops, with only 16,479 acres in permanent plantings, such as orchards and vineyards. The area served by the district in Mexico in 1927 was 156,168 acres, of which 72 per cent was in cotton. Counting lands in both United States and Mexico, the district supplied water in 1927 to 545,216 acres.

Water supply.—The right of Imperial Irrigation District to water from Colorado River is based on appropriation and use. The first filing was made on behalf of the proposed Imperial Canal May 16, 1895, and was for 10,000 cu. ft. per sec. Similar filings were made at intervals later in 1895 and during the four years following. Earlier filings of importance are those of the Blythe Ranch, to which Palo Verde Irrigation District has succeeded, and filings in 1890 and 1891 to which the Yuma project of the U. S. Bureau of Reclamation is the successor. The Yuma project also has claims under a grant by Congress giving general authority to divert water from Colorado River in connection with reclamation of lands in the Yuma and Colorado River Indian reservations in California and Arizona under the act of June 17, 1902. There is a filing for the Colorado River Indian Reservation dated April 21, 1904, which presumably was for water for the entire 104,000 acres in the proposed Parker Indian project. There are also a large number of additional filings in the upper states, both for power and irrigation, but all of importance are much later in date than those of Imperial Irrigation District and the other lower users referred to. In the absence of an agreement between the Colorado River basin states or an adjudication, no definite statement can be made with reference to the extent of the right of Imperial Irrigation District, except that its right under the old code filings to sufficient water for the present project has not been questioned.

With the exception of a few brief periods the flow in Colorado River at the intake of Imperial Canal has always been ample to meet the requirements of the Imperial system, although it has usually been necessary to construct a temporary weir across Colorado River at the intake to facilitate diversion during certain periods in the summer. A temporary shortage occurred in 1924, when from August 4 to October 16 the entire flow of the river was diverted by Imperial Canal, the flow reaching a minimum of 1295 cu. ft. per sec. on September 11. The total diversion shortage in that year has been estimated at about 200,000 acre-feet. From January 4 to 11, 1925, there was a shortage during which the discharge dropped to 1300 cu. ft. per sec., viz., on January 8. Another shortage occurred in September, 1926, when it was necessary to prorate water to the different operating divisions.

Imperial Canal has a diversion capacity in excess of 7000 cu. ft. per sec., the maximum diversion in 1927 having been 6612 cu. ft. per sec., on July 15. The total quantities diverted are of record for the years since 1912. From that year until 1921, the amounts taken annually into the main canal ranged from 1,433,753 to 3,095,956 acre-feet. From 1922 to 1927 the diversions by the entire canal system ranged between 2,890,282 acre-feet, in 1922, and 3,275,425 acre-feet, in 1923. In 1927, the total diversion was 3,089,191 acre-feet, which was 18.07 per cent of the 1927 discharge of Colorado River at Yuma. Owing to operating needs, however, much more water is diverted from the river than is delivered. From 1912 to 1925, for instance, the quantity wasted, lost, and unaccounted for ranged between 520,665 acre-feet, in 1912, and 1,741,003 acre-feet, in 1923.

In outlining the history of Imperial Irrigation District, reference was made to a concession granted by the Mexican government to the California Development Company through its subsidiary company, *La Sociedad de Riegos y Terrenos de la Baja California*, later changed to *Compania de Terrenos y Aguas de la Baja California, S. A.* The original concession, dated May 17, 1904, provides in article two that, of the water authorized to be carried through canals in Mexico, "enough shall be used to irrigate the lands susceptible of irrigation in Lower California * * * without in any case the amount of water used exceeding one-half of the volume of water passing through said canals." This requirement will be referred to in more detail under the heading "Use and delivery of water." The terms of this concession in this regard are adhered to, as demanded, on the basis of delivery of half of the quantities available daily. The area irrigated from Imperial Canal system in the United States greatly exceeds the area irrigated from that system in Mexico, and the amount of water needed in Mexico is therefore much less than half of the total. The requirement of the concession, therefore, needs to be enforced only during periods of shortage.

Works.—Imperial Irrigation District maintains an extensive system of works. Besides having to deal with the usual problems of construction, maintenance, and operation of a large irrigation and drainage system, it must also deal effectively with an unusual silt problem, and protect the valley against the floods of Colorado River. Obtaining water from an interstate and international stream, on which water rights must be settled, and flood control, storage, and hydro-electric works must be built, it must deal with other states, and with the United States and Mexican governments.

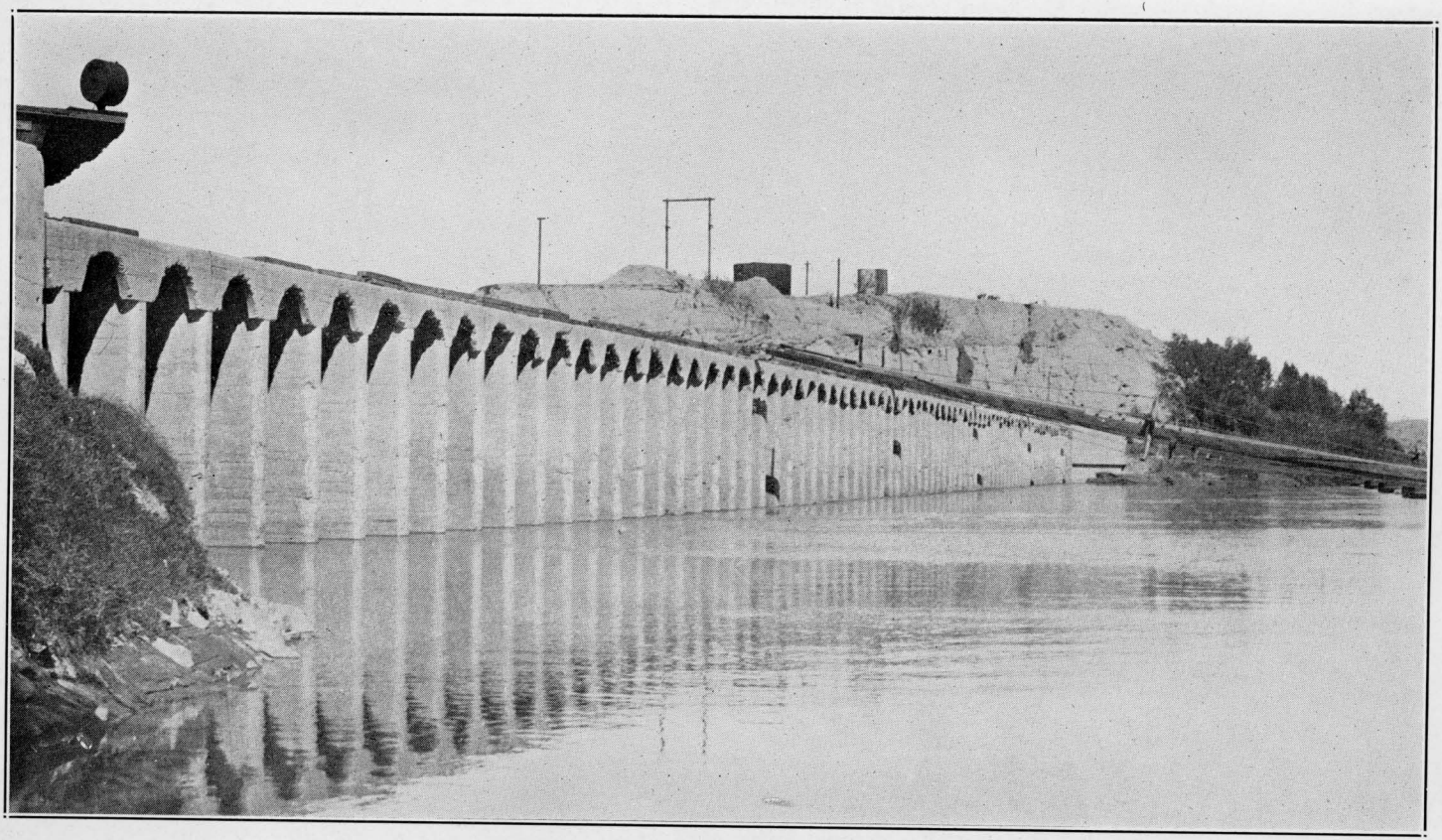
The principal physical works in the district now include the following:

Rockwood Heading, on the left bank of the Colorado, about 1.5 miles above the international boundary, a concrete structure with 75 openings, built in 1917, at a cost of about $250,000.

An intake canal 6000 feet long from Rockwood Intake to Hanlon Heading.

Hanlon Heading, a concrete regulating gate, formerly the main intake structure, about ¼ mile above the international boundary.

The main canal, extending from Hanlon Heading through Mexico along the old Alamo channel east of Calexico. This canal delivers



Rockwood Heading of Imperial Irrigation District Canal on Colorado River.

Plate XL.

water to canals which lead northerly across the international boundary to irrigate the lands extending from the eastern boundary of the district westerly to the channel of New River; it also carries water to Westside Main Canal, which, with its branches, crosses the international boundary west of Calexico to supply the lands between New River and the western boundary of the district.

Two main canals leaving the Alamo at Cudahy Creek to water the central area of land irrigated in Mexico, one of these, Cerro Prieto Canal, leading back into Westside Main, south of Calexico and Mexicali.

73.5 miles of protective levees in Mexico, of which 47.5 miles are provided with standard railway.

Pescadero Cut, about 3.4 miles long, constructed to divert the entire flow of Colorado River from the old channel of Bee River to the channel of Pescadero River.

Main canals and laterals in the United States totaling 2441 miles, and numerous gates, checks, drops, and other structures.

Drains totaling 200 miles in length, built at the cost of about $2,500,000, and involving the moving of about 12,000,000 cu. yds. of earth.

The district, on October 23, 1918, entered into an agreement with the Secretary of the Interior for the diversion of water for Imperial Irrigation District at Laguna Dam of the Yuma reclamation project. For the right to use Laguna Dam and the main canal and structure leading from that dam, and for the right to divert water, the district is obligated to pay to the United States the sum of $1,600,000 in twenty annual installments, of which $544,000 had been paid to December 31, 1927.

The total fixed assets of the district, as of December 31, 1927, amounted to $18,213,305, of which $10,387,027 represented the cost of the canal system, including additions and betterments, $3,011,987 was for protective works, and $2,590,453 was for drainage canals and structures. The total fixed assets include equipment and facilities valued at $1,224,164, and buildings, land, and other fixed assets, valued at $455,673.

In referring to the various problems confronted by Imperial Irrigation District mention was made of silt. Cleaning operations are constantly necessary throughout the system, both for irrigation canals and surface drains. In 1927 the total mileage cleaned was 3274, the cost of this cleaning for the year having been $480,000.

The cost of operating and maintaining the entire system of the district in 1927 was $1,723,694. This did not include $202,460 charged off for depreciation on buildings, equipment, and facilities; $868,250 accrued interest on district bonds, and miscellaneous expenses amounting to $57,009.

The district is proposing to build five hydro-electric plants at various points on the canal system, together with a reserve steam plant at Imperial, a loop system of transmission lines throughout the valley, a line to Andrade, at Hanlon Heading, and distribution systems within the various towns of the valley. The estimated cost of this power development is $2,000,000. Application for approval of plans and the necessary bond issue is pending before the Bond Certification Commission.

All operations of Imperial Irrigation District in Mexico, whether they have to do with canal maintenance and operation, protective works, or delivery of water, are carried on through the Mexican subsidiary, *Compania de Terrenos y Aguas de la Baja California, S. A.* To meet the requirements of the Mexican government, the stock of this Mexican company is owned, not by Imperial Irrigation District, but by the individual members of the board of directors, each director on leaving the board assigning his interest to his successor. The district is required to maintain a complete staff of operating officials in Mexico, and all business connected with the *compania* is required to be transacted in Spanish. A recent requirement of the Mexican government is that the metric system shall be employed in all transactions in Mexico.

There is an area of about 16,000 acres in the northern end of Imperial District not yet supplied with a distribution system. This area has been organized into Niland Water District, and an agreement has been entered into with Imperial District by which a distribution system to be constructed by Niland Water District will be purchased by Imperial District at actual cost of construction, without interest.

Use and delivery of water.—Imperial Irrigation District undertakes to deliver water to any part of the district or along its canal system in Mexico on 24 hours' notice. Until 1923 the district followed the practice of its predecessor, California Development Company, and sold water at wholesale to the various mutual water companies, which in turn made deliveries to landowners. During the period November 1, 1922, to March 1, 1923, the district took over the properties of the thirteen mutual water companies within the district, thus assuming direct responsibility not only for the diversion and transportation of water from Colorado River, but for its distribution and delivery to individual headgates serving some 450,000 acres of land within the district. The original plans for the absorption of the mutual companies provided for payments to them by the district at the rate of $10 per acre for all land fully covered by mutual water company stock, and also for payment for equipment, real estate, and certain irrigation works. Owing to discount on the bonds issued to pay for the absorption of these mutual companies, the price paid was reduced to $9.12 per share. The total cost to the district for this absorption was $4,724,612.

Delivery of water by the district to lands in Mexico is made from the main canals and not to individual users as within the district.*

Payment for water is required in advance. Water used in Mexico is delivered mainly from the Alamo, East High Line, Mesa, Carrillo Bend,

* Until March 10, 1928, aside from small quantities of water used by a few Mexican or Indian squatters in the lower delta, a few relatively small pumping plants, and about 1350 acres being supplied by wells on the Paul Williams tract near Cuervos station on the Inter-California Railroad, all water used from Colorado River in Mexico for irrigation has been obtained from the Imperial irrigation system. On March 10, 1928, however, the first three units of a battery of siphons being installed at the upper end of Pescadero Cut by Delta Canal Company, under permit from the Mexican government to Colorado River Land Company, were started in service. These, with two additional units installed a little later, have a combined capacity of about 500 cu. ft. per sec. It is understood that sixteen additional units are to be installed. Under the concession from the Mexican government, these siphons can be used for supplying water anywhere within the holdings of the Colorado River Land Company, which is the owner of some 800,000 acres of land in Lower California, and the largest purchaser of water from Imperial Irrigation District. Since these siphons divert directly from the channel of Colorado River, and not from the Imperial canal system, their use will materially reduce income of the district from water sales in Mexico. Until Colorado River is controlled by storage, the siphons can not operate during the periods of low flow, and at any rate, their installation does not affect the right of lands in Mexico to receive half of the water carried through Mexico by Imperial Canal.

East Side Main, Solfatara, South Alamo, Ash, Alamitos, Central Main, Woodbine, Wormwood, Cerro Prieto, Westside Main, Wistaria, and Encina canals. The largest use is from the Alamo, Solfatara, Wormwood, Cerro Prieto, and West Side Main. All laterals in Mexico are built and maintained at the expense of Mexico water users. Certain lands receiving water from the Imperial canal system in Mexico are too high for gravity delivery, and are therefore supplied by pumps, of which there are eight now in use. These pumps have a combined capacity of 988 cu. ft. per sec.

Within Imperial Irrigation District water deliveries are made to the high point on each 160 acres. Deliveries are by orifice measurement, and are considered by the district to be at least 10 per cent low. For the purposes of deliveries the district is divided into five operating divisions. Deliveries by the district in Mexico are measured by current meters and are generally accepted as accurate.

Records of deliveries are available for lands in the United States since 1904. Prior to November 1, 1922, records of deliveries relate to the quantities turned over to the mutual water companies and are only approximately correct. With the exception of three years, annual deliveries within the United States since 1914 have exceeded 1,000,000 acre-feet, and since 1908, the gross duty, as roughly determined, has ranged between a minimum of 2.26 and a maximum of 3.69 acre-feet per acre.*

Records of deliveries in Mexico are available since 1905. During the past six years, they exceeded 500,000 acre-feet. In four of these years, they exceeded 600,000 acre-feet, and in one year reached the maximum of 728,529 acre-feet. The quantities supplied to users in Mexico since 1911 have ranged between 2.93 and 3.96 acre-feet per acre.

In February of each year reports are obtained by the district, through the *zanjeros*, regarding areas being irrigated or to be irrigated during the year, subdivided according to crops. The maximum area irrigated in any one year during the past ten years has been 414,724 acres in the United States, and 216,912 acres in Mexico. The areas irrigated in the United States and in Mexico in 1927 were 389,048 acres and 156,168 acres, respectively.

The irrigation season of Imperial Valley in the United States and in Mexico extends throughout the year.

Bonds.—Imperial Irrigation District has issued bonds in the amount of $16,000,000, of which $15,350,000 were outstanding December 31, 1927. The first issue was for $3,500,000, is dated January 1, 1915, and carries interest at 5 per cent, with maturities from 1936 to 1955; the second issue, dated July 1, 1917, was for $2,500,000, bearing interest at 5 per cent, with maturities from 1938 to 1957; the third issue, dated October 1, 1919, was for $2,500,000, with interest at 5½ per cent, and maturities from 1925 to 1934; the fourth issue of $7,500,000, dated July 1, 1922, carries 6 per cent interest and has maturities from 1934 to 1955. Of the first issue, $3,000,000 was taken by Southern Pacific Company at par.

The bonds outstanding in Imperial County other than the Irrigation District bonds, but not including bonds of municipalities, totalled

* The district lays emphasis on the fact that measurements of deliveries in the United States on which these duty of water figures are based are made through orifices, and have been found to be at least 10 per cent low, while deliveries in Mexico are made by current meter, and are considered correct.

$3,652,500, on June 30, 1927. Of these, $1,150,000 were for elementary schools, $739,500 for high schools, $1,500,000 for highway improvement, and $263,000 were courthouse bonds. The state and county tax rate outside of incorporated cities for 1927–28 was $2.30 on each $100 of valuation. Special, bond, and high school rates increased the state and county rate by varying amounts in the different school districts.

Assessments and water tolls.—Imperial District has had a difficult task in arriving at a satisfactory method of obtaining income from lands within the district. Part of the time assessments only have been levied and at other times both assessments and tolls.

The first district assessment was made by contract, names and descriptions of property being taken from the county records, and all lands being valued at $30 per acre. A little later these valuations were increased to $50 per acre maximum and in 1918 to $100 per acre maximum. At one time each district director undertook to make a return for property in his division. In 1921 the engineering department of the district made surveys to determine the water table and alkali conditions, and these gave a basis for readjusting the assessments. In 1923 the field men of the county assessor's office were given extra compensation by the district to report allowances that should be made for roads and canals. In 1925, in order to equalize assessments in accordance with the district act, the assessor made a further classification, raising the maximum valuations on the better lands to $125 and $150 per acre. It was not until 1926 that the district assessor began to send special deputies into the field. During all this period the district had been assessing lands of lower value at $20 to $40 per acre, except that lands without distribution systems and nonagricultural lands were given nominal valuations of $1 to $5 per acre.

Prior to taking over the mutual water companies in 1922–23, all water income from lands in the United States was obtained through the mutual water companies. Up to 1923–24 water had been charged for at the rate of $1 per acre-foot, and in that year the district assessment rate was $2.50 per each $100 of valuation, the normal valuations being $100 per acre. Absorption of the mutual water companies in 1922–23 made necessary a new arrangement regarding tolls and assessments. For the year 1923–24 the district assessment rate was raised to $5 per $100 of valuation, but, while the water toll of $1 per acre-foot was retained, it was provided that, after the district assessment on any land had been paid for the year, water would be furnished free to such land up to 2.5 acre-feet per acre for land valued by the assessor at $100 per acre, or a proportionately larger or smaller quantity if the land valuation was more or less than $100 per acre. Slight changes were made in this arrangement in 1924 and 1925, but, effective January 1, 1926, tolls were discontinued for lands assessed on an acreage basis, except for a service charge of $0.25 per gate for each day of delivery. Lands within incorporated cities and towns still pay at the rate of $1 per acre-foot, but with no service charge.

Thus, in the main, the income of Imperial Irrigation District from lands within the United States is now obtained from the annual district assessment at the rate of $5 per $100 of valuation. For each of the past two years this assessment rate has been divided as follows: bond interest, $2.088; bond retirement, $0.483; general fund, $2.198. The amounts raised annually from lands within the United States in 1926

and 1927 were $2,444,903 and $2,420,110, respectively. In 1927 city property paid 9.88 per cent of the total district tax. The total valuation for district purposes in 1927 was $48,420,214, of which a little less than $5,000,000 was for city property and about $1,450,000 for subdivisions outside of the cities and towns.

Water charges in Mexico imposed by Imperial Irrigation District through its subsidiary *compania* are in accordance with rates fixed by the Mexican government. The authorized rate at present is $1.40 Mexican gold, or $0.70 United States gold, for each 1000 cubic meters, equivalent to $0.86 (U. S.) net per acre-foot. Where the one paying for water is not the user the charge is passed by the purchaser on to the user, together with a flat or prorated charge to cover maintenance and operation of delivery canals or works. On lands of Colorado River Land Company, which is the largest user of water from the system in Mexico, the average annual cost per acre is reported by the general manager to range from $6.50 to $7.00 per acre, these figures including a Mexican tax of $0.11 (Mex.) per 1000 cubic meters. Of the total water charge, under this company, one-third is estimated to be for maintenance and operation and two-thirds, or approximately $4.65 per acre, is for water. These charges are said to represent actual cost to the company. Income to the district from water sales in Mexico during the past five years has ranged from $526,971 to $630,258; in 1927 it was $496,017.

CHAPTER VI

INACTIVE OR PARTIALLY ACTIVE IRRIGATION DISTRICTS

There are twenty-six irrigation districts in California which seem properly to fall within the classification "inactive or partially active districts." Some of these have done little or nothing since organization, several having been organized with the sole purpose of keeping the land embraced within them from being included within other irrigation districts. At the other extreme are districts which have spent both money and effort in endeavoring to work out a plan of development and to acquire a water supply, but at present are taking no definite steps to carry out their plans. Between these two classifications are districts which have undergone various degrees of activity. In including these twenty-six districts within the classifications "inactive or partially active districts," rather than within the "active" districts,* there has been no intention either to prejudice their present standing or to attempt to forecast their future.

It has not been deemed necessary for the purposes of this report to make thorough field studies of these twenty-six districts. To the extent necessary for the purposes of this report, however, the information which has been collected regarding them is briefly summarized below. The districts are taken up in geographical order, from north to south.

CROOKS CANYON

Location: 10 miles south of Alturas, in Modoc County.
Date of organization election: September 27, 1919.
Gross area: 5029 acres.
Post office: Alturas.

This district was organized without a feasibility report by the state engineer being rendered. The area included lies at an elevation of about 4500 feet, and was in part dry-farmed to grain at the time of organization, the remainder being raw sagebrush land.

Three separate engineering reports were prepared for the district, all involving storage in Crooks Canyon, a tributary of South Fork of Pit River.

The first report outlined a project to cost $79,830, of which $39,000 was for a dam 37 feet high which would impound 9617 acre-feet of water. The Bond Certification Commission approved a bond issue of $80,000 to carry out this project and these bonds were subsequently authorized by the electors of the district and validated by the Bond Certification Commission.

The district board of directors accepted a contractor's bid of 82 per cent of par for the bonds, and his offer to do the construction work at cost plus 10 per cent. Work under this bid started and materials were

*For a definition of "active" districts as used in this report see footnote on page 51.

ordered, but the Bond Certification Commission refused to sanction the arrangement, and the district decided to proceed on force account. Later, all work was shut down and orders for material and equipment were canceled. The bonds were offered for sale a third time but the only bid, which offered 83½ per cent of par, was rejected.

Some six months later, the board of directors authorized the second engineering report on an enlarged project. This report, calling for a bond issue of $180,000, which included some $31,000 for interest on bonds during construction, was accepted by the board of directors and approval of the Bond Certification Commission was requested. At the same time, namely, on March 7, 1922, the board of directors ordered the cancellation and destruction of the original $80,000 issue, and the bonds were accordingly burned. The request of the district to issue $180,000 in new bonds was disapproved by the Bond Certification Commission, because the cost was considered more than the lands could pay.

On August 7, 1923, the third engineering report was presented, calling for a smaller project to cost $35,000, and to store 3800 acre-feet of water. No action, however, was taken on this later report, as it was not acceptable to the proponents of the district. On November 23, 1925, a resolution was passed to disorganize, and an assessment was levied to pay the debts of the district. Disorganization was authorized by a vote of 7 to 0 at an election held December 15, 1925, but when the district was visited in August, 1928, the necessary steps for disorganization had not yet been taken.

The district levied annual assessments in the years 1920–21, 1921–22, and 1923–24, the total levies amounting to $10,741. Delinquencies on dates of tax sales amounted to $249 for the year 1920–21, $1,521 for 1921–22, and $964 for 1923–24.

In a suit brought against the district to collect for materials delivered for construction, settlement was made by payment of $1,070. All other claims against the district have either been paid or are now barred by the statute of limitations.

BIG VALLEY

Location: along Pit River from Lookout to south of Bieber, in Lassen and Modoc counties.
Date of organization election: October 12, 1925.
Gross area: 12,430 acres.
Post office: Bieber.

This district was organized after two previous efforts to organize had failed. The first petition for a district was filed with the supervisors of Lassen County in April, 1919, and contemplated a district of 22,000 acres. It was proposed to store water of Ash and Rush creeks to the extent of 47,000 acre-feet in Round Valley. Formation of this district was approved by the state engineer July 31, 1919, but it was defeated at the organization election November 7, 1919, by a vote of 70 for and 51 against, a two-thirds affirmative vote then being necessary. The second petition was presented to the supervisors September 4, 1923, the boundaries enclosing 41,620 acres. The state engineer reported unfavorably to the supervisors January 1, 1924, and the project was abandoned. The third petition, which was approved, was presented to the supervisors February 4, 1925. The plan proposed included

storage in Jess Valley near Likely, in cooperation with a large landowner, each of the interests to pay half of the cost of storage and to receive half of the water stored. In the recent water resources studies in California made by the State Department of Public Works, the run-off available for storage at Jess Valley was estimated at 22,100 acre-feet.

Big Valley, in which Big Valley Irrigation District is situated, was first settled about 1870. Meadows and adjacent lands were flooded by inexpensive ditches and checks in Pit River. As irrigation was extended on the lands farther up Pit River, the supply available to lands in Big Valley became increasingly deficient.

Numerous studies have been made of possible irrigation development along Pit River, notably that by the United States Reclamation Service in 1914 and 1915, cooperating with the California State Department of Engineering.* Earlier reports by the Reclamation Service had indicated the storage possibilities on Pit River. In the report of the later investigations, a plan for the irrigation of lands in Big Valley to the extent of 30,000 acres was outlined, storage being proposed in Round Valley.

Although the organization of Big Valley Irrigation District apparently represented a bona fide attempt to improve irrigation conditions in Big Valley, the directors of the district held only two or three meetings and nothing important has been done. The district has, in fact, remained practically inactive since formation. No assessments have been levied and no warrants have been issued.

About 60 per cent of the land within the district is now irrigated. In July, 1928, there were 39 landowners, of whom 8 were non-residents. The usual holding is about 320 acres, but there is one holding of 1560 acres, three of 720 acres each, and one of 680 acres. The estimated population of the district is 100.

JUNIPER

Location: east of Bieber, in Modoc County.
Date of organization election: November 6, 1925.
Gross area: 1820 acres.
Post office: Bieber.

This small district was formed by a vote of 16 to 0, after disapproval by the state engineer on August 11, 1925. It was proposed to take over and complete an irrigation system owned by several landowners organized as Juniper Irrigation Company. Works constructed by Juniper Irrigation Company included a shallow reservoir known as Juniper Creek Reservoir, with an estimated capacity of 3900 acre-feet, and about one mile of canal leading out of Juniper Canyon. Juniper Reservoir covers about 815 acres and is formed by two levees 11 and 15 feet high and 1200 and 1500 feet long, respectively, one of the levees being wholly and the other partly riprapped with rock. The watershed above the reservoir comprises about 10 sq. mi. near the summit of Hayden Hill.

The district board of directors held only a few meetings and nothing has been done towards taking over the Juniper Irrigation Company

*Dept. of the Interior, U. S. Reclamation Service, in cooperation with State of California. Report on Pit River Basin, April, 1915.

system or building additional works. It is reported that no district assessments have been levied. The cost of organization was paid by the proponents.

The land in the district is light sandy loam and is reported to produce good crops of alfalfa, grain and potatoes. About 600 acres of alfalfa was irrigated in 1927. Twelve families live within the district.

The present owners of the system are planning to complete the riprapping at the reservoir, and in the near future to build a diversion canal from an adjacent ravine, by which it is hoped to increase the water supply.

FALL RIVER VALLEY

Location: north of junction of Fall and Pit rivers, in Shasta County.
Date of organization election: July 1, 1922.
Gross area: 13,890 acres.
Post office: Glenburn.

An attempt to form an irrigation district in Fall River Valley was made in 1914, when, on September 7, a petition signed by 15 landowners on the west side of Fall River was presented to the supervisors of Shasta County. No action resulted from this petition. A second petition was filed December 3, 1919. A favorable report was made by the state engineer February 21, 1920, but at an election held May 24, organization was defeated by vote of 16 for and 26 against. In the third attempt at organization, which resulted in the present district, only those landowners were included who were favorable, and the election held July 1, 1922, carried by the unanimous vote of 28 electors.

While efforts to organize an irrigation district were in progress, Pacific Gas and Electric Company, through its subsidiary, Mount Shasta Power Corporation, was constructing its Pit River power development. This development provided for diverting water from Fall River about two miles above its junction with the Pit, and carrying it by conduit, including a tunnel about 2 miles long, from the end of which it would be dropped through Pit Powerhouse No. 1, located on Pit River below Fall River Mills. Construction work on this development was carried on during 1921 and 1922, and the water was first diverted through the conduit September 27, 1922.

Riparian lands along both Fall and Pit rivers, from the intake on Fall River to the power plant on the Pit, were purchased by Mount Shasta Power Corporation, the power company thereafter relying on the riparian rights for its use of water. Proponents of the irrigation district, however, filed applications 1467 and 1874 with the Division of Water Rights, calling for 240 cu. ft. per sec. to be pumped from Fall River. Permits 898 and 899 were issued on these applications, and it was on these that the district was relying for its authority to obtain water from Fall River. Before proceeding with construction work, however, the proponents of the district, on June 21, 1922, in the case entitled *John F. Sheehan, Jr.* vs. *Mount Shasta Power Corporation* (later changed to *Fall River Valley Irrigation District* vs. *Mount Shasta Power Corporation*), brought suit in the superior court of Shasta County to quiet title to the right to divert 240 cu. ft. per sec. from Fall River. Judgment was rendered in favor of the power corporation, the court holding that the permits obtained from the Division of Water Rights were void, because when they were issued,

there were no public waters flowing in Fall River subject to appropriation under the water commission act. On appeal, the judgment and decree of the lower court, on September 1, 1927, were affirmed.* Thereafter, on December 1, 1927, the permits issued by the Division of Water Rights, at the request of the permittee, were canceled without prejudice, leaving the district without the right to divert any of the waters of Fall River.

Since the cancellation of these rights, the district has been inactive. Some of the officers of the district believe that they still have certain valid claims against the power company, and are endeavoring to obtain a settlement. Others are of the opinion that no useful purpose can be served by maintaining further the district organization.

Fall River Valley is a flat plain tilted in a northerly direction with a slope of about 3 feet to the mile, the course of Fall River being southerly against the natural slope of the land. Because the surface of the valley dips in this way towards the source of the river, gravity diversions from Fall River to the lands within the irrigation district have not been possible; nor has it been possible to make gravity diversions from Pit River, which has eroded its channel to a depth of from 75 to 100 feet below the plain along the southeastern boundary of the district.

The predominating soil types in the district are sandy loams and adobes, about half being shallow and underlaid at a depth of about 2 feet with hard-pan. Small timber covers about 1600 acres, mostly on shallow soil.

No land is irrigated within the district. The principal dry-farmed crop is wheat, with a few scattered areas in nonirrigated alfalfa. The estimated areas within the district in crops in 1928 were: wheat, 2000 acres; alfalfa, 300 acres, and apples, 30 acres. There were, in 1928, 45 separate holdings averaging about 286 acres, with one of 2120 acres, one of 1280 acres, one of 988 acres, and one of 440 acres. The population in the district is about 50.

It was proposed to pump water from Fall River from several points, but as previously indicated, no construction was undertaken, and no capital expenditures made.

In order to carry on legal and other expenses, the district levied assessments in each of the assessment years from 1923–24 to 1927–28. Agricultural lands were valued at $10, $20, and $30 per acre, and timbered and brush lands at $1. The total amount of the levies for the five years was $17,505. On December 31, 1927, assessment delinquencies amounted to $2,130, and there were $1,800 in registered warrants outstanding.

RED ROCK CREEK

Location: 12 miles east of Ravendale, in Lassen County.
Date of organization election: June, 1918.
Gross area: 11,844 acres.
Post office: Susanville.

Red Rock Creek Irrigation District represents the second effort to develop an irrigation project in Madeline Plains, an open plateau area situated at an elevation of about 5300 feet north of Honey Lake Valley. The first of these efforts, by Madeline Valley Land and Irrigation

*74 Cal. Dec. 275.

Company, was most active about 1910 and 1911, and although a small water supply was made available and a distribution system was constructed, the enterprise was not successful and was later practically abandoned. This first effort was made in the northwesterly portion of the plains, extending south from Madeline.* The second effort, made by Red Rock Creek Irrigation District, although contemplating the use of some of the water supply developed by Madeline Valley Land and Irrigation Company, is confined to an area in the easterly portion of the plains. Thus far it, too, has been unsuccessful.

Red Rock Creek Irrigation District was organized without approval of the state engineer. It originally embraced 3700 acres, but was enlarged by petition on May 2, 1922, to include 23,515 acres, and on July 1, 1922, the board of directors adopted an engineering report which called for a bond issue of $600,000. The project did not receive a favorable report from the Bond Certification Commission and no action was taken.

A second engineering report in September, 1923, was based on an area of 18,349 acres and contemplated a bond issue of $750,000, but this proposition was also unacceptable to the Bond Certification Commission.

A revised estimate made in February, 1925, proposed reducing the area to 10,300 acres and the bond issue to $442,160. On April 1, 1925, this last plan and the proposed bond issue were approved by the Bond Certification Commission and bonds were voted by the district on May 9, 1925. When validation of the bonds was later requested, however, the Commission stipulated that the district should proceed with construction on a progressive basis.

On May 17, 1926, the Bond Certification Commission authorized the validation of $175,000 of the bonds that had been voted. The board of directors set September 27, 1926, for receiving bids on the bonds and for construction work, but none were offered, and since then the district has been practically inactive. Many of the landowners have moved away.

One landowner, who was also a director in the district, has acquired, or is in process of acquiring, reservoirs and storage rights which the district had contemplated purchasing. He is using these on his own land and holding them to be turned over to the district if the project is later revived. A portion of his farm was irrigated when the district was organized. In 1921 he was irrigating 250 acres of alfalfa within the district and about 1000 acres within the district was being dry-farmed. In addition, a few acres in the north end of the district were being flooded for meadow hay.

Lands in the district are a portion of what was once the flat bottom of an ancient lake. Soils range from coarse sands to more compact clay loams. Rye, barley, and oats are dry-farmed for hay. Stock raising is the principal industry. In 1918 there were about 50 separate holdings, averaging about 200 acres, with one of 1200 acres, one of 360 acres, and one of 320 acres.

The proposed water supply for Red Rock Creek Irrigation District was to come from Red Rock and Cold Springs creeks. Three reservoirs on Red Rock Creek, previously in part constructed by Madeline

*For brief description of Madeline Plains and brief statement regarding plans of Madeline Valley Land and Irrigation Company, see Report of Conservation Commission of California, 1912, page 118.

Valley Land and Irrigation Company, were to be utilized. Reservoir No. 1 was to be enlarged to a capacity of 3690 acre-feet and Reservoir No. 3 to a capacity of 5569 acre-feet. These reservoirs then had capacities of 710 and 910 acre-feet, respectively, and Reservoir No. 2 had a capacity of 20 acre-feet. A reservoir of 20,000 acre-feet storage capacity was also contemplated for Cold Springs Creek.

Applications 1141, 2855, 4980, and 4981 for use of this water were filed with the Division of Water Rights, but were canceled because of failure to complete. A fifth application, No. 188, for 2 cu. ft. per sec. direct diversion and 80 acre-feet of storage, was originally made by one of the directors, and assigned to the district, but if not used by the district will revert to the former owner.

Red Rock Creek, the principal proposed source of water supply, is a torrential stream which rises on the sparsely wooded slopes of Warner Mountains and flows southerly, entering the eastern section of Madeline Plains and then continuing southwesterly about 10 miles until it spreads out laterally and sinks or is lost by evaporation. The district proposed purchasing the reservoirs and storage rights on Red Rock Creek for $32,500.

Several small assessments were levied by the district during the period 1919 to 1923, but the amounts collected are not known. Delinquencies were not followed up and no land was taken for non-payment of district assessments. Warrants were issued for engineering, legal, promotion, and other expenses in the amount of $62,089.82, of which $48,088 were later canceled and $11,870.06 were outstanding when the district was visited in 1928. The district and the holders of these warrants have signed an agreement by which all interest payments are waived on condition that the district pay the principal sum when in condition to do so.

The principal landowner of the district is endeavoring to keep the district organization intact and is hoping to establish title to all of the water rights, which may later be turned over to the district. Others, however, believe that the district will not go ahead and should be disorganized. Those holding the latter view have contemplated an action to require the levying of an assessment to clear up the outstanding warrants.

SOUTHERN LASSEN

Location: southeastern portion of Honey Lake Valley, in Lassen County.
Date of organization election: December 24, 1915.
Gross area: 22,565.
Post office: Constantia.

This is the only remaining one of three irrigation districts formed in Honey Lake Valley in 1915–16, the other two, Honey Lake Valley and Long Valley Creek districts having been dissolved by the superior court of Lassen County on June 8, 1920, and February 3, 1922, respectively, on suit filed by the attorney general of the state. Southern Lassen Irrigation District is now inactive, and, practically speaking, nonexistent, but since it has not been dissolved, it comes within the classification "inactive and partially active districts." Because these three districts were more or less related, brief comment will be included herein regarding Honey Lake Valley and Long Valley Creek districts.

Southern Lassen Irrigation District was formed on petition signed by 58 landowners, presented to the supervisors of Lassen County November 8, 1915. At that time the irrigation district law allowed the state engineer only thirty days in which to make a feasibility report, and he was unable to do so within that time. Nevertheless, the petition went to final hearing by the supervisors on November 23, 1915, and organization was carried by a vote of 25 to 2 at an election December 24, 1915. Little was done by the district during 1916, its first year.

On October 2, 1916, landowners on the westerly side of Long Valley Creek petitioned for the formation of Long Valley Creek Irrigation District, contemplating the use of part of the water supply included in the plans of Southern Lassen District. The state engineer reported adversely on formation, but the district was organized.

An engineering report was presented to the directors of Southern Lassen District on August 6, 1917. It was proposed to obtain water from Last Chance Creek, a tributary of Feather River, from Long Valley Creek, and from Red Rock Creek, the latter in Nevada. A reservoir was to be constructed on Last Chance Creek with a capacity of 19,500 acre-feet, and the water stored there was to be carried through Beckwith Pass to Long Valley Creek. This water, together with water from Long Valley Creek, was then to be conveyed to Red Rock Valley Reservoir, in Nevada, with an estimated capacity of 100,000 acre-feet. The estimated cost of partial development was $635,170, and of complete development was $1,400,004.

Examination of the project on behalf of the Bond Certification Commission resulted in an unfavorable report by the state engineer on October 30, 1919. The water supply available was considered inadequate, and it was suggested that Southern Lassen Irrigation District and Long Valley Creek Irrigation District voluntarily dissolve and make a new start, incorporating only such territory as might be supplied with the water available. No effective cooperation was worked out and no further progress was made. Applications 85, 85*a*, and 85*b*, filed by Southern Lassen District with the State Water Commission July 16, 1915, were canceled on October 25, 1922, for failure to show due diligence in completing them.

Southern Lassen Irrigation District covers a portion of the old bottom of Honey Lake, elevations ranging from 4000 to 4440 feet. Aside from state and vacant lands, 104 separate ownerships are listed. The average holding is about 203 acres, with one of 2080 acres. The present population is about 25. Development consists of a few scattered patches of alfalfa and grain. The district levied assessments from 1916–17 to 1919–20, the four assessments aggregating $27,652. Delinquencies were large in the first three assessments, and very little of the last assessment was paid. Outstanding warrants issued from 1916 to 1923 totaled about $14,300, the statute of limitations having run against all of them.

Long Valley Creek Irrigation District, which was organized at an election December 2, 1915, and which, as has been indicated, was in a way involved with Southern Lassen District, comprised 34,345 acres on the opposite side of the creek, to the southwest of Southern Lassen District. Its plans proposed the construction of a dam on Long Valley Creek, creating a reservoir in what is known as Warm Springs Valley.

The flow of Long Valley Creek was to be augmented by water diverted from Little Truckee River near the confluence of that stream with Independence Creek and brought by ditch, flume and tunnel into the head of Long Valley Creek. Storage was to be created in Red Rock Reservoir in Nevada. The diversion of water from Little Truckee River was opposed by the United States Reclamation Service because of their interest in Truckee River for the Newlands reclamation project. Other than engineering studies and negotiations, the district was not active, and water applications on file with the State Division of Water Rights were canceled on December 2, 1922, and on April 29, 1926, the filings canceled on the latter date having been made by a proposed district of reduced area after the original applications had been canceled.

Honey Lake Valley Irrigation District, organized September 7, 1916, included an area of 32,500 acres lying north and west of Honey Lake. It was proposed to utilize flood waters of Susan River and the run-off of several small mountain drainage basins, first accumulating them in Eagle Lake, the waters of that lake also being a part of the supply. A new tunnel outlet was to be constructed from Eagle Lake to the head of Willow Creek, and water was to be passed down that stream and stored in reservoirs. A main diversion canal from Willow Creek and the necessary laterals and distributing ditches within the district were to be constructed. The cost estimate for partial construction was $836,479, and for complete construction was $1,457,218.

The district filed water-right applications with the State Water Com mission in March, 1916. An attempt was made to obtain approval of the bond issue, but this was unsuccessful. Then various schemes were considered for enlisting the aid of outside capital, but these also were without avail.

Assessments were levied in 1917 and 1918 to pay outstanding warrants amounting to about $16,000 plus interest; but the amount collected from the two was only $9,685. In July, 1918, about 65 per cent of the land was sold for delinquent assessments. Finally, the attorney general brought proceedings for the purpose of dissolving the district and for the purpose of having the amount of indebtedness, if any, outstanding against the district determined. Claims for warrants in the sum of $16,025 had been filed at the beginning of the action. It was stipulated by all parties that the district should be dissolved and an order to that effect was thereupon made. The court further held that the warrants could not be collected because the statute of limitations had run against them. It was found that the outstanding indebtedness other than these warrants amounted to $1,165, and this sum was accordingly paid in settling up the affairs of the district.

SOUTH CAPAY

Location: about 6 miles southwest of Hamilton City, in Glenn County.
Date of organization election: November 22, 1921.
Gross area: 1486 acres.
Post office: Orland.

Prior to the formation of this district fifteen deep-well pumps had been installed and the land on which they were located had been subdivided and some of it sold. The promoters of the subdivision

desired to transfer the cost of the irrigation system to an irrigation district, and brought about its organization by a vote of 5 to 0. The irrigation system, wells, equipment, water rights and easements were to be taken over at a cost of $88,300, which it was proposed to obtain by issuing bonds in that amount.

The petition for organization of the district was presented to the board of supervisors of Glenn County April 11, 1921, and approval was given by the state engineer October 7, 1921. After further examination, however, the state engineer recommended to the Bond Certification Commission that it should not approve the proposed bond issue of $88,300. The district officers then collected a voluntary assessment of $268 to pay the costs of organization and dissolution, but in October, 1928, no record of dissolution could be located.

DRY CREEK

Location: along Dry Creek, 3 miles northeast of Wheatland, in Yuba County.
Date of organization election: March 1, 1926.
Gross area: 9330 acres.
Post office: Wheatland.

This district was organized without approval of the state engineer by the owners of five ranch holdings varying from 1500 acres to 2600 acres, totaling 9330 acres. The purpose was to unify the irrigation interests of the landowners. A plan of storing 2400 acre-feet of water on Dry Creek was first considered. There was also a proposal to obtain water by purchase from Excelsior Water and Power Company, owners of certain water supplies in Yuba and Nevada counties. On July 6, 1925, application 4681 was made to the Division of Water Rights, requesting a permit to divert 25 cu. ft per sec. from Dry Creek and to store 17,000 acre-feet. This application was later amended and permit 2630 was granted for 13,798 acre-feet storage, but was revoked by the Division of Water Rights on January 11, 1928.

The district has not been active. At the time organization was being promoted, the proponents stated that a bond issue was not contemplated, but that the cost of the irrigation system would be proportioned to the landowners and raised by assessments. It was also stated that an irrigation system was desired for the use of the landowners, rather than for subdivisional purposes.

One district assessment was levied to pay the expenses of organization. When interviewed October 5, 1928, the secretary of the district stated that the costs of the proposed irrigation system had been found to be more than expected, and for that reason the project had been dropped.

FEATHER RIVER

Location: east side of Sacramento River, between Nicolaus and Vernon, in Sutter County.
Date of organization election: August 10, 1920.
Gross area: 3027 acres.
Post office: Nicolaus.

This district was organized to pump irrigation water from Feather River to lands under cultivation that had an inadequate water supply. A preliminary report of January, 1920, estimated the cost of necessary

works at $47,000, and organization was approved by the state engineer June 5, 1920. A more detailed report subsequent to organization outlined a system to cost $94,612. The Bond Certification Commission reported favorably on a proposed bond issue of $95,000, but the issue was defeated at an election August 19, 1921. The district then levied an assessment to cover the costs of organization and engineering, the total amount collected being $10,594, and total disbursements to January 1, 1924, amounting to $10,211.38.

BAKER

Location: about 2 miles south of Butte City, in Glenn County.
Date of organization election: March 31, 1922.
Gross area: 910 acres.
Post office: Butte City.

In 1919, when the price of rice was at its war-time peak, a pumping plant was installed and ditches were built to serve about 2000 acres of rice in an area of Columbia silt loam a short distance south of Butte City. Owing to the type of soil and hurried construction, together with the drop in the price of rice, the project was not successful. Attempts had been previously made to colonize the land without an irrigation system, but the efforts failed.

In 1920 an attempt was made to form a small district to be known as Afton Irrigation District, but the proceedings were abandoned. On April 11, 1921, a petition was presented to the supervisors of Glenn County for the formation of Baker Irrigation District. Approval of the state engineer was given December 20, 1921, and the organization election carried by a vote of 9 to 2.

It was proposed to purchase the irrigation system that had been built for $29,000. It was also proposed to enlarge the district by the addition of 420 acres. Interest in the project, however, ceased and it has not since been active. No work, in fact, was done, no bonds were issued, and no assessments were levied.

EL SOLYO

Location: on River road, about 12 miles northwest of Patterson, in Stanislaus County.
Date of organization election: August 23, 1921.
Gross area: 3783 acres.
Post office: Vernalis.

This district was formed chiefly to assist in the financing of El Solyo Ranch through issuance of district bonds in the amount of the appraised value of an existing irrigation system. The lands in the district were practically in one ownership and for that reason organization was disapproved by the state engineer, although it was later organized without his approval by a vote of 6 to 0. The same situation with reference to ownerships existed when, in 1925, the board of directors requested approval by the Bond Certification Commission of a bond issue of $278,379.29, and approval of the issue was withheld by that commission largely for the same reason. Thereupon the district project was dropped and the board of directors submitted their resignations to the county supervisors on November 3, 1926, the resignations being accepted February 15, 1927.

In October, 1925, when an investigation of the proposal to issue $278,379.29 in bonds was under way, there was 300 acres of vines and 535 acres of orchard, chiefly peaches, three to four years old, in the district. About 650 acres of the district was reported subject to periodical flooding. Permit 1011 for 46.74 cu. ft. per sec. from San Joaquin River, with priority of October 10, 1919, had been issued by the Division of Water Rights to the El Solyo Ranch interests for the irrigation of 3739 acres. The major portion of the lands not already irrigated were being checked up and the irrigation system was being improved and extended. A land bond issue of $425,000 against lands of El Solyo Ranch had been authorized and $421,000 of these were outstanding, with maturities of 1929 to 1938. A later report states that about 3400 acres was irrigated in 1925.

Although El Solyo Irrigation District is inactive, it has not been dissolved.

KASSON

Location: along San Joaquin River about 6 miles southeast of Tracy, in San Joaquin County.
Date of organization election: February 8, 1921.
Gross area: 5921 acres.
Post office: Tracy.

The purpose of organizing this district was to provide a means of improving and enlarging a pumping irrigation system that was supplying water to lands west of San Joaquin River about 6 miles southeast of Tracy. Later one of the large land interests in the district arranged with Banta-Carbona Irrigation District for an irrigation supply and the Kasson District project was dropped. A small assessment was collected to cover organization expenses but there was no other activity by the district. Organization of the district was approved by the state engineer on November 24, 1920, and the election was carried by a vote of 14 to 0.

HOLLISTER

Location: Hollister and San Juan valleys, in San Benito County.
Date of organization election: July 31, 1923.
Gross area: 30,202 acres.
Post office: Hollister.

This district comprises a developed area lying partly in the southerly extension of Santa Clara Valley, known locally as Hollister Valley, and partly in the easterly portion of San Juan Valley. About half the area, or 15,000 acres, within the district is in deciduous orchards, the areas in other crops being estimated as follows: commercial seed production, 7000 acres; truck crops, 3000 acres; field crops, 3000 acres; grain or grain hay, 1000 acres; alfalfa, 1000 acres.

Irrigation has been practiced near Hollister since about 1891, when an irrigation system consisting of a 3500 acre-foot storage reservoir at Paicines and about 20 miles of canals and laterals was constructed, this system being owned by San Benito Land and Water Company. A canal 6 miles long diverted water from San Benito River into Paicines Reservoir, from which it was released into the river to be again diverted into two distributing ditches leading to lands in the

upper portion of the valley on both sides of San Benito River. This small system was inadequate to meet the irrigation needs of the area and many private irrigation pumping plants were installed. The continued draft on the underground supplies, however, caused a lowering of the water table. Furthermore, underground water was not readily available to all portions of the area.

When the San Benito County Farm Bureau was organized in 1921, and a county farm adviser was appointed, one of the first subjects of study was the falling water table, and the need for developing an additional water supply from San Benito River. About this same time there was being promoted a project for storage of water on the upper San Benito at the Hernandez reservoir site, and its diversion to lands on the west side of San Joaquin Valley. A meeting was held July 8, 1922, attended by the state engineer, at which methods of forming an irrigation district were discussed. Shortly afterwards an irrigation committee was organized, and, through its efforts, Hollister Irrigatiton District was formed, but only by the narrow margin of 50 votes, 474 being cast for and 424 against.

An engineer was employed and during the season of 1924 an investigation of the water supply and of the best means of procedure was made, a report being rendered in January, 1925. This report outlined a project involving storage on San Benito River at the Hernandez site and on Tres Pinos and Pacheco creeks, also recommending the purchase and reconstruction of the system of San Benito Land and Water Company. The total estimated cost was $1,284,895. The general plan of development proposed was to combine storage in the reservoirs named with artificial ground water replenishment within the district. A gravity irrigation system was outlined for only those lands, approximating 7300 acres, for which underground water development seemed to be least feasible.

Because the engineer of the district found that the most economical method of conservation of the flood waters of San Benito River and tributaries would largely be through their use in underground replenishment, he advised against further proceedings under the California irrigation district act, and recommended the formation of a water storage district of 38,700 acres under the water storage district act. He estimated that the cost of organization and development of the water supply alone would be $29.20 per acre, and that the total project cost per acre would range between $29.20 and $59.30, depending upon the location of the land served and the character of the distribution system required. He proposed that all land in the district should be charged equally for the cost of the storage development and organization, which, as indicated, he estimated at $29.20 per acre. This would be the only charge against lands with a present gravity supply in the upper San Benito and Tres Pinos valleys. For lands on the eastern slope of Hollister Valley and in San Juan Valley south of the state highway, he proposed an additional charge to cover cost of canals and diversion works and distribution laterals, this additional charge amounting to $27.50 for the former area and $30.10 for the latter.

No definite steps have yet been taken by Hollister Irrigation District, either toward proceeding under the present organization, or toward the organization of a water storage district. However, stream

gagings and measurements of ground water fluctuations, recommended by the engineer of the district, have been continued, and permit 2997 for the diversion of 100 cu. ft. per sec. and the storage of 78,000 acre-feet has been obtained from the Division of Water Rights.

Well measurements indicate more conclusively than ever the urgent need for water conservation. The annual drop of the water table in 34 wells over the four-year period 1924–1928 has been found to average 4.10 feet. For the eight years previous to 1924 the total drop was about 8 feet.

The mean annual run-off of San Benito River and tributaries above the district was estimated by the engineer of the district to be 173,900 acre-feet, the maximum being 579,300 acre-feet and the minimum practically nothing. The engineer estimated that 42 per cent of this flow will be necessary to meet the needs of the district.

Hollister District levied an assessment of $0.53 on each $100 valuation in 1924, based on the county assessed valuation. The total amount levied was $17,665, and the total amount collected to January 1, 1928, was $17,602. This sum has been used for engineering, legal and general expenses.

It is the general assumption that a water conservation program will ultimately be carried out substantially as outlined by the engineer employed by the district. The exact procedure has not yet, however, been decided upon.

PLAINSBERG

Location: about 15 miles southeast of Merced, in Merced County.
Date of organization election: November, 1919.
Gross area: 5717 acres.
Post office: Merced.

This was one of four districts which landowners in Merced County who objected to inclusion in the proposed Merced Irrigation District sought to organize in 1919 at the time organization of Merced Irrigation District was in progress.* None received approval of the state engineer but the board of supervisors of Merced County allowed Plainsberg District to organize. At the time of organization, an area of 1157 acres on 15 farms was being irrigated by pumping from underground, the lifts being estimated at 32 to 47 feet. Proponents of the district had a general proposal to construct a distribution system connecting existing and future private pumping plants within the district so as to permit increasing the irrigating head of the individual irrigators. No steps in this direction were taken after organization and no other construction was carried out, the district remaining practically inactive from the beginning.

District assessments were collected in 1920, 1921, and 1922, totaling $3,164. The principal disbursements from these funds were for legal, engineering, and organization expenses.

MEDANO

Location: along Chowchilla River, in T. 9 S., R's. 16 and 17 E., Mount Diablo Base and Meridian, mostly in Madera County.
Date of organization election: January 28, 1921.
Gross area: 13,560 acres (approximate).
Post office: Le Grande.

It was proposed through the organization of this district to develop a water supply from Chowchilla and Fresno rivers, South Fork of

*The other three were Nairn, Winton, and Bloss.

Merced River, and from wells, the Chowchilla being the principal intended source. Storage on Chowchilla River in the amount of some 50,000 acre-feet was proposed, the cost of this and other works to be paid by the proceeds of a proposed bond issue of $750,000. The latter was not approved by the Bond Certification Commission and the project was dropped. A resolution for dissolution of the district was adopted by the board of directors on April 16, 1923, but the necessary legal proceedings were not carried through.

WEBSTER

Location: north of San Joaquin River about 10 miles southeast of Madera, in Madera County.
Date of organization election: June 6, 1916.
Gross area: 15,000 acres (approximate).
Post office: Madera.

After approval by the state engineer on May 1, 1916, this district was organized for the purpose, it has been claimed, of remaining outside of the proposed Madera Irrigation District. The lands included are part of the rolling and lower foothill area directly north of San Joaquin River, from which it was proposed to irrigate them by pumping, with lifts of 50 to 100 feet. No water rights were acquired and the district has at no time been active. Organization expenses are said to have been paid from a small assessment levied shortly after organization.

MENDOTA

Location: on west-side plains south of Mendota, in Fresno County.
Date of organization election: November 6, 1921.
Gross area: 67,089 acres.
Post office: Fresno.

Organization of the area in Mendota Irrigation District was first attempted under the California irrigation act, which was later declared unconstitutional. A petition was then presented to the board of supervisors of Fresno County for organization under the California irrigation district act. On June 30, 1921, the state engineer recommended that the petition be denied because the area was practically uninhabited, and because there was a serious question as to the adequacy of the water supply. This recommendation was considered by the supervisors as an unfavorable report, and they declined to set a date for final hearing. Mandamus proceedings were then brought to compel the supervisors to act, the claim being made that the communication from the state engineer did not constitute a report, and that no report had been received within the time prescribed by law. The writ of mandate was granted, and the district was organized by a vote of 41 to 0.

The original plan of the proponents of the district was to obtain water by pumping from wells located east of the district in the vicinity of Jameson. Certain water during high stages was also to be diverted from Kings River and a power plant was proposed in Kings River Canyon. Another plan was to acquire the Herminghaus ranch of some 17,500 acres of riparian lands along San Joaquin River.

The district was unsuccessful in its attempt to be included in the water conservation plans being developed for the Kings River area.

It was proposed that a portion of the land should be included in San Joaquin River Water Storage District, but the abandonment of that district late in 1928 eliminated that source of water supply.

The area included within Mendota District covers a smooth terrain sloping evenly toward the northeast at the rate of ten to twenty feet to the mile. Soils are mainly panoche loams and panoche clay loams.* Ground water varies in depth from 75 feet on the east to 170 feet on the west. About 19,000 acres is irrigable with a 60 to 75 per cent supply from existing private wells. A crop survey in 1927 showed 18,895 acres irrigated, of which 7840 acres was in grain, 7205 acres in cotton, 1419 acres in vineyards, 867 acres in asparagus, 526 acres in vegetables, and the remainder in alfalfa, orchards, melons, and corn.

There are about 150 separate land ownerships within the district, the largest containing 4160 acres, and the two next largest 1280 acres each. The population of the district is about 100.

It is reported that 42,829 acre-feet of water was obtained from 36 wells for the irrigated areas mentioned above, showing an average use of 2.27 acre-feet per acre.

No bonds have been voted by the district. Although the district has remained practically dormant since organization, it has levied assessments in each of the years from 1922–23 to 1927–28. The assessed valuation for district purposes has been $50 per acre. An assessment of $1.40 for each $100 of valuation was levied for 1922–23, $0.20 for the next two years, $0.40 for 1925–26, and $0.20 for the last two years. The total amount of the six annual assessments has been $89.878. Tax certificates unredeemed January 1, 1927, amounted to $1,267.

The district has constructed no works, but has purchased 2250 acres of water-bearing lands, near Shelbyville, for which they paid $12,000.

STRATFORD

Location: east side of Kings River, north of Tulare Lake bed, in Kings County.

Date of organization election: 1916.

Gross area: 9875 acres.

Post office: Stratford.

In 1905, Empire Investment Company purchased 18,712 acres of riparian land lying on both sides of South Channel of Kings River, north of Tulare Lake. The tract was subdivided, canals were constructed, and settlers purchased part of the land. Empire Water Company was organized by Empire Investment Company to handle the distribution of water from Kings River. The investment company conveyed to the water company all of its canals and rights of way, together with 8⅝ shares of stock in Lemoore Canal and Irrigation Company, whose ditches served water to a portion of the area east of Kings River. When the land was subdivided, proportionate shares in the riparian rights to waters of Kings River were attached to the land sold. The purchasers held contracts with the water company under which they were required to pay $1 per acre annually, regardless of whether water was used.

* U. S. Dept. of Agr., Bureau of Soils, Reconnoisance Soil Survey of the Middle San Joaquin Valley, California.

During the dry years 1912 and 1913, many of the irrigators suffered loss, brought suit against the water company and refused to pay water bills. The river flow continued to decrease, due to use farther up the stream. On April 3, 1916, irrigators on the east side of the river petitioned for the formation of Stratford Irrigation District. A favorable report was received from the state engineer on April 29, and the district was organized shortly after May 1, 1916. It offered Empire Water Company $100,000 for the portion of its system within the district, but the company set a price of $150,000. In March, 1917, Empire Water Company filed application 2801 with the Railroad Commission, requesting a raise in irrigation rates, but there was no decision due to uncertainty as to jurisdiction of the Railroad Commission.

On October 11, 1920, Lemoore Irrigation District was organized with the intention of taking over the system of Lemoore Canal and Irrigation Company and that of Empire Water Company on the east side of Kings River.* Stratford Irrigation District was included within the new organization. A proposed bond issue in Lemoore Irrigation District for taking over the system of Lemoore Canal and Irrigation Company, the John Heinlen Ranch system, the east-side system of Empire Water Company, and the Jacobs Ranch Ditch failed at an election held December 30, 1922. A second election was not called and the two districts have continued without material activity.

Of the 9875 acres in Stratford Irrigation District, about 3900 acres can be irrigated only from the Lemoore system, and the remainder can receive water either through the Lemoore system or Empire canals Nos. 2 and 4. Lemoore Canal has an old right on Kings River, but the supply from the Empire canals is somewhat uncertain, since they have to depend on the flow through South Channel of Kings River, in which water runs only when the main river is in flood, and then only for a few days at a time. By utilizing the levee system along South Channel of Kings River, Empire Water Company is able to impound flood waters to the extent of about 6000 acre-feet.

The entire area within Stratford Irrigation District is irrigable from the systems of Lemoore Canal and Irrigation Company and Empire Water Company. The estimated area irrigated in the district in 1927, was: alfalfa, 1000 acres; grain, 4500 acres; field crops, 1000, and pasture, 3200 acres, a total of 9700 acres. In 1928 there were 102 separate ownerships, averaging about 95 acres, with one of 1395 acres and one of 1260 acres. Stratford, with a population of 250, is included within the district, and the additional population numbers about 500. Three private pumping plants wholly or partially serve about 1200 acres.

The $8\frac{5}{8}$ shares of stock in Lemoore Canal and Irrigation Company owned by Empire Water Company gives it about 16.5 per cent of the water diverted by Lemoore Canal. From 1920 to 1927, this gave to lands in Stratford District an annual supply ranging from 8000 acre-feet in 1924 to 23,500 acre-feet in 1922. Diversions by Empire Canal No. 2, owned by Empire Water Company, ranged from 730 acre-feet, in 1925, to 8065 acre-feet, in 1923, not counting a zero supply in 1924. Some additional water was served to lands within Stratford District from Empire Canal No. 4.

*See statement regarding Lemoore Irrigation District, page 241.

Stratford Irrigation District levied assessments in 1917, 1918, 1925, and 1927, the total of the levies for the four years amounting to $7,395.

Stratford Irrigation District is now working towards the inclusion of the remainder of Empire Ranch on the west side of Kings River, and it is hoped that an adjustment of water rights will then be reached which will enable the entire area to be annexed to Lemoore Irrigation District. It is understood that Stratford Irrigation District will then be disorganized, if this purpose is accomplished. The lands in Stratford District expect to benefit by any development of the Pine Flat storage project.

ROUND VALLEY

Location: about 10 miles northwest of Bishop, in Inyo and Mono counties.
Date of organization election: 1923.
Gross area: 6716 acres.
Post office: Bishop.

This district was organized to protect the water rights of landowners in Round Valley against the city of Los Angeles. Approval of the organization was given by the state engineer June 8, 1923. With the exception of about 450 acres of nonirrigable land, practically the entire area included had been under cultivation for many years, irrigation water being obtained from Rock, Pine and Horton creeks. The proponents signed an agreement to pool their water rights without any expenditure, and at least some of the landowners deeded their water rights to a local bank, which, after organization, deeded them to the district.

As shown in the statement regarding Owens Valley Irrigation District below, the city of Los Angeles was purchasing lands and water rights about Bishop and elsewhere in Owens Valley in connection with its aqueduct supply from Owens Valley. Early in 1925, after the greater part of the area around Bishop had been purchased by Los Angeles, a committee from Round Valley Irrigation District started negotiations for the sale to the city of the lands in Round Valley. As a result of these negotiations, the city purchased about 75 per cent of those lands.

Later, in order to remove the cloud on the title to the lands it had purchased which resulted from transferring of water rights to the district, the city sought to have the district dissolved, dissolution of the district being made a condition precedent to the making of final payments on the land. Before the plan for dissolution could be consummated, however, many who had sold their land to the city, including two of the directors, moved away, and those remaining who had not reached an agreement with the city blocked the attempt to dissolve made in 1926.

Round Valley Irrigation District has functioned in a limited way. The ditches supplying water in Round Valley were turned over to the district and it has been operating them, still having a ditchtender in its employ in 1928. The only annual financial statement on file in the office of the state engineer is for 1925. It shows a cash balance of $2,220.86 carried over on January 1, 1925, collections in 1925 of $2,995.43, expenditures for the year amounting to $4,930.88, and a carryover to 1926 of $285.41. However, an assessment was levied for the year 1928–29.

OWENS VALLEY

Location: from north of Bishop to south of Big Pine, in Inyo County.
Date of organization election: December 26, 1922.
Gross area: 53,990 acres.
Post office: Bishop.

Early in 1920, landowners in Owens Valley receiving water mainly from Bishop Creek and Owens River for the irrigation of lands in the neighborhood of Bishop initiated a movement for the formation of an irrigation district. At a public meeting at Bishop April 7, 1920, a resolution was unanimously adopted requesting the directors of Owens Valley Associated Ditches to proceed at once with the necessary steps for the formation of such a district.

The recommendations made at this meeting were not immediately put into effect, but during the next two years the boundaries of the district were outlined. In the meantime, crosscurrents of opposition had developed, based largely on long-standing personal animosities and on differences regarding policies being pursued by the city of Los Angeles in the acquisition of lands and water rights in Owens Valley. However, at the organization election late in 1922, formation of the district was approved by a vote of 599 to 27.

Numerous motives prompted the formation of this district. The purpose most evident was the protection of the area embraced within the district from encroachment by the city of Los Angeles in connection with the Los Angeles aqueduct project. Other purposes in minds of the proponents were storage of water at the Fish Slough site, situated north of the district boundaries, more economical utilization of water through a centralized control of the various existing ditches, and drainage of a large area of waterlogged lands.

With reference to protection from the encroachment of Los Angeles, it was felt locally that a better control of water rights of the valley would be possible if they were centralized in one organization competent to deal with the city of Los Angeles. On the other hand, the city of Los Angeles favored the organization of the district on the ground that it could deal with a single agency more satisfactorily than with numerous ditch owners.

At an early meeting of the board of directors of the irrigation district, that is, on April 24, 1923, an engineering report was adopted which called for a bond issue of $1,650,000, of which $1,500,000 was "for the acquisition of all water, water rights, works and other property necessary for the proper irrigation of lands in said district," and $150,000 was for "the construction of proper and necessary gates, weirs, measuring devices, connecting canals, and the necessary expense incident to the acquisition of said property." On June 15, 1923, the Bond Certification Commission approved the proposed bond issue and on August 7, 1923, on petition filed by 648 electors, including the holders of title, or evidence of title, to lands in the district valued on the county assessment roll at $1,300,340, the issue was authorized by the electors of the district by a vote of 702 to 80. On October 15, 1923, the Bond Certification Commission approved the validation of the entire issue, and on February 14, 1924, bonds of the first division of the issue, of a par value of $471,500, were sold at a price of 88.49.

According to a resolution of the board of directors, it was proposed to use proceeds of the above bond issue in the amount of $374,908.20 for the purchase of 4242 shares of Bishop Creek Ditch Company stock at $46.10 per share, and 3760 shares of Owens River Canal Company stock at $40.70 per share. These purchases, however, were never made, and according to the amended complaint in a suit filed by the city of Los Angeles against W. W. Watterson and others, in case 238,430, and also according to an audit of the books of the irrigation district made for the city of Los Angeles under date of August 26, 1927, the proceeds of the bonds were never received by the irrigation district. Furthermore, the audit of the books of the district showed a shortage in its accounts of $463,476.59. The president and treasurer of the district, who were also bankers in Bishop, and who were involved in the sale of the bonds, were indicted in connection with the failure of their bank and were subsequently convicted. In the suit mentioned, the city of Los Angeles seeks to have the sale of the bonds declared invalid and the bonds delivered returned to the district. In lieu of the return of the bonds the city prays that Owens Valley Irrigation District have judgment against the defendants in the sum of $1,038,220, which was the face value of the bonds sold and attached interest coupons.

While Owens Valley Irrigation District is still a legally organized project, there is no intention to proceed along the line originally planned. Most of the lands within the district have been purchased by the city of Los Angeles and it desires to have the district disorganized. The records available disclose no constructive work on the part of the district since organization. Proposals to acquire the stock of the local mutual water company were, of course, not carried out.

Bond interest accruing from January 1, 1927, to July 1, 1928, inclusive, amounting to $51,865, was defaulted. District assessments were levied in the years 1923–24, 1924–25, and 1925–26, the total collections to January 1, 1927, as shown by the tax collector's monthly reports, having been $124,704.29. The last meeting of the board of directors was held April 5, 1927. At the time of field investigation in 1928, interested parties were awaiting the outcome of the suit brought to invalidate the sale of bonds.

BLACK ROCK

Location: T. 11 S., R. 34 E., Mt. Diablo Base and Meridian, north of Independence, in Inyo County.
Date of organization election: January 27, 1915.
Gross area: 1870 acres.
Post office: present address not known.

The early history of this district is covered in a previous publication.* At the time of that publication (1916) the district was inactive, and nothing has been done since then.

The original plan of the district was to purchase 1870 shares of stock in Red Mountain Mutual Water Company at $50 per share, and to build a system of distributing ditches, the total estimated cost having been $108,500, assuming bonds could be sold at par. Later the district intended to acquire a water supply from underground sources, but this plan was also abandoned, and there is no record of further activities.

*State Dept. of Eng., Bul. 2, 93–94.

LITTLEROCK-MIDLAND

Location: south side of Antelope Valley, west of Littlerock Creek, in Los Angeles County.
Date of organization election: December 22, 1924.
Gross area: 2490 acres.
Post office: Palmdale.

This small district lies between Palmdale and Littlerock Creek irrigation districts, as to both of which statements appear above.* Organization of Littlerock-Midland District was proposed as Littlerock Dam was near completion. At that time 1420 acres, of which about 90 per cent was in Bartlett pears, was being irrigated within the area, water being obtained from wells fed principally by underflow from Littlerock Creek. Landowners felt that their water supply was being put in jeopardy by the construction of Littlerock Dam, and considered that an irrigation district would not only furnish them with an organization through which their rights might be protected, but would also furnish them an agency through which an additional water supply might be obtained. The original proposal was to include 4000 acres, but this was reduced at the suggestion of the state engineer.

The district has done very little since organization. In 1925 an assessment of $1.50 on each $100 valuation was levied on a total assessed valuation of $249,000, the total amount of the levy being $3,725. All but about $500 of this has been collected and the money used for organization, engineering, and routine expenses extending over the years 1923 to 1927. At one time the district negotiated with an organization known as Littlerock Water and Power Company, which was planning to construct two reservoirs on Littlerock Creek above Littlerock Dam, and which it was thought would be able to deliver some stored water to Littlerock-Midland Irrigation District. Possibility of obtaining water from this source was, in fact, one of the purposes of organizing the district.

About 1600 acres in the district is now planted to Bartlett pears. This land receives irrigation from 17 private wells drilled to depths ranging from 225 to 500 feet. When the district was being promoted in 1924 ground water was reported at 75 to 150 feet below the surface and yields of the pumping plants at from 10 to 90 miners inches each. The water table has receded during the recent dry seasons, it being stated that there has been a standing drop of about 7 feet during the past two years.

After negotiations with Littlerock Water and Power Company were abandoned, the district filed application 4574 with the Division of Water Rights. This sought a permit to divert 50 cu. ft. per sec. from Littlerock Creek and to store water to the extent of 5000 acre-feet per annum. The application was canceled July 27, 1927, for failure to complete.

The flow of Littlerock Creek has been studied by a number of engineers, and the mean seasonal run-off has been estimated at from 17,700 to 23,000 acre-feet. A study for the state engineer covering the 27-year period 1894–95 to 1920–21 indicated a mean surplus of 4,000 acre-feet per annum after supplying the needs of Littlerock Creek and Palmdale irrigation districts. The study indicated no surplus, however, during 15 years, 7 of which were consecutive. Extensive studies

*Pages 268 and 272.

of the underground water supply are reported in Water Supply Paper 278 of the United States Geological Survey, published in 1911, and in an unpublished report by the Geological Survey covering studies from December, 1919, to January, 1921.

The soils in Littlerock-Midland Irrigation District are classified as Hesperia and Adelanto loamy sands.* The area is a gently sloping alluvial fan with an elevation of about 2800 feet. In 1928 there were 36 separate holdings, averaging 60 acres each on the basis of the net irrigable area of 2140 acres. The four largest holdings were of 310 acres, 250 acres, 200 acres, and 120 acres, respectively. The county assessed valuation of lands in the district for 1927–28 was about $100,000.

VICTOR VALLEY

Location: on mesa west of Victorville and Hesperia, and west of Mojave River, in San Bernardino County.
Date of organization election: October, 1917.
Gross area: 71,517 acres.
Post office: Victorville.

Reference to this district was made in the statement regarding Mojave River Irrigation District previously given.** It was formed on a 'three-fourths' petition, by vote of 44 to 0, after the original petition had been reported on unfavorably by the state engineer. When formed, the district embraced 34,281 acres of patented land, 9417 acres of railroad land, 9456 acres in homestead entries, and 18,363 acres in entries under the desert land act. About 65,000 acres of the area was considered irrigable.

As indicated in the statement regarding Mojave River Irrigation District, an engineering board, known as the Mojave River Commission, was organized in 1917 to report on the utilization of Mojave River for irrigation in Victor Valley. Their report suggested an irrigation project of 29,000 acres for the west mesa and one of 23,000 acres on the east mesa. Victor Valley District, however, has done nothing towards carrying out this suggestion, and has remained inactive. Litigation in which the district was a party, and which related to the legality of certain warrants issued, was carried to the state Supreme Court.† The facts presented in this litigation showed that district warrants amounting to $6,635 were issued by the board of directors at an early meeting to pay for 'organization' expenses. A bill for these expenses had been rendered in a single statement by an employee of the local committee under whose auspices the district was formed. The expenses included salary for the employee, costs of securing options on certain water rights, reservoirs, land, and other property essential to the district, and general promotion costs. The Supreme Court held that services rendered prior to the time of filing of the petition for organization with the board of supervisors could not be considered services rendered for the purpose of organization. On the other hand, it held that expenses incurred for securing valuable options necessary to the purposes of the district could properly be paid by the district. However, the court declared the warrants totally void, because based upon a single demand of which a substantial part was beyond the power of

*U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Lancaster Area, California.
** Page 274.
† *Ser-Vis* vs. *Victor Valley Irrigation District,* 190 Cal. 732.

the board of directors to allow. Of the $6,635 in warrants issued, approximately $3,055 was outstanding at the time of litigation.

Entries under the desert land act are no longer permitted in Victor Valley Irrigation District, the General Land Office, on October 28, 1924, having rejected the district as a basis for entries on the ground that no water rights had been established.

MOORPARK-CONEJO

Location: largely in Little Simi, Russell, and Conejo valleys, in Ventura County.
Date of organization election: January 13, 1925.
Gross area: 26,277 acres.
Post office: Moorpark.

On September 6, 1921, a petition was presented to the supervisors of Ventura County for the formation of Conejo Irrigation District, embracing 18,200 acres and including portions of Conejo and Russell valleys, in El Conejo Grant. In February, 1922, the state engineer reported that he considered the plan as outlined not feasible and the petition was withdrawn. A second petition was filed November 6, 1923, for the formation of the present district. In both cases it was proposed to convey water to the district from Sespe and Piru creeks, tributaries of Santa Clara River, lying to the north in a separate watershed.

As in the case of the proposals for the Conejo District project, the state engineer was unwilling to endorse the second project, both because of the large proportion of nonagricultural land within the boundaries, and because it had not been demonstrated that there was sufficient surplus water in the Santa Clara River watershed above the needs of Santa Clara River Valley lands to meet the requirements of Moorpark-Conejo District. He suggested that the proponents of the plan cooperate with the landowners in Santa Clara River Valley in a study of the available water supply.

An engineering firm reported that a surplus of water existed, but there was still opposition on the part of water users in Santa Clara River Valley. The proponents were unwilling to exclude the poorer lands as proposed by the state engineer and proceeded with the organization without his approval, the organization election carrying by vote of 168 to 46.

The district has not been very active during the four years since the organization election. Applications 3459 and 3460 to store 150,000 acre-feet of water per annum on Sespe and Piru creeks were filed with the Division of Water Rights, but no action on these filings has been taken. The Division of Water Rights, in cooperation with Ventura County, is conducting an extensive investigation of the available water supply from Santa Clara River and its tributaries, and decision on the water-right applications is being delayed pending completion of these investigations.

The proposal to convey water from Sespe and Piru creeks in Santa Clara River watershed to lands generally within the area now included in Moorpark-Conejo District has for several years been tied up with proposed power development on Sespe and Piru creeks. Some time prior to 1918, Sespe Light and Power Company was organized to develop power on Sespe Creek, supplemented by Piru Creek. A large amount of money was spent in surveys, but the company was unable to finance

its project. Its property and water filings were later acquired by Ventura Power Company, which, like its predecessor, sought an irrigation outlet for the water it proposed to pass through its power house. While proponents of Moorpark-Conejo District originally had in mind competing with the power company for water rights on Sespe and Piru creeks, they later negotiated with them, but without any material results.

It has been recognized that the conveyance of water from the Santa Clara River watershed to the lands in Moorpark-Conejo District would be costly, and that any feasible plan of combining the irrigation project with the power development would be advantageous to the district. Since nothing materialized from the negotiations with Ventura Power Company, the district has considered other plans, but nothing definite has yet been worked out.

The land in Moorpark-Conejo District is now mostly without an irrigation water supply. The report of the engineering study made in 1924 states that in that year there was within the district 4384 acres of orchard, 3499 acres of beans, and 9239 acres of grain. All of the land in grain and beans and much of that in orchard is dry-farmed. In Little Simi Valley surrounding Moorpark, orchard and alfalfa plantings have been established on the basis of the limited water supply at hand. With the exception of a small amount of water from Conejo and Las Posas creeks, the present supply available to lands in the district comes entirely from wells, in which continued pumping has caused an appreciable drop in the water level. The uncultivated areas lie principally in the southern portion of the district. Within the last few years, subdivisions have been made in several sections in the southern area which lie near or along the state highway.

In 1925 the district levied an assessment of $1.44 on each $100 valuation on a total assessed valuation of $1,137,690, the average assessment valuation per acre being $43. Up to the close of 1928, a total of $14,793 had been collected on this assessment.

FULLERTON

Location: Bastanchury Ranch, northwest of Fullerton, in Orange County.
Date of organization election: October 18, 1919.
Gross area: 2700 acres (approximate).
Post office: Fullerton.

This district, comprising only the Bastanchury Ranch, was organized by the heirs of the Bastanchury estate by a vote of 7 to 0. The land included had a developed water supply and was nearly all in citrus plantings. The water rights, rights of way, and irrigation system on the ranch were appraised at $1,246,933.50, and it was proposed that the district should issue $700,000 of 20-year, 5½ per cent bonds, for their purchase. The matter of this proposed bond issue proceeded to the point of investigation by the state engineer in May, 1920, but was then dropped following a change in policy regarding the development and management of Bastanchury Ranch. The district organization has since remained inactive. No assessments were levied.

LAGUNA (In Imperial County)

Location: west of Colorado River below Laguna Dam, in Imperial County.
Date of organization election: August 2, 1927.
Gross area: 6827 acres.
Post office: Ross Corner, Yuma, Arizona.

This district comprises what is known as the reservation unit of the Yuma project of the United States Bureau of Reclamation. The entire project embraces about 65,000 acres, of which all but the 6827 acres in Laguna Irrigation District, in Califorina, lies on the Arizona side of the Colorado. Land in the reservation unit was opened for irrigation and for entry early in 1910, and water was first turned into the reservation canals on March 14, 1910. In 1927 the area reported irrigated included 1300 acres of alfalfa, 3600 acres of cotton, 200 acres of garden truck, and 1000 acres of corn and grain. There are now about 175 separate farm holdings, averaging about 33 acres each. The estimated population of the area is about 600.

There were numerous purposes which prompted the water users in the reservation unit of the Yuma project to form Laguna Irrigation District. Perhaps the more important of these was a desire to have a legal form of organization for present dealings with the Bureau of Reclamation, and for ultimate operation of the reservation unit of the project. The organization election carried by a vote of 50 to 4, indicating that sentiment for the district was practically unanimous.

Activities of the district have been limited. The first assessment was levied for the year 1928–29, amounting to $1 on each $100 of valuation, the district valuation for assessment purposes being $100 per acre.

CHAPTER VII

STATUS OF DISTRICTS ORGANIZED FOR IRRIGATION OR WATER CONSERVATION, OTHER THAN IRRIGATION DISTRICTS

In the earlier pages of this report * the various types of districts, other than irrigation districts, formed in California for irrigation or water conservation purposes, or authorized by the California statutes, are mentioned, and brief outlines of the laws under which they have been or may be formed are given. Not counting reclamation districts, the most numerous of these other types are county water districts, county waterworks districts, and municipal improvement districts. In only a few of these, however, is irrigation an important feature. Water storage and conservation districts, which are among the other types mentioned, are thus far few in number, but they have to do entirely with irrigation, or with conservation of water for irrigation. A great many reclamation districts have been formed in the state, but in nearly every case the first purpose has been either to drain over-wet lands, or to protect lands from overflow by construction and maintenance of levees. In the reclamation districts in Sacramento-San Joaquin Delta control of ground water in the protected areas is the main feature in operation, and this involves both the removal of excess ground water by drainage, and the addition of ground water through subirrigation. In some cases, as was indicated in the earlier reference to reclamation districts,** irrigation works within reclamation districts are operated by individual landowners or mutual water companies, and in a few cases by the reclamation districts.

Since this report deals principally with irrigation districts formed under the California irrigation district act, or its predecessor, the original Wright act, complete studies of the other types of districts just mentioned have not been undertaken. However, because of their economic importance, the status in 1928 of those, other than reclamation districts, formed or in process of formation entirely, or in an important degree, for irrigation purposes, is briefly sketched below.

County water districts.

A large number of county water districts have been organized in the state under the act approved June 10, 1913, but the following seem to be the only ones which are concerned in any important way with irrigation.

*Pages 17 to 31.
**Page 28.

Alameda County Water District.—Organization election, December 30, 1913. Votes for, 884; votes against, 19. Gross area, 54,000 acres (approximate).

This district lies in the Niles Cone area, to which underground water is mainly fed from Alameda Creek. The purpose prompting the formation was protection of this underground water from outside encroachments, particularly by Spring Valley Water Company through storage in Calaveras Reservoir; also, to develop the water supplies used within its boundaries, and to protect the underground waters of the area from encroachments by East Bay Water Company.

An intensive study of the water supply was made during the years 1916 to 1920 under the auspices of the State Water Commission, and on the basis of this study an agreement was reached with Spring Valley Water Company under which a certain quantity of water is released from storage to maintain percolation into the underground basin.*

The district has spent many thousands of dollars in removing trees from the channel of Alameda Creek, in blasting the bottom of the channel, and in scarifying and plowing it, and in building numerous gravel dams across the creek, all for the purpose of increasing percolation into the gravels of Niles Cone. The engineer of the district reports that these operations have been highly successful. The district has also spent large sums in introducing clear water from subsidiary streams into wells bored by the district, this being for the purpose of raising the water table. It is reported that this work, also, has had highly beneficial effects. Furthermore, the district has carried on, through its own engineering staff, intensive studies of the water supply, and has made plans for developing the underground water sources of the district on a large scale. Finally, the district has taken steps to prevent the incursion of salt water from San Francisco Bay into the wells in the district.

The land in Alameda County Water District is for the most part highly developed. There are now 2000 or more wells in the district, of which about 600 are used for irrigation.

From 1914 to October 16, 1928, the district collected assessments totaling $180,258.84, these amounting to less than $0.22 per acre per year. No bonds have been issued.

Eden Township County Water District.—Organization election, December 26, 1919. Votes for, 298; votes against, 7. Gross area, 20,000 acres (approximate).

This district, like Alameda and Pleasanton Township County Water districts, was organized to protect its underground water supply. In this case that supply has been drawn on by East Bay Water Company, recently taken over by East Bay Municipal Utility District. East Bay Water Company has been pumping 4½ to 5 million gallons per day at their Roberts Landing wells. The district has reached an agreement with East Bay Water Company whereby the latter is to be permitted to pump only in case of emergency in the water supply of Oakland, this pumping to begin not earlier than April of each year and not to exceed an average of 4½ million gallons daily. Under this agreement pumping from the Roberts Landing wells by the water company or its successor must cease forever on January 1, 1930. The pumping from

*For report of these investigations see Biennial Report of the State Water Commission of California, 1919–1920, pp. 95–131.

these wells strongly affects a large number of wells over a wide area of the district.

On a number of occasions the district has been called upon to examine into and protest applications for diversion of water from San Lorenzo Creek, a main feeder of the underground supplies of the district. The engineer of the district has suggested that wells may be bored near the edge of San Lorenzo Creek into which water could be introduced from the creek to raise the water table. There are now about 1700 wells in the district, of which about 260 are used for irrigation.

Assessments have been levied each year from 1920 to 1927, collections to October 16, 1928, totaling $111,825.71.

Pleasanton Township County Water District.—Organization election, August 3, 1914. Votes for, 307; votes against, 61. Gross area, 12,000 acres (approximate).

This district operates a small water system comprising three wells and four to five miles of pipe line which furnishes water to 50 or 60 acres in small holdings near Pleasanton, in Alameda County. This system was put in by Spring Valley Water Company in accordance with an agreement made with the district shortly after the latter was organized. The holdings supplied with water are those not purchased by Spring Valley Water Company. The water system is operated by the district, Spring Valley Water Company paying the pumping costs when the underground water falls below a certain level. An area estimated to comprise from 5000 to 7000 acres is irrigated from private wells, mostly belonging to Spring Valley Water Company.

The district has no plans for developing an irrigation system. No bonds have been issued, but several assessments have been levied, collections totaling $12,899.68 to August 3, 1928.

Montecito County Water District.—Organization election, November 10, 1921. Gross area, original, 5330 acres; present, 7790 acres.

Although from 800 to 900 acres of lemons are irrigated within this county water district, it is essentially a municipal and domestic water supply project, and only brief reference will be made to it.

The district was organized for the purpose of developing a water supply and system for Montecito, in Santa Barbara County. A distribution system has been built. Buell Reservoir, with a capacity of about 180 acre-feet, has been completed. Doulton Tunnel has been put through the mountains to the Santa Ynez watershed. The Juncal reservoir site on Santa Ynez River has been acquired by transfer from the city of Santa Barbara, and work on Juncal Dam has been commenced.

The area in Montecito County Water District is chiefly in large estates. Besides the 800 to 900 acres of lemons that receive water, the area irrigated is mainly shrubs, lawns, and gardens. Water is very valuable and there are no special rates or accounts for irrigation service.

San Gabriel County Water District.—Organization election November 7, 1921. Votes for, 176; votes against, 101. Gross area 3000 acres (approximate).

Although only about 11 per cent of the income from water sales in this district is derived from irrigation service, this county water district is perhaps more nearly similar to some of the irrigation districts

in the state, particularly some of the smaller irrigation districts in southern California, than any of the others that have been organized.

The district lies east of and including San Gabriel, in Los Angeles County. There are a few small citrus groves, but in the main the area embraced is subdivided into small suburban holdings. Water is obtained by pumping from underground sources, the lift in 1928 approximating 125 feet. The district water system consists of wells, pumping plants, small reservoirs, and distribution pipes. All water is metered and sold in units of 100 cu. ft. The irrigation rate is $0.10 per 100 cu. ft. up to 5000 cu. ft. per month, and $0.05 per 100 cu. ft. for consumption over 5000 cu. ft. per month, with a monthly minimum charge of $1.50 for a 1½ or 2-inch meter. The monthly minimum irrigation charge can, if desired by consumers, be made collectible only six months during the year. Commercial and domestic rates are $1 for the first 600 cu. ft. per month, $0.15 per 100 cu. ft. for consumption from 600 to 2000 cu. ft. per month, $0.10 per 100 cu. ft. for consumption from 2000 to 5000 cu. ft. per month, $0.05 per 100 cu. ft. for monthly consumption over 5000 cu. ft. Monthly minimum rates are $1, $1.25, or $1.50, for ⅝-inch, 1-inch, and 1½-inch meters, respectively. The district has issued printed rules and regulations covering matters pertaining to rates, service connections, collections, etc. Collections for water service during 1927 totaled $52,135, of which $5,017 was for irrigation service.

The district has put out two bond issues. The first, of $250,000, is dated August 1, 1922, bears interest at 5 per cent, and has maturities from 1926 to 1950; the second, of $150,000, is dated February 1, 1924, bears interest at 5½ per cent, and matures from 1934 to 1948. An assessment of $0.23 on each $100 valuation was levied in 1926, this being based on the county assessed valuation within the district, amounting to $5,631,655. The amount of this levy was approximately $12,950.

La Puente Valley County Water District.—Organization election, June 17, 1924. Votes for, 106; votes against, 2. Gross area, 1300 acres (approximate).

This district is mainly concerned with furnishing domestic water in and about the unincorporated town of Puente, but also supplies a small quantity for irrigation. A bond issue of $135,000 was voted April 28, 1925, and sold July 15, 1925. Assessments were levied for district purposes amounting to $12,637 for 1926–27 and $12,661 for 1927–28. A budget of $10,000 was fixed for 1928–29.

Coachella Valley County Water District.—Organization election January 5, 1918. Gross area, 992,320 acres.

This large district was formed primarily for the purpose of gathering data regarding the water supply available to Coachella Valley from the streams, especially Whitewater River, which enter that valley from the San Bernardino, San Jacinto, and other surrounding mountain drainage areas. While a large amount of information regarding this water supply has been obtained through studies by the district, the principal activity of the district in recent years has been in connection with the promotion of the Boulder Canyon bill in Congress.

Agricultural development in Coachella Valley has taken place mainly since 1900. The water supply comes almost entirely from the artesian basin underlying Coachella Valley. The realization, about 1918, that the underground supply was being drawn upon in excess of annual

replenishments convinced landowners that action to safeguard and increase that water was essential to the future development of the valley.

Within the large area of the district it is estimated that some 260,000 acres is irrigable if water can be made available to it. The present irrigated area approximates 16,000 acres, and is said to be increasing at the rate of about 1000 acres per year. A crop census in 1925 showed an irrigated area at that time of 13,263 acres, distributed by crops as follows: cotton, 4241 acres; truck crops, 2996 acres; grapes, 2540 acres; dates, 1316 acres; alfalfa, 1096 acres; pasture, 620 acres; deciduous and citrus fruits, 454 acres. The main development of the valley is that of date culture, grapes being second in importance, grapefruit third, Bermuda onions fourth, and cotton fifth. Most of the irrigable land lies below sea level, and 72,000 acres in the valley is considered irrigable by gravity from the proposed All-American Canal, provided for in the Boulder Canyon bill. About 40,000 acres within the district is alkaline and requires drainage. Between these lower lands which require drainage and the outer margins of stony and gravelly lands, the principal soil classifications are Indio loam and clay loam and Woodrow fine sandy loam.* Present development extends mainly along or near the main Sunset line of the Southern Pacific railroad, from Indio to Mecca. The last census of holdings, taken in 1925, showed 431 planted farms, the total number of private irrigation wells being used in that year having been 626, these serving some 15,000 acres. Approximately 85 per cent of the total water used is pumped.

Coachella Valley County Water District has obtained permits 536 and 3011 from the Division of Water Rights for spreading and sinking of 119,000 acre-feet of water annually from Whitewater River and tributaries for the benefit of landowners within the district. Since 1919 a wood and wire dam 3000 feet long and 5 feet high across Whitewater River has been built for the purpose of spreading flood waters, and this is being replaced as required with concrete sections. The total expenditures on this work to the close of 1928 have approximated $40,000.**

Coachella Valley County Water District has levied assessments each year since organization in 1917, based on the county assessed valuations. The latter have varied from $1,911,220, in 1918, to $4,514,680, in 1927. In 1918 the assessment rate was $1.34, and in 1919, $1.10, on each $100

*U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Coachella Valley Area, California.

** Additional benefits have accrued to the lands in Coachella County Water District through the activities of Coachella Valley Storm Water District, the areas in these two districts overlapping.

Coachella Valley Storm Water District was organized in 1916 under the act of March 13, 1909, for the purpose of providing protection against the storm waters of Whitewater River and tributaries. It has a gross area of approximately 217,000 acres. A bond issue of $300,000 was authorized at an election in December, 1918, and the entire issue was sold April 2, 1919. In addition to other work, this district has constructed a flood channel 6 miles long, with a capacity of 3000 cu. ft. per sec., from Point Happy to Thousand Palms Canyon Wash; a flood channel 7 miles long in Thousand Palms Canyon Wash; a flood channel about 7 miles long with capacity of 3000 cu. ft. per sec., from a point about one mile above Thermal railroad crossing to Salton Sea; embankments, riprapping, concrete lining, and so forth, at the junction of the Whitewater River flood channel and Thousand Palms Canyon Wash; and other less important works.

Assessments have been levied each year since 1916 to cover both bond interest and retirement and current expenses. The total collections for the former, including 1927–28, have been $282,306, and for the latter, $119,930. In addition, there have been collections for a special improvement fund amounting to $45,500. The assessment rate for each $100 valuation during this period ranged from $0.28, in 1917, to $2.70, in 1919. The total county assessed valuation within the district in 1927, including personal property, was $3,439,050.

of valuation. Since then the minimum has been $0.28, in 1921, and the maximum $0.86, in 1920. The district has issued no bonds.

Water districts.

Niland Water District.—Year organization initiated 1921. Gross area, 16,234 acres.

This is the only district organized under the water district act of June 13, 1913.* It comprises the northwesterly end of Imperial Irrigation District and was formed for the purpose of financing the construction of an irrigation distribution system to connect with East High Line Canal of Imperial Irrigation District. It includes the only important area in Imperial District for which a distribution system has not been built.

As indicated in the statement regarding Imperial Irrigation District,** other areas in that district were originally, in the main, supplied with water through canals built by mutual water companies, but taken over by Imperial District in 1922 and 1923 at a price slightly less than $10 per acre, plus payments for equipment and certain works. Because of the precedent thus set, it was thought necessary that the owners of these north-end lands should also finance the construction of their distributing canals and works, and in turn convey them to Imperial District.

Niland Water District commenced activity late in 1923. An engineering board was first appointed according to the terms of the water district act, early in 1924. An engineering report was subsequently prepared outlining a complete irrigation and drainage system, including about 31 miles of irrigation canals and about 53 miles of drainage ditches. The estimated cost of these works was given as $139,893, and in November, 1925, a bond issue of $140,000 was authorized at an election at which 47,312 votes were cast for, and none against, the issue. At this election each landowner was authorized to cast one vote for each one dollar's worth of land within the district to which he held title or evidence of title as valued on the next preceding county assessment roll. These bonds were duly approved by the board of engineers required by the water district act, and were later approved by the state superintendent of banks. The district was not, however, successful in selling them, and recently has made other plans for financing construction through a new agreement with Imperial Irrigation District. This new agreement supersedes an agreement with Imperial Irrigation District dated December 6, 1927, which superseded an agreement signed in December, 1923.

More than half of the land in Niland District is held in parcels up to 640 acres each, but mostly 160 acres or less. Forty-five per cent of the area is held by Southern Pacific Land Company, a subsidiary of Southern Pacific Company.†

Niland District in 1926 levied an assessment at the rate of $1.20 on each $100 valuation on a total valuation of $391,501, the total levy being $4,681. A budget adopted for the calendar years 1928 and 1929 called for $16,600 and $11,750 in these two years, respectively. This budget was made up on the assumption that the bonds would be sold

*For summary of the act see page 18.
**See page 334.
†The soils of the district are described in detail in the U. S. Dept. of Agr., Bureau of Soils, Soil Survey of the Brawley Area, California.

and that work on the system would begin about September 15, 1928, a program which was not carried out. Interest on the bonds, all of which Niland District was to pay, was therefore included for the two years. An assessment at the rate of $4.13 per $100 valuation was levied for 1928 on a total assessed valuation of $403,354, the total levy being $16,658. There have been substantial delinquencies in assessments, but the district officers have assumed that these would mostly be paid up whenever the district should be ready to proceed with its construction plans. The 1928 assessment roll carried 55 separate assessments, exclusive of government land which totaled 2607.90 acres in area.

County waterworks districts.

As indicated in connection with the outline of the county waterworks district act previously given,* a number of waterworks districts have been organized in southern California, not all of which, however, serve water in important amounts for irrigation. The county waterworks district in which irrigation is most important is Los Angeles County Waterworks District No. 3 in San Fernando Valley. Orange County Waterworks District No. 3 serves irrigation water for a small area. San Bernardino County Waterworks District No. 2 and Ventura County Waterworks District No. 3, which was in process of organization in 1928, include irrigation service. Brief statements regarding these districts are given below.

Los Angeles County Waterworks District No. 3.—This district was formed in 1913, the first under the act. Its purpose was to construct a water distribution system from the Los Angeles aqueduct for all lands in San Fernando Valley except the city of San Fernando and the 'mission' district, the latter comprising all of the old San Fernando Mission area. It embraces about 89,000 acres, irrigation extending over about 60,000 acres. The entire district was annexed to the city of Los Angeles on May 4, 1915, and the distribution system constructed at the expense of Los Angeles County Waterworks District No. 3. It has since been operated as a part of the city system.

Under the terms of the waterworks district act, construction of the works of county waterworks districts is under the jurisdiction of the board of supervisors of the county in which the district is located. However, in the case of this district, the task of constructing the works was delegated to the Board of Public Service Commissioners of the city of Los Angeles. Bonds for paying the cost of construction were voted by the district in the amount of $2,604,000, these bonds being dated February 1, 1916, and maturing at the rate of $84,000 annually from 1919 to 1949, with interest at 6 per cent. Interest and principal of these bonds is a charge against the lands in the district and is raised by an ad valorem tax. Operation, maintenance, and betterments are an obligation on the water revenues of the department of water and power, the same as any other part of the city.

The system of Los Angeles County Waterworks District No. 3 was mainly built during the period July 1, 1915, to June 30, 1917, and was

*See page 20.

practically complete at the end of the fiscal year 1917–18. Sale of water for irrigation in San Fernando Valley was commenced in 1915. In the previous year about 3000 acres in the area included within the district was irrigated from local sources. By 1928 the area irrigated from the aqueduct system in San Fernando Valley, mainly within Los Angeles County Waterworks District No. 3, had reached 54,156 acres. The different crops irrigated, with area of each, were as follows: beans, 12,340 acres; citrus, 9084 acres; walunts, 5468 acres; alfalfa, 5384 acres; potatoes, 3166 acres; lettuce, 3096 acres; corn, squash, celery, and cucumbers, 2737 acres; deciduous, 2447 acres; tomatoes, 2217 acres; melons, 1513 acres; grapes, 1329 acres; roses and bulbs, 577 acres; figs, 342 acres.

Under ordinance 53,099 of the city of Los Angeles, the rate charged for water "for combined domestic and irrigation use, through the same meter, under constant pressure, and at the will of the consumer, upon tracts or parcels of land under single occupancy, aggregating not less than one acre where water is used on ground planted to trees and crops grown for commercial purposes, shall be five (5) cents per 100 cubic feet," with monthly service charge of $1 to $1.50. For water "used intermittently for irrigation, for limited periods, and under the control of the local water overseer," the charge is 1.8 cents per 100 cu. ft., with a minimum charge of $3 each time the water is turned on. The ordinance states that the water for intermittent use shall be delivered at the convenience of the department of water and power and subject to the demands of commercial and domestic consumers. In other words, water delivered from the aqueduct system for irrigation is considered surplus water. The irrigation rate applies only to gravity water.

The nonoperative valuation on real and secured personal property in 1927 within Los Angeles County Waterworks District No. 3 was $39,367,770. The tax rate was $0.41 on each $100 of valuation, and the amount produced from the levy on this property was $161,407.85. An additional revenue of $3,915 was secured from the tax on unsecured personal property.

Orange County Waterworks District No. 3.—This district, which was organized by a vote of 231 to 21 at an election held February 16, 1926, has taken over Home Tract Water Company and Garden Grove Water Company, the former at a price of $7,500 and the latter for $14,149.80, net.

The Home Tract Water Company water system is for irrigation service, although the amount of irrigation service is gradually decreasing. The water supply for both systems is obtained from wells, with a present lift of 50 to 60 feet. Distribution of water is through a gravity concrete pipe line. The area served for irrigation is only about 25 acres. Water is delivered in heads of approximately 30 to 35 inches for which the charge is $1 per hour. The total annual income from irrigation service is only from $150 to $200, whereas that from domestic service is about $10,000.

The district authorized $50,000 of 6 per cent bonds at the time of organization. These have maturities from 1926 to 1948, and were sold at a small premium. The assessed valuation of nonoperative property for 1928–29 was $775,725. A levy of $1,550 was requested for that year.

San Bernardino County Waterworks District No. 2.—This is located in the Mojave Desert surrounding the town of Adelanto, and embraces 1800 acres. It was organized January 14, 1928, by a vote of 37 to 0. When visited in September, 1928, it was just getting started. The district planned to purchase the properties of Adelanto Mutual Water Company, consisting of wells, pumping equipment, and pipe lines for irrigation; also the properties of Adelanto Water Company, consisting of wells, tank, and pipe system for domestic water supply. Bonds in the amount of $160,000 were voted January 14, 1928, but at the time of field investigation only a few of them had been sold. It was the intention to postpone for some time the sale of additional bonds, and, in the meantime, the district is leasing the systems of the two water companies.

Adelanto Mutual Water Company has been supplying irrigation water to about 600 acres, the rate being $0.021 per hour-inch. Water is pumped from several wells located in a flat about 4 miles west of Mojave River, and is lifted 35 feet to a small reservoir from which a second lift of 250 feet is made to a tank to supply the domestic system in the town. Two wells of Adelanto Water Company furnish about 25 and 35 inches, respectively. A number of springs furnish a gravity flow of about 40 inches.

An assessment of $3 per $100 of valuation, to yield $2,700, was levied in 1928 to cover organization expenses.

Ventura County Waterworks District No. 3.—This district was still in process of formation at the time of field investigation in September, 1928. The area included in the petition for organization was about 370 acres. The first petition was filed May 2, 1928, but after certain changes in the boundaries it was dropped. A second petition was filed July 17, 1928, but was successively continued from August 21 to September 4 and September 18, 1928.

The district includes the small town of Simi and the purpose of formation, as stated in the petition, was to supply water for irrigation, domestic, and fire protection purposes. Water was to be obtained by pumping from wells, the estimated cost of the water system being $30,000. At the hearing August 21, 1928, three owners of 87 acres sought exclusion.

Municipal improvement districts.

Municipal Improvement Districts 2 and 9, and, in a lesser degree, Municipal Improvement District 27, all in or adjacent to San Fernando Valley, in Los Angeles County, serve water for irrigation, and appear to be the only ones out of a large number formed in the state which do so. In each case the source of the water is the Los Angeles aqueduct system in San Fernando Valley. They are all operated by the city of Los Angeles, although each has its separate bond issue which is chargeable against the lands within its boundaries. Brief mention regarding these three districts was made above in the statement pertaining to the municipal improvement district act.* Additional information regarding numbers 2 and 9 is given below.

*See page 21.

Municipal Improvement District No. 2 (Los Angeles County).—This comprises the 'mission' district in San Fernando Valley, the area included being about 11,000 acres. When the improvement district was formed the area was obtaining its water supply from wells and this was entirely being applied to citrus lands. The distribution system from Los Angeles Aqueduct was constructed by the Board of Public Service Commissioners of Los Angeles, along with the system of Los Angeles County Waterworks District No. 3 referred to above. The cost was within the estimate of $390,000, which was the amount of the bond issue authorized in 1916. This issue is dated December 1, 1916, bears interest at 5 per cent per annum, and has maturities from 1917 to 1946 at the rate of $13,000 annually. The total nonoperative valuation of real and secured personal property in 1927 was $4,400,165, the rate was $0.55 per $100 of valuation, and the amount produced was $24,400.90. A small additional sum was raised from taxes on unsecured personal property.

The area embraced within Municipal Improvement District No. 2 was annexed to the city of Los Angeles in 1915. Irrigation service is subject to the same rates and service as in Los Angeles County Waterworks District No. 3, detailed above.

Municipal Improvement District No. 9 (Los Angeles County).—This district covers the Hansen Heights area lying east of Tujunga Wash. It is now within the city limits of Los Angeles, but was not included in the original San Fernando Valley annexation. A bond issue of $150,000 for construction purposes was voted in 1923. The bonds carry interest at 5½ per cent per annum and mature at the rate of $4,000 annually from 1924 to 1959, and $6,000 in 1960. The nonoperative valuation of real and secured personal property in 1927 was $1,386,210, the tax rate was $0.92 on each $100 valuation, and the amount produced from the tax was $12,753.13. A small additional amount was produced from the tax on unsecured personal property.

Water storage districts.

Reference has already been made to the water storage district act and to the few districts that have been organized under it.*

*San Joaquin River Water Storage District***.—The first attempt to form a water storage district in the area covered by this district was made in 1922, a petition for formation having been filed with the state engineer May 26 of that year. The boundaries included about 550,000 acres on the west side of San Joaquin River under the canals controlled by Miller and Lux. The proposal was protested by Madera Irrigation District, situated on the east side of San Joaquin Valley. This petition was allowed to lapse and the Madera Irrigation District and Miller and Lux interests agreed to join in a district covering lands of both. A petition for the formation of San Joaquin River Water Storage District, embracing about 933,000 acres, was accordingly presented to the state engineer January 18, 1923, but was withdrawn to permit of a general feasibility investigation by the state engineer. A report recommending a district of about 550,000 acres, of which about 184,000 acres

*See page 22.
**See also statement regarding Madera Irrigation District, page 199.

lies east of San Joaquin River, mostly in Madera Irrigation District, and about 366,000 acres lies west of San Joaquin River, mainly under canals controlled by Miller and Lux, was filed September 1, 1923. Organization was accomplished at an election February 9, 1924, 84,542 votes being cast for and 8911 against organization.

From the date of organization to late in 1928, San Joaquin River Water Storage District was engaged in engineering and legal studies and negotiations which it was hoped would result in working out a satisfactory project. No final plan, however, was perfected. One proposed project included the purchase of the water rights and properties of existing systems, the construction of works to some areas not under systems, the construction of drainage works, and the construction of storage at the Millerton reservoir site on San Joaquin River, together with a hydro-electric plant below the Millerton dam. The estimated cost of this project was in excess of $31,000,000, of which $9,738,350 was for the purchase of water rights.

About November, 1928, some of the major interests concerned in the district concluded that further activity by the district should cease, and in February, 1929, the board of directors resolved to request the attorney-general of the state to bring dissolution proceedings.

Tulare Lake Basin Water Storage District.—A petition for the formation of this district was presented to the state engineer October 7, 1925, and his final order approving the organization was filed July 29, 1926. Organization was carried at an election held September 10, 1926, 12,047 votes being cast in favor and none against. The project plan was accepted for filing by the state engineer July 22, 1927, and the report on the project by the state engineer is dated October 13, 1927. An election on the acceptance or rejection of the project held December 6, 1927, resulted in the casting of 11,948 favorable and 98 unfavorable votes. A board of assessors was appointed on February 7, 1928, for the purpose of assessing the costs of the project.

Tulare Lake Basin Water Storage District embraces 192,729.45 acres, of which 11,520 acres will be set aside for reservoir purposes, giving a net assessable area of 181,209.45 acres. Of this, about 162,000 acres is classed as irrigable, although portions of this area will be subject to overflow during years of excessive run-off. The district includes about twenty reclamation districts and also Lakeland Irrigation District. With the exception of a small area which projects into Tulare County north of Alpaugh, the entire district is within Kings County.

The first effort to form a water storage district in this basin was made in 1923, a petition for the formation of Tulare Lake Water Storage District having been filed with the state engineer August 30, 1923. Organization was approved by the state engineer August 12, 1924, and the organization election was carried October 10, 1924. The area included was about 175,000 acres. In order to permit the formation of a larger district, Tulare Lake Water Storage District was voluntarily dissolved by court decree entered July 29, 1927. Prior to this date, however, namely on October 7, 1925, a petition had been presented for the formation of the present district.

The first project plan was filed with the state engineer April 20, 1927, but it was rejected because of failure to provide a definite basis

for assessing benefits and for handling water naturally reaching Tulare Lake, and because of lack of details regarding structures.

Tulare Lake receives the surplus flow of Kern, Tulare, and Kaweah rivers and the portion of Kings River flow which enters through South Fork Channel. Early records show a maximum depth in Tulare Lake of 20 to 30 feet. Since the late seventies, irrigation diversions on the streams which naturally enter the lake have restricted the run-off, and as the lake level has receded, marginal lands have been planted and levees constructed to reclaim land subject to overflow. At the present time, only about 30,000 acres, in the center of the lake bed, remains unprotected. The lake was dry in 1899 and 1905, after which the years of heavy run-off maintained its level above elevation 190 until 1912, when a general recession began. The floods of 1916 restored the level to elevation 190, but in 1919 the lake bed was again dry and has remained so since then, with the exception of the years 1922 and 1923.

With the exception of cotton, which has been grown in recent years on some of the higher lands, grain farming predominates. Land ownerships are large, the estimated number being 400. The water supply considered or expected to be available to the district has been segregated by the engineer appointed by the state engineer, as follows: (a) present flow in South Fork of Kings River; (b) surplus flow in northside channels of Kings River; (c) water reaching Tulare Lake from Kaweah, Tule and Kern rivers; (d) ground waters; (e) supply from Lakeland Canal; (f) additional water which may be obtained from mountain storage. The last item has reference to participation in the proposed Pine Flat storage project on Kings River.* The total estimated water requirement of the district is given in the report made for the state engineer as approximately 230,000 acre-feet annually.

The project plan adopted by the district calls for an expenditure of $1,608,434, of which $921,500 is for a reservoir and flowage area in Tulare Lake, $147,690 is for channel rectification, $16,650 is for water rights, $86,650 is for structures, and $50,000 is for mountain storage, the remainder being for rights of way, levee protection, and contingent expenses, legal, engineering, and supervision expenses.

Tulare Lake Basin Water Storage District has been included in the 1927 Kings River water schedule, and has been accepted as a participant in the proposed Pine Flat storage project. At this writing (March, 1929) the various interests within the district are seeking to reach adjustments among themselves of water rights and water supply.

Kern River Water Storage District.—This district embraces 248,300 acres in Kern County, extending from about two miles south of Delano southerly to the south rim of the former bed of Kern Lake, a total north and south distance of 44 miles. The petition for the formation of the district was filed with the state engineer May 4, 1922, and final order approving organization was given by the state engineer July 20, 1922. The organization election held November 10, 1923, carried by a vote of 68,507 to 21,969. A feasibility report, approved by a consulting board, was presented to the board of directors of the district January 10, 1928, and a final feasibility report, containing a modified plan, was prepared

*The proposed storage on Kings River at Pine Flat is discussed in the statements regarding irrigation districts receiving water from Kings River, pages 204 to 244.

for submission to the state engineer under date of September 1, 1928. This was placed in his hands informally on October 20, 1928.

Formation of an irrigation district under the California irrigation district act was attempted in the Kern River area in 1919, but failed. In the following year a detailed investigation was made under the direction of the state engineer and the report published by the state engineer carried the conclusions that the water resources available to the area could be made to serve 292,000 acres.* Based largely on the information presented in this report, the present district, and also Buena Vista Water Storage District referred to below, were organized, the two together comprising a total of 327,125 acres, of which 28,420 acres in Buena Vista District, lying mainly in Buena Vista Lake, is considered as not receiving any benefit from the district plans.

A complete report covering all details of the plan of development which was adopted by the board of directors of Kern River Water Storage District is on file with the state engineer, and it is sufficient for the purpose of this bulletin to outline briefly the main features of the modified plan, with brief reference to present irrigation development within the area.

According to a recent report,** the usual area in Kern County (mostly in Kern River Delta) receiving canal service only, is 190,000 acres; the area receiving both canal and pump service is 10,000 acres; the area receiving only pump service is 90,000 acres, and the total irrigated area is 290,000 acres.

The principal source of water supply is, of course, Kern River, of which the average seasonal run-off over a 33-year period has been 737,200 acre-feet. According to past agreements, the share of this average supply available to Kern River Water Storage District is given as 537,600 acre-feet.

Irrigation water received from canals is being delivered mainly by public utility water companies owned or largely controlled by Kern County Land Company, which company also owns lands represented by about half of the total assessed valuation within the water storage district. It has been estimated that there are between 4500 and 5000 smaller ownerships, mostly between 10 and 100 acres, in the area. For some of the area water-right priorities furnish a nearly complete water supply; for other parts the supply may, in dry years, be as much as 100 per cent deficient, with the quantity available varying between these two extremes.

All plans for increasing utilization of the water resources of Kern River have contemplated mountain storage on that stream. The plan outlined by the engineer of the district under date of January 10, 1928, called for a storage reservoir at Isabella with capacity of 150,000 acre-feet. Under the modified plan, storage on Kern River would be at Isabella dam site B, and be limited to a capacity of 75,000 acre-feet.

As proposed under the modified plan, (1) certain areas in the district south of Kern River would continue with unregulated water supply in accordance with their present water-right priorities, capital charges to be those resulting from the purchase of public utility systems

*Calif. State Dept. of Eng., Bul. 9, Water Resources of Kern River and Adjacent Streams and their Utilization. 1921.

**State Dept. of Public Works, Divisions of Engineering and Irrigation and of Water Rights. Bul. 11, p. 31.

and water rights, and with no improvements or extensions except joint diversion works; (2) certain southside water-right lands would sell their water rights to the district 'pool' and buy the physical works of the public utilities now serving them; (3) water-right lands under Calloway Canal—one of the main northside systems—north of a certain east and west line would sell their water rights to the district 'pool,' and along with dry lands would develop an irrigation supply through privately owned pumping plants, capital charges to be based upon benefits accruing through stabilization by the district of the ground water plane; (4) service to the Shafter-Wasco-McFarland unit, comprising the north end of the district, would be given entirely through privately owned wells and pumping plants, with immediate construction of ground water replenishment works north of Poso Creek, to be charged against the McFarland area only, replenishment works for the benefit of the Shafter and Wasco areas to be deferred; (5) two northside units, known as the Lerdo-Calloway and Beardsley units, would receive a complete regulated surface supply to tracts of 160 acres or smaller, in the case of ownerships now receiving public utility service, and with extensions and enlargements of all systems to be made to afford such service; (6) the Pioneer unit, another northside unit, would be completely supplied by district pumping plants located along the canals; and (7) the eastside unit, a southside area with a late river priority, would be afforded a complete surface supply to 6200 acres of water-right land and 4000 acres of dry land, the remaining 5354 acres of dry land being left to service through private pumping plants.

The cost of the district water supply 'pool' would consist of the following elements: (*a*) storage development of 75,000 acre-feet at Isabella; (*b*) a southside pumping development of capacity of 350 cu. ft. per sec.; (*c*) construction of pumping plants and canal lining for the Pioneer unit; and (*d*) purchase of detached water rights, out-of-demand water of attached rights, and surplus water in Kern River.

In accordance with the provisions of the water storage district act which permit progressive development, the estimated cost of the projects, totaling $8,270,486, is set up in eleven construction units, the first ten of which were recommended for immediate completion. These were as follows: (1) purchase of all water rights the waters of which would be detached from the lands they now serve; (2) purchase of existing physical properties of public utility canal systems with water rights to remain attached to district lands; (3) purchase of the existing canal distribution system of Kern River Land Company; (4) purchase of privately owned properties; (5) extensions and improvements of existing systems; (6) ground water replenishment works in the Lerdo extension north of Poso Creek; (7) installation of district pumping systems; (8) surface drainage in the Kern Lake area; (9) storage development of Isabella on Kern River; (10) general expense; and (11) construction of ground water replenishment works for the Shafter and Wasco areas. Not counting the last item, which it was proposed to defer, the average cost per acre for the gross area of 248,300 acres in the district would be $32.70. Applied to the estimated net irrigable area of 216,000 acres in the district, this average cost would be $37.59.

The development of the modified plan briefly outlined above has involved a large amount of work by the engineers and officers of the district. Costs were substantially reduced below those given in the report filed January 10, 1928, due partly to omission or deferment of certain new works, and partly to a substantial reduction in the price to be paid for existing irrigation properties of Kern County Land Company and its subsidiary, Kern County Canal and Water Company. Whether the project is to go forward as outlined is still uncertain. On March 12, 1929, however, the board of directors of the district instructed the attorney to begin dissolution proceedings and passed a resolution of intention to sell the properties of the district. This action was taken following withdrawal of the offer of Kern County Land Company to sell its irrigation systems to the district.

Buena Vista Water Storage District.—This district was organized June 28, 1924, by unanimous vote of 25,100. Petition for formation had been filed with the state engineer August 9, 1922, this proposing a district of about 125,000 acres. To meet objections of the state engineer, the area was reduced to 78,825 acres, and a final order approving organization was filed by the state engineer April 10, 1924. The final project plan was accepted by the state engineer December 21, 1927, and approved by the landowners March 22, 1928, by unanimous vote of 22,578. Assessors to apportion the benefits were appointed April 14, 1928, and their report was presented to the state engineer September 27, 1928.

Buena Vista Water Storage District embraces land receiving water from Kern River at the so-called 'second point of measurement,' which is below the diversions of the various canals which water the main portion of Kern River Delta northwest, west, south, and southeast of Bakersfield. The area in Buena Vista Water Storage District is largely owned by Miller and Lux, or controlled by it through sale contracts. The district boundaries include Buena Vista Lake, containing 25,459 acres. This lake is owned by Buena Vista Reservoir Association, in which Miller and Lux hold an 84 per cent interest, and is used as a storage reservoir. The area in the district over which assessments have been spread is 50,405 acres.

Present irrigation in Buena Vista Water Storage District is of the character usually found on large holdings devoted mainly to cattle raising. The area under canals and dependent on 'second point' water from Kern River south of the Wasco road, which is approximately the northern boundary of Buena Vista Water Storage District, was reported in 1920 as 46,860 acres,* of which 43,610 acres was classified as having been at least partially prepared for irrigation. In that year use of water was confined to 15,450 acres, of which 11,350 acres received one irrigation, 3540 acres received two irrigations, and 525 acres received three irrigations. The flow at the second point of measurement in that year was reported as equal to the "usual average amount received." However, the water supply available at the second point of measurement is extremely variable.

The project plan adopted by Buena Vista Water Storage District contemplates the purchase of existing canals that may be utilized, with

*State Dept. of Eng., Bul. 9, p. 10.

the exception of the small systems of Carmel Cattle Company, and transfer of the water rights to the district. A new diversion weir and main canal, with a capacity of 600 cu. ft. per sec., will be constructed, and the east levee of Buena Vista Lake will be repaired. The lands in Buena Vista Lake will be leased with an option to purchase. Ultimately the district may cooperate with Kern River Water Storage District in the construction of storage at Isabella. If this is not done, it is possible to reduce the area of Buena Vista Lake by reclamation of marginal lands, thus conserving water by reduction of present large evaporation losses.

The cost of development which the district proposes now to undertake is $945,000, the assessed benefits having been segregated as follows: flood protection, $170,000; drainage, $165,092; irrigation, $446,752; new construction, $163,156.

Water conservation districts.

In previously outlining the various water conservation district laws that have been enacted by the California Legislature,* reference was made to a proposed conservation district on Kings River, and to districts that have been formed on Kaweah and Santa Clara rivers. The status of these districts in 1928 is outlined below.

Kings River Water Conservation District (Proposed).—Organization of the irrigation interests along Kings River for the purpose of water-right agreements and water storage at the Pine Flat site has been under way since about 1917, when the California irrigation act of 1915 was amended at the instance of those concerned in the proposed Pine Flat storage project. Previous to this, namely in 1909 and 1914, water filings for storage at Pine Flat had been made. Quite unusual water-right agreements have been reached and are now the basis for distributing the waters of the river under state authority,** but a complete organization for carrying out so much of the Pine Flat storage project as shall finally be found economical has not yet been perfected. Organization of Kings River Water Conservation District is the step in that direction that has most recently been under consideration.

The first petition for the formation of a so-called 'super district' on Kings River was for a water storage district, under the water storage district act. In order to make a test of the constitutionality of the water storage act before the state supreme court, the state engineer refused to receive this petition. The supreme court upheld the constitutionality of the act in a decision rendered March 13, 1923,† but in the meantime the Kings River interests had decided to draft a new act to meet their special needs, and the California water conservation district act resulted.

A petition proposing the formation under this act of Kings River Water Conservation District was filed with the state engineer June 12, 1924, and an order establishing the sufficiency of that petition was issued July 16, 1924.

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*Page 25.

**Reference is here made to the water-right indenture and monthly diversion schedule signed May 3, 1927, by nearly all of those holding irrigation rights from Kings River. This is discussed in the statements relating to the various irrigation districts which obtain water from Kings River, pp. 204 to 244.

† *Tarpey* vs. *McClure,* 190 Cal. 593.

The principal activity to date of those interested in the proposed district has been in connection with the establishment of the Kings River water-right indenture and monthly diversion schedule which has been referred to. This schedule covers direct-flow rights to Kings River. A second schedule, covering storage rights, is part of the program, but this has not yet been very actively undertaken. However, the interested parties, acting largely through Kings River Water Association, have prosecuted legal and engineering studies, but have postponed further activity toward perfecting organization of the district until general conditions in the area make the movement more opportune.

Irrigation in the Kings River area is covered in detail in the statements that have been made above relating to active irrigation districts which obtain water from that stream.* Fifteen irrigation districts and one water storage district are involved. The total area embraced within these districts approximates one million acres, of which some 650,000 acres is now irrigated to the extent the unregulated flow of Kings River makes this possible. A very large portion of the area receives its supply wholly or partly by pumping from underground.

Storage at Pine Flat, together with present or proposed storage above the Pine Flat site for power purposes, would give practically complete regulation. Total storage on the river has been proposed up to approximately 1,000,000 acre-feet, including 650,000 acre-feet at Pine Flat, but at least so far as the irrigation interests are concerned, decision has not yet been reached as to the amount of storage that should be undertaken at the Pine Flat site.** In the meantime, activity in connection with Kings River Water Conservation District is marking time.

. *Kaweah Delta Water Conservation District.*—This district was organized at an election November 5, 1927, and originally embraced 259,360 acres in Tulare County and 87,160 acres in Kings County. On March 20, 1928, the total area was reduced to 342,360 acres by exclusion of 4160 acres in Kings County. The district was promoted by Kaweah Delta Underground Water Protective Association, St. Johns River Association, and Kaweah River Association.†

The purposes prompting formation of this district were "the conservation and preservation of the underground waters of the Kaweah Delta, together with their sources of supply." Outlying portions of the delta are suffering from a greatly lowered water table, and some active means of replenishment were considered necessary. Kaweah Delta is traversed by a number of old natural channels of Kaweah River, and it was the belief of the sponsors of the district that by a reasonable amount of work these old channels could be put into condition to carry water when the river flow is above normal, and that this water could be distributed to the areas suffering from depressed water table. This plan the district is attempting to carry out. A budget of about $12,000 has been prepared for 1929. This and the funds to be needed in 1930 have been provided for by an assessment of $0.13 on each

*Pages 204 to 244 and page 257.

**For details regarding present and proposed use of water of Kings River for irrigation and power development see State Dept. of Public Works, Division of Water Rights, Bul. 2, Kings River Investigation. 1923.

† For reference to the two last-named associations and to irrigation conditions in Kaweah River Delta see statement on Tulare Irrigation District, page 245.

$100 valuation levied in 1928 on a total assessed valuation of $21,339,086, of which $19,322,286 is in Tulare County.

Santa Clara Water Conservation District.—This district was organized by a vote of 48,202 to 3453 at an election December 9, 1927. It embraces 111,899 acres along Santa Clara River and on the coastal plain from Ventura southeasterly to Rancho Guadalasca, all in Ventura County. The most easterly point of the district lies about three miles east of Piru. Incorporated cities within the exterior boundaries of the district are excluded except in the case of Santa Paula, where a comparatively large area inside the city limits which is strictly agricultural is included.

The purpose of forming this district was to conserve the waters of Santa Clara River and tributaries, and to protect them from diversion to an outside watershed.

Santa Clara River Valley is a well-watered area, but the demand for water for both irrigation and domestic use is steadily increasing. Prior to the organization of the conservation district, that is, in January, 1925, Santa Clara River Protection Association was formed with purposes similar to those of the present district, and a beginning was made in water studies. As an outgrowth of the efforts of this association, the water conservation district act of 1927 was drawn and passed by the legislature, and organization under it soon followed.

When visited in the summer of 1928, plans were being prepared for a series of small impounding dams in a side channel of Sespe Creek, to which water from Santa Clara River could be diverted and allowed to percolate into the gravel beds; also for diverting water and sinking it in wells along Santa Clara River bottoms. It has been since reported that the experimental work has given very satisfactory results.

The assessed valuation of the district in 1928 was $20,823,678. An assessment of $0.15 on each $100 valuation was levied for collection along with county taxes. This is the maximum annual assessment allowed under the water conservation district act of 1927. As indicated in the brief outline of the water conservation district act of 1927 on page 27, the district has no power to create bonded indebtedness.

SUMMARY OF STATISTICAL DATA RELATING TO GROSS, ASSESSED, IRRIGABLE, AND IRRIGATED AREAS, AND LAND OWNERSHIPS AND POPULATION IN ACTIVE CALIFORNIA IRRIGATION DISTRICTS, 1927-1928

TABLE I

District	County or counties	Post office	Year formed	Gross area, acres	Area assessed 1927-1928, acres	Irrigable areas reported (without deductions for roads and ditches)			Areas irrigated, as reported by districts			Land holdings, 1927				Population estimates		
						Total irrigable, acres (Note.—In some cases, includes town areas receiving domestic service)	Irrigable with present developed water supply, acres (Note.—In some cases, water available during only part of irrigation season)	Irrigable with present distribution system, acres (Note.—In some cases, only skeleton distribution system provided)	Year of last record	Total irrigated, acres	Crops, with acreages of each if reported (Note.—'Deciduous' includes fruits and nuts; 'Citrus, etc.' includes oranges, lemons, grapefruit, olives, avocados, and other sun-tropical fruits; 'Grain' includes grain hay)	Estimated number of farm holdings	Largest holdings: Number	Largest holdings: Combined area, acres	Areas held by districts under tax deed, acres	Inside cities and towns	Outside cities and towns	Total
Alpaugh	Tulare	Alpaugh	1915	8,175	8,105	8,039	[1]8,039	8,039	1927	4,085	Grain, 2,360; cotton, 1,100; alfalfa, 440; vines, 110; corn, 75	306	4	803	655	None	500	500
Alta	Tulare, Fresno, Kings	Dinuba	1888	129,300	127,000	112,600	[2]80,000	112,600	1925	[3]77,950	Vines, 54,840; deciduous, 8,960; grain, 6,950; alfalfa, 4,690; citrus, etc., 1,430	2,000	2	3,500	None	12,500	8,000	20,500
Anderson-Cottonwood	Shasta, Tehama	Anderson	1914	32,113	32,000	28,064	28,064	28,064	1927	16,061	430; truck, 450; field crops, 430; cotton, 200	350	2	4,299	1,500	1,600	800	2,400
Banta-Carbona	San Joaquin	Carbona	1921	14,379	14,379	14,248	14,248	14,248	1927	10,924	Alfalfa, deciduous, field crops, and grain	140	4	4,020	None	None	500	500
Baxter Creek	Lassen	Litchfield	1917	9,336	9,336	8,636	See statement, page 68	See statement, page 68	1928	1,500	Alfalfa, 1,700; field crops, 1,690; deciduous, 754; citrus, etc., 743; vines, 561	91	1	550	3,316	None	225	225
Beaumont	Riverside	Beaumont	1919	4,141	3,161	3,161	3,161	3,161	1927	2,047	Alfalfa, pasture and general crops	348	2	160	None	1,500	500	2,000
Big Springs	Siskiyou	Montague	1927	3,570	None	2,546	[4]2,546	1,900	1927	1,767	Deciduous, 2047	44	3	475	None	None	120	120
Browns Valley	Yuba	Browns Valley	1888	40,000	None	11,740	See statement, page 119	9,600	1927	6,438	Alfalfa, 1,638; other, 129	170	4	6,850	None	90	730	820
Butte Valley	Siskiyou	Macdoel	1920	28,686	20,596	17,500	[5]17,500	17,500	1928	4,660	Pasture, 2,690; field crops, 1,690; deciduous, 754; citrus, etc., 743; vines, 561	184	2	4,950	2,224	100	100	200
Byron-Bethany	Contra Costa, San Joaquin, Alameda	Byron	1919	17,200	17,200	12,544	12,544	12,544	1927	9,000	Grain, 3,600; pasture, 600; alfalfa, 450; truck, 10	250	3	2,291	None	300	700	1,000
Camp Far West	Placer, Yuba	Wheatland	1924	4,089	4,089	2,658	2,658	1,800	1928	[6]	Alfalfa, 8,400; deciduous, 400; grain, 200	6	1	2,069	None	None	100	100
Carmichael	Sacramento	Sacramento	1916	3,121	3,121	3,021	3,021	3,021	1928	1,810	Mostly deciduous; hops	250	3	333	10	None	750	750
Carpenter	Orange	Orange	1927	1,328	None	1,328	1,328	[7]1,328	1928	[8] [2]2,300	Deciduous, 1,310; citrus, etc., 300; vines, 200	[1]200			None	200		[9]1,800
Citrus Heights	Sacramento, Placer	Roseville	1920	3,077	3,077	3,066	3,066	3,066	1927	2,642	Citrus, 2,000; walnuts and miscellaneous, 300	206	5	400	None	None	600	600
Compton-Delevan	Colusa	Maxwell	1920	12,652	12,652	11,500	11,500	11,500	1927	2,695	Deciduous and olives, 2,237; vines, 285; citrus, 130	9	2	9,368	720	None	20	20
Consolidated	Fresno, Tulare, Kings	Selma	1921	149,047	149,047	145,757	[11]127,000	138,000	1928	[3]126,500	Rice, 2,695	4,850	3	1,932	None	None	24,250	24,250
Corcoran	Kings	Corcoran	1919	51,606	51,606	51,000	[12]19,000	50,000	1927	[3]19,000	Vines, deciduous, alfalfa, and field crops	295	4	10,851	None	None	1,500	1,500
Cordua	Yuba	Marysville	1919	5,461	5,461	5,221	5,221	5,221	1927	1,042	Cotton, grain, alfalfa, and melons	19	3	2,359	857	None	50	50
Crescent	Fresno, Kings	Fresno	1925	13,150	13,150	13,000	13,000	13,000	1928	[13]	Rice, 930; field crops, 85; alfalfa, 10; other, 17	60	3	2,360	None	None	100	100
Deer Creek	Tehama	Vina	1926	1,907	1,907	1,663	1,663	1,663	1926	1,476	Mostly grain; some alfalfa	13	1	364	None	None	30	30
East Contra Costa	Contra Costa	Brentwood	1926	20,200	20,000	19,760	19,760	19,760	1927	13,834	Deciduous, 750; alfalfa, 425; field crops, 200; truck, 100	326	3	4,631	None	500	700	1,200
El Camino	Tehama	Gerber	1921	7,549	7,549	7,549	6,600	7,549	1927	2,958	Deciduous, 5,871; alfalfa, 4,125; truck, 3,224; vines, 589; grain, 25	250	3	3,868	None	None	600	600
El Dorado	El Dorado	Placerville	1925	30,703	29,996	19,905	6,000	See statement, page 135	1927	6,000	Deciduous, 1,321; field crops, 935; alfalfa, 617; truck, 45; other, 40	442	5	3,346	None	2,500	2,000	4,500
Fairoaks	Sacramento	Fairoaks	1917	3,900	3,975	3,400	2,600	3,400	1927	2,600	Deciduous, 5,950; alfalfa, 50	400	3	220	3	300	1,200	1,500
Fallbrook	San Diego	Fallbrook	1925	10,217	9,904	10,203	[14]	None	1926	[9]712	Citrus, etc., 1,500; deciduous, 700; vines and miscellaneous, 400	299	5	2,931	None	100	800	900
Foothill	Fresno, Tulare	Orange Cove	1920	50,687	59,687	45,837	[14]	None	1927	[9]16,970	Citrus, etc., 665; walnuts, 30; persimmons, 17	1,200	4	3,814	None	660	3,000	3,660
Fresno	Fresno	Fresno	1920	241,300	240,728	239,080	[15]193,539	220,000	1927	[3]193,539	Vines, 8,100; citrus, etc., 4,780; figs, 3,090; other deciduous, 1,000	8,570	3	20,597	None	None	50,000	50,000
Glenn-Colusa	Glenn, Colusa	Willows	1920	121,592	121,592	[16]118,592	118,592	118,592	1927	36,188	Vines, 94,250; field crops, 29,840; deciduous, 26,190; alfalfa, 19,520; cotton, 2,000; citrus, 1,400; pasture, 20,389	451	5	24,197	4,859	None	1,200	1,200
Grenada	Siskiyou	Grenada	1921	4,948	4,948	3,510	2,000	3,510	1928	1,360	Rice, 25,450; alfalfa, grain, and field crops, 8,936; pasture, 1,802	44	3	1,229	1,707	100	160	260
Hemet	Riverside	Hemet	1927	9,815	9,775	9,551	[17]See statement, page 293	[17]See statement, page 293	1928	[4]	Practically all in alfalfa					3,000	2,500	5,500
Hot Spring Valley	Modoc	Alturas	1919	9,497	9,497	9,000		[18]7,500	1927	6 410	Practically all in citrus and deciduous	35	4	3,675	237	None	150	150
Imperial	Imperial	El Centro	1911	605,000	585,000	557,000	557,000	440,000	1927	389,048	Grain, 5,800; alfalfa, 590; potatoes, 20							
Island No. 3	Kings	Laton	1921	4,620	4,620	4,120	[19]3,000	3,300	1928	[3]3,000	Alfalfa, 178,210; truck, 95,576; grain, 51,708; field crops, 39,706; cotton, 23,102; pasture, 13,519; citrus, etc., 7,540; vines, 5,598; other, 3,341	4,907	3	44,100	[33]	24,000	26,000	50,000
Jacinto	Glenn	Glenn	1917	11,554	11,481	10,300	10,300	10,300	1927	4,088	Deciduous, vines, field crops, and alfalfa	155	3	520	None	None	600	600
James	Fresno	San Joaquin	1920	26,266	26,266	18,266	12,500	18,000	1928	12,500	Field crops, 1,588; alfalfa, 1,471; deciduous, 660; pasture, 369	185	3	4,779	None	None	320	320
La Canada	Los Angeles	La Canada	1924	1,294	1,239	1,294	800	1,294	1927	800	Alfalfa, 6,500; vines and deciduous, 2,968; cotton, 1,782; grain, 785; field crops, 465	190	2	18,750	None	None	600	600
Ladera	Riverside	Elsinore	1922	1,632	1,632	1,481	[20]300	[20]	1927	[21]575	Shrubs and gardens, 400; citrus, etc., 300; vines, 100	[1]492	1	180	None	None	700	700
Laguna	Fresno, Kings	Laton	1920	34,858	34,858	30,000	25,000	30,000	1927	[3]25,000	Deciduous, 349; citrus, etc., 157; vines, 21; other, 48	[1]283	3	595	None	None	300	300
Lakeland	Kings	Corcoran	1923	23,283	23,283	23,283	[22]9,158	[22]22,500	1927	[3]9,158	Grain, field crops, alfalfa, cotton	800	2	6,920	None	None	3,000	3,000
Lakeside	San Diego	Lakeside	1924	320	320	288	288	288	1927	50	Chiefly grain and cotton	20	3	18,851	None	None	10	10
La Mesa, Lemon Grove, and Spring Valley	San Diego	La Mesa	1913	18,000	18,000	13,500	See statement, page 316	8,000	1927	3,000	Alfalfa, 50 (Principal service domestic)	95	2	75	None	450	50	500
Lemoore	Kings	Lemoore	1920	53,100	52,300	53,100	53,100	[23]53,100	1921	[24]	Citrus, etc., 1,500; truck, 1,000; other, 500	[1]4,386	5	3,004	None	4,500	5,000	9,500
Lindsay-Strathmore	Tulare	Lindsay	1915	15,250	15,250	14,540	[25]9,362	14,540	1928	9,362	Alfalfa, 24,780; pasture, 13,470; grain, 7,385; deciduous, 6,165	682	3	15,200	None	200	3,800	4,000
Littlerock Creek	Los Angeles	Littlerock	1892	3,073	3,040	2,877	2,877	2,877	1927	2,000	Oranges, 7,869; olives, 477; vines, 467; truck, 300; cotton, 184; deciduous, 65	500	2	1,380	895	None	1,500	1,500
Lucerne	Kings	Hanford	1925	33,407	33,407	30,000	[23]30,000	[23]30,000	1921	[26] [9]	Pears, 2,000	85	3	1,240	None	None	250	250
Madera	Madera	Madera	1920	352,000	330,000	222,000	[27]60,000	10,000	1927	60,000	Pasture, 9,230; grain, 7,240; vines, 7,080; deciduous, 6,050; alfalfa, 4,600	325	2	4,400	None	200	1,200	1,400
Maxwell	Colusa	Sacramento	1918	8,820	8,820	6,000	See statement, page 98	See statement, page 98	1927	394	Grain, alfalfa, cotton, and deciduous	2,000	8	143,000	1,350	5,500	6,500	12,000
Merced	Merced	Merced	1919	189,682	185,682	171,700	[28]171,700	171,700	1927	111,858	Rice, 394; duck clubs flooded, 882	31	3	2,438	None	None	5	5
Modesto	Stanislaus	Modesto	1887	81,183	79,000	78,759	78,759	78 759	1927	64,882	Deciduous, 21,509; rice, 16,923; alfalfa, 15,511; vines, 15,437; pasture, 13,264; field crops, 10,704; grain, 7,711; truck, 6,085; cotton, 2,979; other, 1,800; Alfalfa, 14,976; deciduous, 11,992; field crops, 10,862; vines, 10,788; grain, 7,167; truck, 3,170; rice, 1,068; other, 4,859	2,300	5	34,583	None	9,800	11,700	21,500
Mojave River	San Bernardino	Victorville	1917	27,665	27,665	20,000	See statement, page 274	See statement, page 274	1928	[14]1,000	Mostly deciduous	2,000	2	1,148	None	18,200	6,800	25,000
Montague	Siskiyou	Montague	1925	26,117	22,424	18,531	18,531	18,531	1927	None	Irrigation system under construction	150	2	8,158	None	None	100	100
Naglee Burk	San Joaquin	Tracy	1920	2,871	2,871	2,846	2,846	2,846	1928	2,525	Alfalfa, 1,600; grain, 400; field crops, 400; rice, 125	76	4	7,563	None	500	200	700
Nevada	Nevada, Placer	Grass Valley	1921	268,500	267,633	167,789	40,000	40,000	1928	11,704	Deciduous, 6,552; forage crops, 5,152	57	5	656	165	None	250	250
Newport Heights	Orange	Costa Mesa	1918	1,503	1,503	1,503	1,503	1,503	1927	185	Apples, 100; bulbs, 40; citrus, etc., 35; pears, 10	3,117	6	39,374	800	None	5,500	5,500
Newport Mesa	Orange	Costa Mesa	1918	694	694	694	694	694	1927	250	Truck, 250; deciduous not irrigated, 40	503	2	79	None	400	1,100	1,500
Oakdale	Stanislaus, San Joaquin	Oakdale	1909	74,240	74,240	66,800	66,800	66,800	1927	23,150	Alfalfa, 6,117; deciduous, 5,896; field crops, 3,981; vines, 3,180; cotton, 1,303; grain, 1,115; truck, 828; rice, 342; other, 385	[1]170	2	182	None	None	350	350
Oroville-Wyandotte	Butte	Oroville	1919	24,100	24,090	22,390	7,500	10,000	1927	2,797	Olives, 1,090; citrus, 590; deciduous, 500; field crops, 250; figs, 187; truck, 150; alfalfa, 20; avocados, 10	948	5	7,594	747	3,700	2,800	6,500
Palmdale	Los Angeles	Palmdale	1918	4,756	4,698	4,756	[29]740	4,756	1927	740	Pears and apples, 580; field crops, 160	238	6	11,084	None	200	500	700
Palo Verde	Riverside, Imperial	Blythe	1923	88,693	78,504	70,000	70,000	45,000	1926	32,522	Cotton, 20,034; alfalfa, 5,769; pasture, 4,343; grain, 1,217; vines, 884; miscellaneous, 275	[1]174	4	3,880	None	550	65	615
Paradise	Butte	Paradise	1916	11,260	11,260	9,836	4,000	8,000	1927	3,200	Deciduous, 2,600; other, 600	850	2	2,160	Not known	2,000	4,000	6,000
Potter Valley	Mendocino	Potter Valley	1924	5,042	4,905	4,195	4,195	[30]4,195	1928	[3] [0]	Alfalfa, 383; pears, 867; a portion irrigated. A total of 4,138 planted and cultivated	400	1	640	None	None	2,000	2,000
												114	6	915	None	None	301	301

SUMMARY OF STATISTICAL DATA RELATING TO GROSS, ASSESSED, IRRIGABLE, AND IRRIGATED AREAS, AND LAND OWNERSHIPS AND POPULATION IN ACTIVE CALIFORNIA IRRIGATION DISTRICTS, 1927-1928

District	County or counties	Post office	Year formed	Gross area, acres	Area assessed 1927-1928, acres	Irrigable areas reported (without deductions for roads and ditches)			Areas irrigated, as reported by districts			Land holdings, 1927				Population estimates		
						Total irrigable, acres (Note.—In some cases, includes town areas receiving domestic service)	Irrigable with present developed water supply, acres (Note.—In some cases, water available during only part of irrigation season)	Irrigable with present distribution system, acres (Note.—In some cases, only skeleton distribution system provided)	Year of last record	Total irrigated, acres	Crops, with acreages of each if reported (Note.—'Deciduous' includes fruits and nuts; 'Citrus, etc.' includes oranges, lemons, grapefruit, olives, avocados, and other sun-tropical fruits; 'Grain' includes grain hay)	Estimated number of farm holdings	Largest holdings: Number	Largest holdings: Combined area, acres	Areas held by districts under tax deed, acres	Inside cities and towns	Outside cities and towns	Total
Princeton-Cordora-Glenn	Glenn, Colusa	Princeton	1916	13,656	13,656	12,290	12,290	11,800	1927	5,959	Rice, 3,311; deciduous and general crops, 2,648	185	3	3,322	None	None	1,000	1,000
Provident	Glenn, Colusa	Willows	1918	22,805	22,805	21,000	21,000	21,000	1927	8,462	Rice, 8,364; general crops, 98	40	6	15,309	1,859	None	250	250
Ramona	San Diego	Ramona	1925	650	600	585	585	585	1928	30	Alfalfa and corn, 30	[10]160	2	40	None	750	None	750
Riverdale	Fresno	Riverdale	1920	15,830	15,830	14,800	14,000	14,800	1927	[3]14,000	Alfalfa, 10,000; pasture, 2,000; field crops, 1,500; grain, 500	250	2	1,280	None	None	1,200	1,200
San Dieguito	San Diego	Encinitas	1922	3,900	3,850	3,700	3,700	3,700	1928	1,700	Truck, 1,167; avocados, 533; bulbs and flowers, 200; other, 33	200	3	890	20	900	700	1,600
Santa Fe	San Diego	Rancho Santa Fe	1923	9,258	9,258	6,366	6,366	6,366	1927	1,625	Citrus, 716; avocados, 575; truck, 160; deciduous, 134; bulbs, 40	345	3	3,600	None	300	165	465
San Ysidro	San Diego	San Ysidro	1911	497	467	457	457	457	1928	15	Alfalfa, 15	[10]400	1	20	23	1,250	None	1,250
Scott Valley	Siskiyou	Fort Jones	1917	5,125	5,125	4,000	4,000	4,000	1927	4,000	Alfalfa, 2,500; grain, 1,500	27	3	1,641	None	None	100	100
Serrano	Orange	Orange	1927	1,505	None	1,505	1,505	[7]1,505	1928	[8]2,300	Citrus and deciduous	160	------	------	None	None	------	[11]1,800
South Montebello	Los Angeles	Montebello	1922	910	829	894	894	894	1927	810	Citrus, etc., 300; truck, 300; nursery and flowers, 130; alfalfa, 50; deciduous, vines, and berries, 30	[10]214	3	189	None	850	None	850
South San Joaquin	San Joaquin	Manteca	1909	71,112	66,871	66,465	66,465	66,465	1927	52,781	Alfalfa, 20,980; vines, 11,581; grain, 8,816; field crops, 4,727; deciduous, 4,710; truck, 793; other, 1,174	1,979	4	2,580	20	3,600	6,400	10,000
Stinson	Fresno	Helm	1921	11,750	11,150	11,000	9,000	11,000	1928	9,000	Grain, 5,000; cotton, 3,000; alfalfa, 600; field crops, 400	20	4	9,680	None	15	300	315
Table Mountain	Butte	Oroville	1922	1,955	1,955	1,780	1,780	1,780	1927	520	Rice, 448; alfalfa, 55; truck, 15; deciduous, 2	7	3	1,679	None	None	50	50
Terra Bella	Tulare	Terra Bella	1915	12,285	12,285	12,070	4,500	9,000	1927	4,490	Citrus, 1,879; deciduous, 1,051; vines, 841; figs, 437; olives, 222; truck, 60	650	3	1,440	75	150	800	950
Thermalito	Butte	Oroville	1922	3,110	3,040	2,940	2,940	2,940	1927	1,458	Citrus, etc., 842; deciduous, 367; vines, 130; other, 119	371	1	220	None	None	600	600
Tia Juana River	San Diego	San Ysidro	1924	1,511	1,511	1,511	See statement, page 323	See statement, page 323	1928	None	Irrigation system not yet constructed	110	6	240	None	None	150	150
Tracy-Clover	San Joaquin	Tracy	1922	1,084	1,034	984	984	984	1926	740	Alfalfa, 596; field crops, 55; pasture, 50; grain, 38; vines, 1	67	3	248	None	None	60	60
Tranquillity	Fresno	Tranquillity	1918	10,750	10,190	10,650	9,000	10,000	1927	9,000	Alfalfa, 7,000; grain, 2,000	185	3	3,353	444	300	400	700
Tulare	Tulare	Tulare	1889	34,000	34,000	28,000	[3]15,000	20,000	1927	[3]22,000	Alfalfa, field crops, deciduous, and pasture	755	2	4,300	None	None	4,000	4,000
Tule	Lassen	Litchfield	1920	15,015	15,015	9,795	See statement, page 68	See statement, page 68	1928	1,000	Alfalfa, grain, pasture, field crops, truck, and deciduous	75	3	10,033	4,235	20	100	120
Turlock	Stanislaus, Merced	Turlock	1887	181,498	177,082	179,278	179,278	179,278	1927	130,068	Alfalfa, 37,768; field crops, 25,047; grain, 20,692; vines, 14,749; truck, 14,629; deciduous, 11,484; rice, 1,715; other, 3,984	[4]500	3	8,950	None	8,300	12,000	20,300
Vandalia	Tulare	Porterville	1923	1,276	1,276	1,253	1,253	1,253	1927	1,069	Citrus, 1,069	44	1	184	None	None	100	100
Vista	San Diego	Vista	1923	18,162	18,142	14,610	14,610	14,610	1928	3,019	Truck and berries, 1,437; citrus, etc., 1,200; field crops, 155; deciduous and mixed orchards, 105; nursery, bulbs, etc., 47; vines, 25	[2]759	5	4,777	None	250	817	1,067
Walnut	Los Angeles	Rivera	1893	911	911	911	911	911	1927	900	Citrus, etc., 700; walnuts, 180; other, 20	59	3	192	None	None	250	250
Waterford	Stanislaus	Waterford	1913	14,110	13,424	11,425	7,000	11,425	1927	4,865	Deciduous, 1,642; alfalfa, 1,450; citrus, etc., 844; field crops, 506; truck, 155; grain, 82; pasture, 50; other 136	325	1	2,687	None	220	580	800
West Side	San Joaquin	Tracy	1915	11,828	11,828	11,811	11,811	11,811	1927	10,416	Alfalfa, grain, field crops, and deciduous	174	4	2,967	None	None	842	842
West Stanislaus	Stanislaus, Merced	Westley	1920	21,400	21,400	21,390	21,390	21,390	1928	None	Irrigation system under construction	79	6	9,623	None	15	300	315
Woodbridge	San Joaquin	Woodbridge	1924	13,430	13,430	12,930	12,930	12,930	1927	[22]	Vines, alfalfa, field crops, and deciduous	123	4	4,000	None	None	200	200
Totals				3,540,852		3,035,927				1,634,183								330,920

[1] About 8,000 acres, principally grain and cotton, irrigated in 1927 with about 7,250 acre-feet.
[2] Does not include pasture lands which receive gravity water only in years of excess run-off.
[3] Includes areas irrigated by private pumping plants.
[4] District has not yet acquired system.
[5] Based upon preliminary water-supply study by district engineer.
[6] No record of area irrigated. Mostly fruit, except 340 acres of hops.
[7] Distribution system owned by mutual companies.
[8] Carpenter and Serrano districts combined area.
[9] Irrigated entirely from privately-owned systems.
[10] Includes residential holdings.
[11] Includes 42,500 acres irrigated entirely from private wells.
[12] Area reported as irrigated in 1927. See statement page 257.
[13] Practically entire area has been planted to grain and irrigated partially. There are some small areas of alfalfa in southeastern portion of district.
[14] No district system yet; irrigation from private wells.
[15] Area reported irrigated in 1927, including 29,611 acres irrigated solely by private pumps. District reports that present rights accrued by use, together with reasonable proportion of flood waters, will supply reasonable water demand for entire irrigable area after suitable reservoir regulation is available.
[16] Irrigable area difficult to determine. District states that all except about 3,000 acres has been irrigated at some time.
[17] Water now supplied by Lake Hemet Water Company, and from wells.
[18] District does not own distribution system. Water is delivered into channel of Pit River for diversion by private ditches.
[19] Practically all lands receive supplemental supply from private wells.
[20] Area irrigated solely by private pumps.
[21] Total area planted; about 300 acres irrigated.
[22] Area irrigated in 1927, all of which received some water from wells. See statement page 261.
[23] Distribution system owned entirely by individuals and mutual companies.
[24] Crop survey made in 1921. Very little change since that time. Crops reported include those not irrigated.
[25] Area irrigated in 1927 with 13,312 acre-feet. Diversions are regulated by court order.
[26] Crop survey made in 1921. Crops reported exceed total area in district.
[27] 10,000 acres under system of Madera Canal and Irrigation Company; 50,000 acres under private pumping plants.
[28] Includes 10,000 acres supplied entirely from private wells.
[29] Area irrigated in 1927. See statement page 268.
[30] Irrigation system under construction.
[31] Maximum area estimated to have been irrigated in any year with gravity water.
[32] Area reported irrigated by Stockton and Mokelumne Canal in 1913, 10,634 acres; from 1920 to 1926, 4,127 to 8,714 acres.
[33] District usually takes tax deed only on disposal of property.

TABLE II. SUMMARY OF STATISTICAL DATA RELATING TO ASSESSED VALUATIONS PER ACRE, ASSESSMENT RATES, IRRIGATION WATER TOLLS, AND ANNUAL ASSESSMENTS PER ACRE, IN ACTIVE CALIFORNIA IRRIGATION DISTRICTS, 1927-1928

NOTE.—Table does not include active districts in which neither assessments nor water tolls were levied for 1927-1928. For summary of data relating to domestic rates see Table III

District	Assessed valuation per acre exclusive of town lots			Assessment rate each $100 valuation	Irrigation water tolls charged in addition to assessments levied NOTE—1 statute inch=1-40 cubic foot per second=approximately 1-20 acre-foot in 24 hours. 1 customary inch=1-50 cubic foot per second=approximately 1-25 acre-foot in 24 hours. 1 cubic foot per second=approximately 2 acre-feet in 24 hours	Basis of water delivery, irrigation service	Annual assessment per acre on land of usual valuation		
	High	Low, other than nominal	Usual on irrigable land				1925–1926	1926–1927	1927–1928
Alpaugh	$60 00	$25 00	$60 00	$10 00	$1 for 200 customary inches for 1 hour, inside district; $1.50, outside district.	10 acres	$6 00	$6 00	$6 00
Alta	60 00	10 00	60 00	2 85	None	Existing main canals	1 92	1 60	1 59
Anderson-Cottonwood	75 00	50 00	50 00	8 50	None	Each farm, about 80 acres	4 25	4 25	4 25
Banta-Carbona	150 00	130 00	150 00	5 00	$2.75 per acre foot	160 acres	5 50	5 50	7 50
Baxter Creek	50 00	50 00	50 00	2 00	$3 per acre	Existing laterals	6 00	3 00	1 00
Beaumont	100 00	100 00	100 00	9 50	$7 per acre	10 acres	10 00	9 50	9 50
Browns Valley	-------	-------	-------	None	1 statute inch for entire year, $4; 1 statute inch April 1 to September 1, $2.50.	About 40 acres	None	None	None
Butte Valley	40 00	40 00	40 00	6 50	None	160 acres	2 32	2 60	2 60
Byron-Bethany	200 00	75 00	200 00	4 10	$3.50 per acre-foot	160 acres	6 00	6 60	8 20
Camp Far West	150 00	20 00	150 00	5 00	None	Each ownership (6 only)	1 90	7 50	7 50
Carmichael	80 00	80 00	80 00	7 00	$2.50 per acre irrigated	Each 10 acres	8 80	6 40	5 60
Citrus Heights	100 00	100 00	100 00	10 00	None	Each 10 acres	10 00	10 00	10 00
Compton-Delevan	75 00	75 00	75 00	4 35	Rice, $7 per acre; general crops, $2 per acre.	80 acres	8 38	4 20	3 26
Consolidated	110 00	30 00	100 00	2 20	City lots with water rights $2.25 per lot	Main laterals	2 20	2 20	2 20
Corcoran	100 00	100 00	100 00	1 35	$1 per acre per irrigation of 6 acre-inches	640 acres	1 65	1 65	1 35
Cordua	75 00	65 00	75 00	5 43	Rice, $3 per acre; general crops, $1.25 per acre.	160 acres	3 80	4 36	4 07
Crescent	50 00	10 00	35 00	1 00	None	Main laterals	44	35	35
Deer Creek	100 00	40 00	100 00	3 13	None	Each ownership (13 only)	None	None	3 13
East Contra Costa	190 00	160 00	190 00	4 00	$4 per acre-foot	10 to 40 acres	-------	7 46–7 84	7 60
El Camino	125 00	62 50	125 00	7 50	None	About 13 acres	25	25	9 37
El Dorado	155 00	30 00	75 00	80	1 statute inch 120 days, continuous flow, $34; 1 statute inch 120 days, cumulative flow, $38; 1 statute inch for 24 hours, $0.45.	Main laterals	None	60	60
Fairoaks	90 00	90 00	90 00	4 75	$2.50 per acre on non-irrigated land; $5 per acre on irrigated land.	5 acres	3 82	4 72	4 27
Fallbrook	150 00	85 00	85 00	60	None	Not operating	53	96	51
Foothill	100 00	20 00	60 00	None	None	Not operating	1 20	None	None
Fresno	100 00	50 00	100 00	2 50	No water toll charged. Assessed valuation reduced 40% on land receiving no water service.	Main laterals, 20 to 640 acres	2 40	2 40	2 50

TABLE II. SUMMARY OF STATISTICAL DATA RELATING TO ASSESSED VALUATIONS PER ACRE, ASSESSMENT RATES, IRRIGATION WATER TOLLS, AND ANNUAL ASSESSMENTS PER ACRE, IN ACTIVE CALIFORNIA IRRIGATION DISTRICTS, 1927-1928—Continued

NOTE.—Table does not include active districts in which neither assessments nor water tolls were levied for 1927-1928. For summary of data relating to domestic rates see Table III

District	Assessed valuation per acre exclusive of town lots			Assessment rate each $100 valuation	Irrigation water tolls charged in addition to assessments levied NOTE—1 statute inch=1-40 cubic foot per second=approximately 1-20 acre-foot in 24 hours. 1 customary inch=1-50 cubic foot per second=approximately 1-25 acre-foot in 24 hours. 1 cubic foot per second=approximately 2 acre-feet in 24 hours	Basis of water delivery, irrigation service	Annual assessment per acre on land of usual valuation		
	High	Low, other than nominal	Usual on irrigable land				1925–1926	1926–1927	1927–1928
Glenn-Colusa	$44 00	$40 00	$44 00	$6 50	Rice, $5 per acre; general crops $1 per acre; one irrigation, $0.50 per acre.	Main laterals	$2 86	$2 86	$2 86
Grenada	200 00	60 00	200 00	7 50	None	40 acres	14 90	13 00	15 00
Hot Spring Valley	30 00	15 00	20 00	10 00	None	Stored water delivered to channel of Pitt River.	1 72	2 00	2 00
Imperial	150 00	40 00	100 00	5 00	Service charge of $0.25 per gate for each day of delivery.	160 acres	5 00	5 00	5 00
Island No. 3	60 00	18 00	40 00	25	None. See statement, page 220	Main laterals	10	10	10
Jacinto	60 00	60 00	60 00	4 75	General crops, $1 per acre; single irrigation, $0.50 per acre.	40 acres	2 85	2 85	2 85
James	150 00	25 00	150 00	4 66	$1.75 per acre per irrigation	40 acres	4 50	4 50	7 00
La Canada	1,500 00	1,000 00	1,000 00	1 25	First 800 cubic feet, $2 per month, minimum. Over 800 cubic feet per month, $0.10 per 100 cubic feet.	5 acres	6 10	13 50	12 50
Ladera	400 00	200 00	400 00	1 00	None	Not operating	1 33	1 33	4 00
Laguna	100 00	60 00	100 00	1 85	None	Main laterals	2 40	2 00	1 85
Lakeland	100 00	100 00	100 00	2 52	$0.75 per acre-foot	Distribution system owned by individuals and mutual companies.	1 55	1 99	2 52
Lakeside	150 00	25 00	100 00	4 25	First 1,000 cubic feet, $2 per month, minimum. Over 1,000 cubic feet per month $0.05 per 100 cubic feet.	4 acres	2 67	3 50	4 25
La Mesa, Lemon Grove, and Spring Valley.	500 00	125 00	300 00	2 45	See statement, page 316	Small units	--------	7 50	7 35
Lemoore	100 00	50 00	100 00	None	None by district. See statement, page 241.	Distribution system owned by mutual companies	30	None	None
Lindsay-Strathmore	175 00	175 00	175 00	13 73	$10 per acre-foot	10 acres	12 18	13 51	24 03
Littlerock Creek	100 00	100 00	100 00	9 50	None	Concrete pipes	8 75	9 50	9 50
Madera	180 00	5 00	60 00	30	None	Not operating	None	None	18
Maxwell	100 00	100 00	100 00	23 80	Rice, per acre	160 acres	15 46	18 00	23 80
Merced	200 00	--------	150 00	6 00	See statement, page 190	160 acres	10 65	9 15	9 00
Modesto	150 00	70 00	70 00–90 00	6 00	None	Main laterals	4 20–5 40	4 20–5 40	4 20–5 40
Mojave River	20 00	15 00	20 00	1 00	None	Not operating	20	20	20
Montague	125 00	10 00	125 00	90	None	Not operating	19	25	1 13

Naglee Burk	100 00	100 00	100 00	9 00	None	160 acres	9 00	8 70	9 00
Nevada	300 00	25 00	25 00–180 00	None	$0.05 to $0.12½ per statute inch for 24 hours.	Main laterals	None	None	None
Newport Heights	1,500 00	300 00	800 00	1 25	See statement, page 288	5 acres	8 00	9 00	10 00
Newport Mesa	600 00	600 00	600 00	2 00	See statement, page 286	5 acres	9 60	12 00	12 00
Oakdale	135 00	10 00	60 00–135 00	6 50	None	Main laterals	3 60–8 10	3 60–8 10	3 90–8 78
Oroville-Wyandotte	100 00	85 00	100 00	2 00	1 customary inch per 24 hours, $0.20; 1 statute inch per 24 hours, $0.25.	No fixed unit	2 00	2 00	2 00
Palmdale	100 00	100 00	100 00	9 25	None	40 acres	7 75	9 25	9 25
Palo Verde	100 00	37 50	100 00	13 84	None	160 acres	13 59	10 68	13 84
Paradise	90 00	60 00	60 00	7 50	None	Each ownership, average 24 acres.	4 50	4 50	4 50
Princeton-Codora-Glenn	70 00	65 00	65 00–70 00	4 30	Rice, $5 per acre; general crops, $1.75 per acre.	Each holding, average 60 acres.	2 76–3 23	2 76–3 23	2 58–3 01
Provident	80 00	60 00	75 00	8 50	Rice, $6 per acre; general crops, $1.50 per acre; flooding, $2.50 per acre.	160 acres	6 73	6 80	6 38
Ramona	50 00	40 00	50 00	8 00	First 1,000 cubic feet, $2 per month, minimum. Over 1,000 cubic feet, per month, $0.08 per 100 cubic feet.	10 acres	None	1 00	4 00
Riverdale	75 00	75 00	75 00	3 00	None	Main canal	2 25	2 25	2 25
San Dieguito	900 00	100 00	400 00	2 75	$0.03 per 100 cubic feet, effective July 1, 1928.	5 to 40 acres	16 00	16 00	11 00
Santa Fe	450 00	25 00	200 00	6 27	$0.03 per 100 cubic feet, with minimum charge of $1 to $3 per month.	10 acres	11 76	12 08	12 54
San Ysidro	260 00	260 00	260 00	4 00	See statement, page 325	1 acre	10 40	10 40	10 40
Scott Valley	50 00	50 00	50 00	9 00	None	Each holding, average 190 acres.	4 00	4 00	4 50
South Montebello	850 00	850 00	850 00	2 00	See statement, page 280	5 acres	17 00	17 00	17 00
South San Joaquin	125 00	20 00	100 00	6 45	None	40 acres	6 30	6 30	6 45
Stinson	50 00	50 00	50 00	8 50	Gravity water, none; pumped water, actual cost of pumping.	40 acres	4 25	4 25	4 25
Table Mountain	125 00	125 00	125 00	4 90	Rice, $6 per acre; alfalfa, $3 per acre	Each ownership	4 17	3 38	6 13
Terra Bella	100 00	100 00	100 00	8 75	$11 per acre-foot, 1927	10 acres	8 50	7 50	8 75
Thermalito	150 00	150 00	150 00	7 20	None	Each holding, average 7 acres.	9 00	11 02	10 80
Tia Juana River	300 00	300 00	300 00	67	None	Not operating	6 00	3 00	2 00
Tracy Clover	100 00	100 00	100 00	8 50	None	10 acres	7 50	8 50	8 50
Tranquillity	150 00	150 00	150 00	2 00	None	40 acres	4 50	3 45	3 00
Tulare	100 00	-------	60 00	60	$1 per acre irrigated	Main laterals	54	45	36
Tule	50 00	50 00	50 00	2 00	$2 per acre	Main laterals	6 00	3 00	1 00
Turlock	125 00	40 00	100 00	4 50	None	Main laterals	4 50	4 50	4 50
Vandalia	200 00	200 00	200 00	9 00	$8.50 per acre-foot	Each holding, average about 20 acres.	16 50	18 00	18 00
Vista	200 00	130 00	160 00	7 85	See statement, page 300	40 acres	2 03	7 95	12 57
Walnut	1,000 00	1,000 00	1,000 00	1 00	100 customary inches per hour, $0.50; 200 customary inches, per hour, $1.	Main pipe lines	5 00	5 00	10 00
Waterford	200 00	5 00	120 00	5 30	None	Main laterals	5 94	6 24	6 35
West Side	100 00	100 00	100 00	4 50	$2.50 per acre-foot	160 acres	9 00	6 00	4 50
West Stanislaus	55 00	16 75	24 00	None	None	Not operating	None	24	None
Woodbridge	100 00	25 00	100 00	80	See statement, page 145	Main laterals	70	None	80

TABLE III. SUMMARY OF DATA RELATING TO CHARGES FOR DOMESTIC WATER SERVICE BY TWENTY-FIVE CALIFORNIA IRRIGATION DISTRICTS, 1928

District	Charges
Alpaugh	**Inside district:** First 4,000 gallons or less, $1.50 per month minimum; over 4,000 gallons per month, $0.10 per 1,000 gallons. **Inside town of Alpaugh:** First 4,000 gallons or less, $2.50 per month minimum; over 4,000 gallons per month, $0.15 per 1,000 gallons.
Beaumont	First 650 cubic feet or less, $1.25 per month minimum; over 650 cubic feet per month, $0.10 per 100 cubic feet.
Carmichael	Domestic water service furnished but with no special charge.
Citrus Heights	Domestic water service furnished but with no special charge.
El Dorado	**Flat rate:** $1.25 per month per service. **Meter rate:** 500 cubic feet or less, $1.25 per month minimum; next 1,500 cubic feet per month, $0.12 per 100 cubic feet; over 2,000 cubic feet per month, $0.06 per 100 cubic feet.
Fairoaks	$18 per year.
La Canada	First 800 cubic feet or less, $2 per month minimum; over 800 cubic feet per month, $0.10 per 100 cubic feet.
Lakeside	First 1,000 cubic feet or less, $2 per month minimum; over 1,000 cubic feet per month, $0.05 per 100 cubic feet.
La Mesa, Lemon Grove, and Spring Valley	**Inside district:** First 1,000 cubic feet per month, $0.15 per 100 cubic feet; next 2,000 cubic feet per month, $0.10 per 100 cubic feet; over 3,000 cubic feet per month, $0.06 per 100 cubic feet. Minimum charges, $1 to $12 per month. **Outside district:** First 1,000 cubic feet per month, $0.25 per 100 cubic feet; next 2,000 cubic feet per month, $0.15 per 100 cubic feet; over 3,000 cubic feet per month, $0.08 per 100 cubic feet. Minimum charges, $1 to $12 per month.
Lindsay-Strathmore	$20 per acre-foot.
Littlerock Creek	Domestic water service furnished but with no special charge.
Newport Heights	$1 per month per service.
Newport Mesa	House on 50-foot lot, $1 per month; court or apartment house, $1 per month minimum; $0.50 per month per apartment.
Oroville-Wyandotte	Flat rates by agreement. Service rendered inside and outside of district
Palmdale	**Inside town:** $3 per month. **Outside town:** $3.25 per month.
Paradise	Domestic water service furnished but with no special charge.
Ramona	First 1,000 cubic feet or less, $2 per month minimum; over 1,000 cubic feet per month, $0.08 per 100 cubic feet.
San Dieguito	$0.07½ per 100 cubic feet. Minimum charge $1 per month.
Santa Fe	First 1,000 cubic feet per month, $0.15 per 100 cubic feet; next 4,000 cubic feet per month, $0.10 per 100 cubic feet; over 5,000 cubic feet per month, $0.08 per 100 cubic feet. Minimum charge, $1 to $3 per month.
San Ysidro	House and lot $2 per month; extra house, $1 per month.
South Montebello	First 800 cubic feet or less, $1 per month minimum; next 2,200 cubic feet per month, $0.05 per 100 cubic feet; over 3,000 cubic feet per month, $0.01½ per 100 cubic feet.
Terra Bella	First 500 cubic feet or less, $1.50 per month minimum; next 10,000 cubic feet per month, $0.02½ per 100 cubic feet; over 10,500 cubic feet per month, $0.05 per 100 cubic feet.
Thermalito	$9 per year. No charge for domestic service if irrigation water is served to 5 acres or more.
Vandalia	First 500 cubic feet or less, $1.50 per month minimum; over 500 cubic feet per month, $0.02 per 100 cubic feet.
Vista	First 500 cubic feet per month, $0.20 per 100 cubic feet; next 1,500 cubic feet, per month, $0.15 per 100 cubic feet; next 3,000 cubic feet per month, $0.10 per 100 cubic feet; over 5,000 cubic feet per month, $0.07 per 100 cubic feet. Minimum charges, $1 to $2 per month.

SUMMARY OF TOTAL ASSESSMENTS LEVIED, TAX CERTIFICATES SOLD AND UNREDEEMED, PERCENTAGES OF ASSESSMENTS DELINQUENT, AND WATER TOLLS COLLECTED IN ACTIVE CALIFORNIA IRRIGATION DISTRICTS

TABLE IV

Name of district	Total assessments levied years 1924-25 to 1926-27			Tax certificates sold, including penalties, costs, and interest			Unredeemed tax certificates January 1, 1928, for assessment years 1924-25 to 1926-27			Percentage of assessment delinquent on date of tax sale for assessment years 1924-25 to 1926-27			Percentage of assessment remaining unpaid January 1, 1928, for assessment years 1924-25 to 1926-27			Water tolls collected 1925 to 1927			Assessment, 1927-28					Assessment, 1928-29		
	1924–25	1925–26	1926–27	1924–25	1925–26	1926–27	1924–25	1925–26	1926–27	1924–25	1925–26	1926–27	1924–25	1925–26	1926–27	1925	1926	1927	Total assessed valuation	Rate per $100 of valuation	Total assessment levied	Tax certificates sold	Percentage of assessment delinquent on date of tax sale	Total assessed valuation	Rate per $100 of valuation	Total assessment levied
Alpaugh	41,408	39,583	39,437	16,246	13,018	12,380	5,983	9,253	10,533	35.6	29.8	28.6	13.2	21.2	24.2	46,526	34,758	28,286	[3]395,826	10.00	39,582	15,097	34.6	390,214	12.00	47,353
Alta	106,877	179,543	148,804	16,370	24,294	19,332	3,750	9,971	12,499	14.0	12.3	11.8	3.2	5.0	7.6	None	None	None	[5]5,387,930	2.85	153,556	18,532	10.9	5,349,775	2.63	140,887
Anderson-Cottonwood	128,115	121,782	119,475	18,745	12,542	9,911	3,580	6,653	8,000	13.3	9.4	7.5	2.5	5.0	6.1	None	None	None	[1]1,398,200	8.50	118,847	18,958	14.5	1,405,641	8.50	119,478
Banta-Carbona	64,064	77,868	78,701	1,864	2,286	3,918	994	586	1,773	12.6	2.7	4.6	1.4	0.7	2.0	None	16,368	40,154	2,063,684	5.00	103,185	942	0.8	2,158,036	5.00	[3]107,901
Baxter Creek	51,544	51,485	25,380	34,701	46,001	24,717	27,786	41,035	22,384	61.2	81.3	88.5	49.0	72.4	80.0	----------	----------	4,000	[4]421,086	2.00	8,421	----------	----------	----------	----------	----------
Beaumont	24,101	38,189	36,269	3,491	5,073	5,721	2,017	3,967	4,837	13.1	12.1	14.3	7.6	9.4	12.1	31,074	29,926	28,808	381,620	9.50	36,266	6,710	16.8	400,140	11.00	44,015
Big Springs	None	None	None	None	None	None	None	None	None	----------	----------	----------	----------	----------	----------	None	None	None	None	None	None	None	----------	453,125	0.70	3,171
Browns Valley	None	None	None	None	None	None	None	None	None	----------	----------	----------	----------	----------	----------	5,472	5,655	5,780	None	None	None	None	----------	None	None	None
Butte Valley	22,859	35,549	48,571	[4]	[4]	[4]	[3]3,196	[7]7,406	[5]24,002	[4]	[4]	[4]	12.7	19.0	45.0	None	None	None	771,375	6.50	50,139	12,939	23.5	602,493	6.50	39,595
Byron-Bethany	48,995	61,057	61,053	1,568	3,355	5,989	1,325	3,346	5,917	2.9	5.0	8.9	2.4	5.0	8.8	33,566	38,585	33,145	1,720,644	4.10	70,546	5,814	7.5	1,706,893	4.10	69,967
Camp Far West	4,475	4,475	17,481	None	None	None	None	None	None	0.0	0.0	0.0	0.0	0.0	0.0	None	None	None	352,025	5.00	17,601	None	0.0	349,625	3.00	10,488
Carmichael	21,794	27,364	19,890	4,369	4,238	2,866	1,238	2,442	2,231	18.2	14.1	13.1	5.2	8.1	10.2	4,442	4,590	4,525	248,662	7.00	17,475	3,180	16.5	249,262	8.00	[1]19,940
Carpenter	None	None	None	None	None	None	None	None	None	----------	----------	----------	----------	----------	----------	None	None	None	None	None	None	None	----------	None	None	None
Citrus Heights	24,443	30,763	30,765	771	1,736	1,770	42	782	1,770	2.9	5.1	5.2	0.2	2.3	5.2	None	None	None	307,658	10.00	30 765	2,091	6.2	315,796	10.00	31,579
Compton-Delevan	78,814	99,964	50,164	7,662	7,061	3,442	3,672	6,858	3,442	8.8	6.4	6.2	4.2	6.2	6.2	21,708	28,788	18,867	894,090	4.35	38,870	336	0.8	894,090	4.35	38,870
Consolidated	199,169	221,594	227,341	26,637	16,135	14,028	3,294	4,801	7,429	12.3	6.6	5.6	1.5	2.0	3.0	[3]3,694	[3]3,312	[2]2,743	10,469,075	2.20	230,319	14,074	5.6	10,523,634	2.20	231,519
Corcoran	72,214	86,732	84,995	4,899	9,990	4,212	[7]	[7]	[7]	6.2	10.5	4.5	[7]	[7]	[7]	2,593	5,921	20,238	5,160,551	1.35	69,537	9,380	12.3	5,160,551	[2]2.08	[3]106,959
Cordua	26,349	19,379	22,221	4,487	99	384	3,580	None	384	15.5	0.5	1.6	12.4	0.0	1.6	None	4,925	4,210	390,162	5.43	21,186	3,558	15.3	390,779	5.25	20,515
Crescent	None	5,997	4,799	None	None	29	None	None	29	----------	0.0	0.5	----------	0.0	0.5	None	None	None	479,960	1.00	4,799	12	0.2	479,960	None	None
Deer Creek	None	None	None	None	None	None	None	None	None	----------	----------	----------	----------	----------	----------	None	None	None	150,714	3.13	4,717	None	----------	177,713	4.30	6,495
East Contra Costa	----------	----------	142,039	None	[2]2,522	880	None	900	218	----------	----------	0.6	----------	----------	0.1	----------	----------	59,934	3,615,344	4.00	145,508	982	0.6	3,626,201	3.73	135,102
El Camino	None	1,887	1,887	[10]None	[10]None	[10]None	----------	----------	----------	----------	----------	----------	----------	----------	----------	None	None	None	[7]750,690	7.50	56,301	461	0.7	943,480	4.80	45,287
El Dorado	None	None	17,141	None	None	330	None	None	277	----------	----------	1.8	----------	----------	1.5	None	50,120	51,132	2,016,129	0.80	16,129	412	2.3	2,103,731	0.80	16,109
Fairoaks	14,437	14,361	17,790	2,231	3,185	3,836	725	1,558	2,502	14.1	20.2	19.6	4.6	9.8	13.0	24,967	20,619	21,822	339,260	4.75	16,115	2,747	15.5	339,815	4.75	16,141
Fallbrook	None	5,488	10,424	None	161	238	None	97	174	----------	2.7	2.1	----------	1.6	1.5	None	None	None	895,787	0.60	5,372	160	2.7	919,733	1.65	15,175
Foothill	None	59,613	None	None	10,281	None	None	6,332	None	----------	15.7	----------	----------	9.6	----------	None	None	None	None	None	None	None	----------	2,849,999	2.25	66,483
Fresno	464,976	446,362	441,867	66,246	66,733	29,947	6,844	9,299	17,681	13.0	13.6	6.2	1.3	1.9	3.6	None	None	None	18,396,800	2.50	459,913	25,062	5.0	18,424,164	2.50	460,604
Glenn-Colusa [11]	323,207	327,800	365,571	50,903	55,253	90,635	23,238	47,095	79,236	14.3	15.3	22.5	6.4	13.1	19.7	122,559	197,389	155,276	4,981,274	6.50	349,086	76,074	19.8	5,020,906	6.50	334,280
Grenada	46,197	43,303	40,113	12,095	19,267	20,992	10,423	18,492	20,856	23.9	40.5	47.5	20.6	38.8	47.3	None	None	None	597,098	7.50	44,782	27,495	55.8	871,597	6.72	58,571
Hemet	None	None	None	None	None	None	None	None	None	----------	----------	----------	----------	----------	----------	None	None	None	None	None	None	None	----------	1,034,795	0.90	9,313
Hot Spring Valley	16,267	16,267	18,875	4,934	2,126	5,137	105	482	2,180	27.5	11.9	24.7	0.6	2.7	10.5	None	None	None	188,759	10.00	18,875	4,122	19.9	188,759	10.00	18,875
Imperial	2,120,594	2,376,092	2,444,903	327,997	331,997	423,502	130,415	200,419	358,613	14.1	12.7	15.8	5.6	7.7	13.4	253,593	82,956	82,307	48,402,214	5.00	2,420,110	419,797	15.8	48,263,664	5.00	2,413,183
Island No. 3	491	487	482	152	113	97	30	30	23	28.0	21.0	18.3	5.6	5.6	4.3	[12]	[12]	[12]	192,027	0.25	480	None	0.0	209,489	None	None
Jacinto	32,819	32,809	32,809	1,430	1,626	1,692	818	896	1,356	4.0	4.5	4.7	2.3	2.5	3.8	2,128	2,374	2,719	688,882	4.75	32,721	9,722	27.0	687,654	4.75	32,958
James	108,600	108,648	108,546	142	3,421	37,690	142	3,421	37,690	0.1	2.9	31.6	0.1	2.9	31.6	47,972	36,178	59,844	3,620,938	4.66	168,733	186,484	100.0	3,612,923	4.70	169,806
La Canada	7,119	7,476	16,755	None	61	153	None	None	20	0.0	0.7	0.8	0.0	0.0	0.1	None	10,216	12,535	1,366,355	1.25	17,080	142	0.8	1,373,310	1.75	24,035
Ladera	1,807	3,616	3,791	495	873	403	None	83	369	24.9	22.0	9.7	0.0	2.1	8.9	None	None	None	771,976	1.00	7,719	1,377	16.2	778,506	0.25	1,929
Laguna	62,902	78,511	64,133	11,028	6,289	8,183	1,754	2,613	2,973	15.9	7.3	11.6	2.5	3.0	4.2	None	None	None	3,197,000	1.85	59,512	6,400	9.8	[3]3,089,200	1.85	57,150
Lakeland	48,738	39,674	46,494	167	289	175	167	136	175	0.3	0.7	0.3	0.3	0.3	0.3	512	290	4,943	2,328,277	2.52	58,611	3,486	5.4	2,328,277	2.59	60,200
Lakeside	None	3,640	3,720	None	None	1,345	None	None	1,319	----------	0.0	32.7	----------	0.0	32.2	101	1,284	3,616	118,608	4.25	5,041	[4]117	----------	117,818	4.25	5,007
La Mesa, Lemon Grove and Spring Valley	16,500	85,000	140,398	[3]350	[3]321	[5]5,448	[13]718	[13]1,590	[13]6,615	----------	----------	----------	----------	----------	----------	33,035	163,519	139,113	6,274,841	2.45	153,705	[4]13,980	----------	6,150,079	2.60	159,902
Lemoore	None	14,041	None	None	616	None	None	433	None	----------	4.0	----------	----------	2.8	----------	None	None	None	None	None	None	None	----------	None	None	None
Lindsay-Strathmore	181,145	170,505	188,925	25,998	33,366	33,482	18,581	20,983	30,955	13.1	17.8	16.1	9.3	11.2	14.9	116,636	142,886	135,054	[2]2,365,717	[14]13.73	[14]324,813	99,070	27.8	2,165,631	[14]13.73	[14]297,339
Litlerock Creek	26,815	26,814	29,027	11,039	14,044	12,356	----------	[11]11,297	[11]10,340	37.3	47.5	38.7	----------	[15]38.2	[15]32.2	None	None	None	310,462	9.50	29,500	9,218	28.4	309,651	9.50	29,295
Lucerne	None	None	None	None	None	None	None	None	None	----------	----------	----------	----------	----------	----------	None	None	None	None	None	None	None	----------	None	None	None
Madera	None	None	None	None	None	None	None	None	None	----------	----------	----------	----------	----------	----------	None	None	None	20,500,670	0.30	61,502	8,163	12.0	----------	None	None
Maxwell	63,060	136,350	158,751	46,709	148,539	174,583	46,531	148,539	174,583	67.3	99.0	100.0	67.0	99.0	100.0	24,158	22,504	12,894	[3]881,955	23.80	209,905	230,911	100.0	881,955	27.83	245,448
Merced	934,932	1,524,589	1,321,528	78,766	118,915	127,767	24,048	50,294	95,807	7.7	7.1	8.8	2.3	3.0	6.6	None	None	None	20,636,465	6.00	1,238,187	116,454	8.6	20,686,900	6.00	[1]1,241,214
Modesto	476,229	445,774	445,926	23,766	14,045	15,777	2,105	2,687	9,524	4.5	2.9	3.2	0.4	0.5	1.9	None	None	None	7,436,880	6.00	446,212	4,747	1.0	7,439,720	5.60	416,624
Mojave River	6,741	5,393	5,393	5,265	4,027	4,002	3,992	4,002	3,857	71.0	68.0	67.6	53.9	67.6	65.1	None	None	None	539,327	1.00	5,393	3,857	65.1	539,327	1.00	5,393
Montague	None	3,668	4,774	None	362	209	None	26	201	----------	8.9	4.0	----------	0.6	3.8	None	None	None	2,191,183	0.90	19,717	1,960	9.0	2,138,868	2.00	42,777
Naglee-Burk	22,519	25,617	25,612	4,665	4,729	2,496	1,337	2,552	2,296	18.9	16.8	8.9	5.4	9.0	8.2	None	None	None	284,524	9.00	25,622	----------	----------	264,705	9.00	23,823
Nevada	3,541	None	None	208	None	None	[16]7	None	None	5.3	----------	----------	[16]0.2	----------	----------	None	19,357	71,150	13,969,106	None	None	None	----------	13,839,145	None	None
Newport Heights	14,517	12,936	14,812	934	375	798	7	12	224	5.8	2.6	4.9	0.1	0.1	1.4	6,216	5,528	5,802	1,349,028	1.25	16,862	1,128	6.1	1,428,845	1.25	17,860
Newport Mesa	8,989	6,750	8,435	442	335	78	None	None	39	4.5	4.5	0.8	0.0	0.0	0.4	2,724	2,501	2,014	421,707	2.00	8,434	456	4.9	421,751	2.00	8,435
Oakdale	239,568	239,809	240,480	24,985	17,216	22,853	8,243	8,359	20,228	9.5	6.5	8.6	3.1	3.2	7.6	None	None	None	4,346,260	6.50	282,506	26,260	8.5	4,300,000	6.50	279,500
Oroville-Wyandotte	44,129	44,247	44,749	5,602	5,910	6,174	[17]699	[17]1,751	[17]3,371	11.6	12.2	12.5	[17]1.4	[17]3.6	[17]6.8	14,271	11,582	15,003	2,235,320	2.00	44,798	1,755	3.6	2,229,485	2.00	44,589
Palmdale	37,007	9,565	76,535	4,771	None	60,047	2,030	None	55,971	11.7	----------	71.4	5.0	----------	66.6	3,336	3,801	3,914	479,812	9.25	44,382	28,481	58.2	479,812	7.62	36,561
Palo Verde	None	685,081	519,927	[22]	[22]	[22]	[22]	[22]	[22]	[22]	[22]	[22]	[22]	[22]	[22]	None	None	None	4,787,831	13.84	613,509	175,162	26.0	4,974,780	17.34	758,365
Paradise	46,030	45,959	45,978	7,182	7,851	9,290	3,932	5,546	7,807	14.2	15.6	18.4	7.8	11.0	15.5	None	None	None	618,525	7.50	46,390	11,061	21.8	620,203	7.50	46,516

SUMMARY OF TOTAL ASSESSMENTS LEVIED, TAX CERTIFICATES SOLD AND UNREDEEMED, PERCENTAGES OF ASSESSMENTS DELINQUENT, AND WATER TOLLS COLLECTED IN ACTIVE CALIFORNIA IRRIGATION DISTRICTS

Name of district	Total assessments levied years 1924-25 to 1926-27			Tax certificates sold, including penalties, costs, and interest			Unredeemed tax certificates January 1, 1928, for assessment years 1924-25 to 1926-27			Percentage of assessment delinquent on date of tax sale for assessment years 1924-25 to 1926-27			Percentage of assessment remaining unpaid January 1, 1928, for assessment years 1924-25 to 1926-27			Water tolls collected 1925 to 1927			Assessment, 1927-28					Assessment, 1928-29		
	1924–25	1925–26	1926–27	1924–25	1925–26	1926–27	1924–25	1925–26	1926–27	1924–25	1925–26	1926–27	1924–25	1925–26	1926–27	1925	1926	1927	Total assessed valuation	Rate per $100 of valuation	Total assessment levied	Tax certificates sold	Percentage of assessment delinquent on date of tax sale	Total assessed valuation	Rate per $100 of valuation	Total assessment levied
Potter Valley	2,086	None	2,121	None	None	None	None	None	None	0.0		0.0	0.0		0.0	None	None	None	None	None	None	None		256,585	2.50	6,414
Princeton-Codora-Glenn	33,451	42,734	42,723	2,633	2,913	2,651	268	1,349	2,044	7.1	6.2	5.6	0.7	2.9	4.3	14,897	18,060	19,149	[18]939,270	4.30	39,829	5,033	11.5	939,270	4.50	40,768
Provident	137,434	145,090	146,553	32,573	32,646	32,975	[19]	[19]	[19]	21.6	20.5	20.5	[19]	[19]	[19]	47,462	52,306	51,770	1,616,520	8.50	137,404	39,007	25.9	1,616,520	8.50	137,404
Ramona	None	None	1,353	None	None	42	None	None	36			2.8			2.4	None	None	3,456	68,767	8.00	6,301	94	1.4	72,600	7.00	5,082
Riverdale	31,395	33,637	33,637	434	1,354	868	138	239	868	1.3	3.6	2.3	0.4	0.6	2.3	None	None	None	1,121,256	3.00	33,637	1,338	3.6	1,121,256	3.00	33,637
San Dieguito	63,172	73,882	73,375	5,387	5,413	2,938	2,517	2,695	2,069	7.7	6.7	3.6	3.6	3.3	2.6	11,171	16,251	21,352	1,796,462	2.75	49,402	871	1.6	1,881,119	3.50	65,839
Santa Fe	69,863	80,870	85,066	None	None	None	None	None	None	0.0	0.0	0.0	0.0	0.0	0.0	13,098	14,253	19,746	1,424,688	6.27	89,327	None	0.0	1,518,200	6.27	95,191
San Ysidro	4,876	3,146	3,103	585	82	127	15	7	96	10.9	2.4	3.7	0.3	0.2	2.8	6,046	6,332	7,613	93,010	4.00	3,720	168	4.1	98,870	5.00	4,943
Scott Valley	14,092	20,498	20,498	None	None	None	None	None	None	0.0	0.0	0.0	0.0	0.0	0.0	None	None	None	256,235	9.00	23,061	None	0.0	256,135	9.00	23,052
Serrano	None	None	None	None	None	None	None	None	None							None	None	None		None	None	None			None	None
South Montebello	14,263	14,137	14,085	6	556	271	None	183	183	0.1	3.6	1.7	0.0	1.2	1.2	9,407	9,586	9,783	704,259	2.00	14,085	1,033	6.6	704,259	2.00	14,085
South San Joaquin	428,980	431,402	430,104	21,274	18,579	23,378	4,690	10,234	16,867	4.5	3.9	4.9	1.0	2.2	3.6	None	None	None	6,810,935	6.45	439,293	18,976	3.9	6,789,405	6.45	437,905
Stinson	27,819	47,485	47,485	None	1,371	2,507	None	None	2,507	0.0	2.6	4.8	0.0	0.0	4.8	5,568	28,032	11,083	558,341	8.50	47,458	22,652	43.4	558,341	8.50	47,458
Table Mountain	7,410	8,378	6,498	None	None	None	None	None	None	0.0	0.0	0.0	0.0	0.0	0.0	None	2,919	2,949	240,670	4.90	11,792	2,917	22.5	240,670	4.80	11,552
Terra Bella	104,335	104,355	91,471	5,290	5,799	14,716	3,082	4,036	13,712	4.6	5.0	14.6	2.7	3.5	13.6	70,682	70,150	67,951	1,211,114	8.75	105,972	25,433	21.8	1,241,640	9.50	117,956
Thermalito	18,487	27,399	33,385	3,820	7,721	7,945	2,114	5,021	6,542	18.8	25.6	21.6	10.4	16.7	17.8	4,278	6,473	1,647	445,650	7.20	32,086	5,489	15.5	442,408	7.20	[23]31,853
Tia Juana River	None	7,096	4,617	None	1,319	994	None	495	622		17.0	19.6		6.3	12.2	None	None	None	469,222	0.67	3,127	546	15.9	467,222	None	None
Tracy-Clover	7,714	7,715	8,749	505	1,224	2,276	None	441	1,466	5.9	14.4	23.6	0.0	5.2	15.3	None	None	None	103,380	8.50	8,787	1,984	20.5	103,380	8.50	8,787
Tranquillity	47,746	47,746	36,608				389	8,017	11,841				0.7	15.0	29.4	1,186	1,208	1,400	1,528,520	2.00	30,570	3,346	10.0	1,212,526	2.00	24,250
Tulare	9,894	17,809	14,841	1,518	2,185	1,902	446	608	1,075	14.0	11.1	11.7	4.1	3.1	6.6	3,395	2,592	6,211	1,978,870	0.60	11,873	1,571	12.0	1,978,870	0.60	11,873
Tule	68,775	81,746	40,496	37,279	79,178	42,640	33,816	71,748	38,718	49.3	88.0	95.8	44.6	80.0	87.0			2,000	[2]658,163	2.00	13,163					
Turlock	601,885	600,822	600,197	38,059	30,610	23,536	[24]4,504	[26]6,047	[26]11,147	5.7	4.6	3.6	[20]0.7	[20]0.9	[21]1.7	None	None	None	13,360,665	4.50	601,229	28,971	4.4	13,365,055	4.50	601,316
Vandalia	10,254	21,072	22,974	None	235	1,457	None	None	1,258	0.0	1.0	5.8	0.0	0.0	5.0	8,210	17,821	14,948	255,267	9.00	22,974	1,333	5.3	255,067	9.00	22,956
Vista	22,884	25,652	112,948	2,479	1,234	11,474	14	220	3,395	9.8	4.4	9.2	0.1	0.8	2.7	None	39,613	84,247	2,246,184	7.85	176,323	37,510	19.4	2,281,674	7.80	177,969
Walnut	4,559	4,528	4,557	None	None	None	None	None	None	0.0	0.0	0.0	0.0	0.0	0.0	729	1,680	3,531	910,930	1.00	9,109	None	0.0	911,000	1.00	9,110
Waterford	53,313	53,039	55,606	18,329	4,683	5,337	1,769	2,314	3,600	31.2	8.0	8.7	3.0	4.0	5.9	None	None	None	1,069,751	5.30	56,695	4,488	7.2	1,079,770	5.46	58,955
West Side	105,742	105,579	70,733	1,842	3,645	2,218	693	821	1,905	1.6	3.1	2.9	0.6	0.7	2.4	None	None	23,242	1,195,876	4.50	53,812	2,216	3.7	1,200,212	4.50	54,009
West Stanislaus	None	None	4,084	None	None	250	None	None	201			6.1			4.5	None	None	None	553,282	None	None	None		554,199	2.35	13,023
Williams [11]	[2]52,214	[2]141,018	[2]140,808	42,036	35,449	36,699	33,831	33,239	35,680	73.2	78.5	81.7	59.0	73.7	79.5	None	None	None	403,440	10.59	[2]142,724	42,261	95.2	396,400	0.50	1,982
Woodbridge	None	6,428	None	None	528	None	None	25	None		7.5			0.4		None	None	None	1,186,123	0.80	9,488	303	2.9	1,145,041	2.00	22,900
Totals	8,227,740	10,202,719	9,912,611	1,073,123	1,257,375	1,426,350	435,634	794,763	1,208,542							997,412	1,233,208	1,381,906	256,297,143		10,542,577	1,856,866		238,953,905		10,712,850

[1] Lands deeded to district for taxes not included.
[2] Calculated from rate and assessment levied.
[3] Calculated from rate and assessed valuation.
[4] Tax certificates sold for first delinquency only.
[5] Unpaid assessments, including penalties, costs, and accrued interest.
[6] From service to Island No. 3 under water-right contracts.
[7] Total tax certificates, from all sales, unredeemed January 1, 1928, amounted to $5,912.
[8] Includes a special assessment of $0.781 per $100 of valuation, amounting to $39,872.
[9] Tax certificates sold in Lone Tree, Knightsen, and Brentwood Irrigation districts after consolidation.
[10] Small delinquencies occurred but no tax certificates were sold.
[11] Williams Irrigation District consolidated with Glenn-Colusa in June, 1924.
[12] Water furnished by Consolidated District under old water-right contracts.
[13] Tax certificates unredeemed plus unpaid assessments, including penalties and costs.
[14] Includes a special assessment of $4.65 per $100 of valuation for purchase of water company stock.
[15] Amount unredeemed September 1, 1928.
[16] Amount unredeemed October 25, 1928.
[17] Amount unredeemed June 1, 1928.
[18] Includes $18,630 of valuation on land excluded from district but still assessed for bond interest.
[19] Total amount of tax certificates, from all sales, unredeemed January 1, 1928, amounted to $102,212.
[20] Amount unredeemed April 1, 1928.
[21] These assessments were levied, in additon to Glenn-Colusa assessments, to meet interest and retirement payments on Williams District bonds.
[22] District taxes collected with county taxes prior to 1927-28 levy.

SUMMARY OF STATISTICAL DATA RELATING TO BONDS AND OUTSTANDING WARRANTS OF ACTIVE CALIFORNIA IRRIGATION DISTRICTS,[1] JANUARY 1, 1929

TABLE V

(Totals for each district are shown in boldface type.)

Name of district	Numbers of bond issues	Dates of bonds	Face value of issues	Range of maturities	Coupon rates per cent	Validation report by Bond Certification Commission		Status of bond issues, January 1, 1929								Outstanding warrants and notes January 1, 1929
								Disposition of bonds certified			Dispositon of bonds sold			Bond payments in default		
						Date	Amount	Sold	Cancelled	Unsold	Refunded	Paid	Outstanding	Principal	Interest[2]	
Alpaugh	1	July 1, 1916	$283,000	July 1, 1927–1946	6	Feb. 13, 1917	$283,000	$283,000	None	None	None	$11,320	$271,680	None	None	$33,177
Alta	1-Ref.	Feb. 4, 1902	500,000	Jan. 1, 1923–1943	5	[3]		492,000	None	$8,000	None	220,500	271,500	None	None	None
Anderson-Cottonwood							1,255,000	1,255,000	None	None	None	66,000	1,189,000	None	None	None
	1	Jan. 1, 1916	480,000	Jan. 1, 1937–1956	6	Jan. 13, 1916	480,000	480,000					480,000			
	2	July 1, 1917	575,000	July 1, 1938–1957	6	July 1, 1917	575,000	575,000					575,000			
	3	July 1, 1920	200,000	July 1, 1925–1934	6	Oct. 5, 1920	200,000	200,000				66,000	134,000			
Banta-Carbona							1,164,000	1,120,000	None	44,000	None	None	1,120,000	None	None	42,000
	1	Aug. 1, 1924	705,000	July 1, 1940–1964	6	Aug. 5, 1924	705,000	705,000					705,000			
	2	Dec. 1, 1925	125,000	July 1, 1941–1965	6	Nov. 20, 1925	125,000	125,000					125,000			
	3	Jan. 1, 1927	334,000	Jan. 1, 1948–1967	6	Jan. 6, 1927	334,000	290,000		44,000			290,000			
Baxter Creek	1	July 1, 1921	511,000	Jan. 1, 1926–1943	6	July 22, 1921	511,000	511,000	None	None	None	None	511,000	$41,000	$99,690	
Beaumont							300,000	300,000	None	None	None	27,600	272,400	None	None	4,443
	1	Nov. 1, 1920	230,000	Jan. 1, 1926–1944	6	Dec. 20, 1920	230,000	230,000				27,600	202,400			
	2	July 1, 1926	70,000	July 1, 1931–1950	6	Sept. 21, 1926	70,000	70,000					70,000			
Big Springs	1	July 1, 1928	69,000	Jan. 1, 1930–1946	6	Oct. 23, 1928	69,000	[4]25,000	None	44,000	None	None	[4]25,000	None	None	1,483
Browns Valley								140,000				140,000	None			None
Butte Valley	1	Sept. 1, 1923	594,000	Jan. 1, 1944–1963	6	Aug. 27, 1923	594,000	594,000	None	None	None	None	594,000	None	[5]71,280	None
Byron-Bethany							650,000	650,000	None	None	None	33,000	617,000	None	None	5,000
	1	Nov. 1, 1920	550,000	Jan. 1, 1924–1952	6	Dec. 17, 1920	550,000	550,000				33,000	517,000			
	2	Sept. 1, 1923	100,000	July 1, 1933–1955	6	Aug. 27, 1923	100,000	100,000					100,000			
Camp Far West	1	July 1, 1927	200,000	July 1, 1937–1956	6	May 10, 1927	200,000	179,000	None	21,000	None	None	179,000	None	None	None
Carmichael							120,000	120,000	None	None	None	16,200	103,800	None	None	None
	1	July 1, 1916	90,000	July 1, 1923–1942	6	Jan. 18, 1917	90,000	90,000				16,200	73,800			
	2	Jan. 1, 1926	30,000	Jan. 1, 1933–1945	6	Nov. 20, 1925	30,000	30,000					30,000			
Carpenter													None			None
Citrus Heights	1	Aug. 1, 1921	262,000	July 1, 1926–1945	6	Aug. 5, 1921	262,000	215,000	None	47,000	None	16,000	199,000	None	None	None
Compton-Delevan							959,000	752,000	$52,000	155,000	$229,000	139,000	384,000	None	None	None
	1	Dec. 1, 1920	575,000	Jan. 1, 1922–1936	6	Dec. 17, 1920	575,000	523,000	52,000		229,000	139,000	155,000			
	1-Ref.	Jan. 1, 1927	384,000	Jan. 1, 1937–1950	6	Aug. 6, 1926	384,000	229,000		155,000			229,000			
Consolidated							850,000	850,000	None	None	None	400,000	450,000	None	None	None
	1	July 1, 1922	775,000	Jan. 1, 1924–1933	5½	July 3, 1922	775,000	775,000				363,000	412,000			
	2	July 1, 1922	75,000	Jan. 1, 1924–1933	5½	July 3, 1922	75,000	75,000				37,000	38,000			
Corcoran	1	Jan. 1, 1920	760,000	Jan. 1, 1931–1955	6	Dec. 27, 1919	760,000	760,000	None	None	None	None	760,000	None	None	70,000
Cordua							454,000	327,000	None	127,000	68,000	None	259,000	None	None	None
	1	June 1, 1920	192,000	July 1, 1925–1940	6	July 14, 1920	192,000	192,000			48,000		144,000			
	2	June 1, 1921	75,000	July 1, 1925–1940	6	July 22, 1921	75,000	65,000		10,000	20,000		45,000			
	3-Ref.	June 1, 1925	187,000	July 1, 1941–1951	6	June 3, 1925	187,000	70,000		117,000			70,000			
Crescent													None			None
Deer Creek	1	Sept. 1, 1927	25,000	July 1, 1929–1938	6	Aug. 19, 1927	25,000	25,000	None	None	None	None	25,000	None	None	None
East Contra Costa[6]							1,324,000	1,301,000	23,000	None	None	26,000	1,275,000	None	None	None
Brentwood	1	Jan. 1, 1924	514,000	Jan. 1, 1935–1954	6	Feb. 11, 1924	514,000	514,000					514,000			
Knightsen	1	July 1, 1921	650,000	July 1, 1927–1946	6	Sept. 20, 1921	650,000	650,000				26,000	624,000			
Lone Tree	1	Mar. 1, 1922	160,000	Jan. 1, 1928–1947	6	April 4, 1922	160,000	137,000	23,000				137,000			
El Camino	1	Nov. 1, 1926	430,000	Jan. 1, 1937–1956			423,000	423,000	None	None	None	None	423,000	None	None	None
	1st Div.			Jan. 1, 1937–1956	6	Dec. 13, 1926	275,000	275,000					275,000			
	2d Div.			Jan. 1, 1940–1952	6	May 24, 1927	28,000	28,000					28,000			
	3d Div.			Jan. 1, 1940–1956	6	Oct. 10, 1927	120,000	120,000					120,000			

SUMMARY OF STATISTICAL DATA RELATING TO BONDS AND OUTSTANDING WARRANTS OF ACTIVE CALIFORNIA IRRIGATION DISTRICTS,[1] JANUARY 1, 1929

TABLE V
Continued

(Totals for each district are shown in boldface type.)

Name of district	Numbers of bond issues	Dates of bonds	Face value of issues	Range of maturities	Coupon rates per cent	Validation report by Bond Certification Commission		Status of bond issues, January 1, 1929								Outstanding warrants and notes January 1, 1929
								Disposition of bonds certified			Dispositon of bonds sold			Bond payments in default		
						Date	Amount	Sold	Cancelled	Unsold	Refunded	Paid	Outstanding	Principal	Interest[2]	
El Dorado	1	Mar. 1, 1927	$1,300,000	Jan. 1, 1948–1967	6	Mar. 31, 1927	$1,300,000	$600,000	None	$700,000	None	None	$600,000	None	None	None
Fairoaks	1	Oct. 1, 1918	200,000	July 1, 1924–1943	6	Dec. 27, 1918	200,000	160,000	None	40,000	None	$28,000	132,000	None	None	None
Fallbrook													None			$4,829
Foothill	1	Sept. 1, 1927	2,270,000	July 1, 1948–1967	6	Oct. 19, 1927	2,270,000	None	None	2,270,000	None	None	None	None	None	17,630
Fresno							2,000,000	2,000,000	None	None	None	1,260,000	740,000	None	None	None
	1	Mar. 18, 1921	1,750,000	Jan. 1, 1923–1932	6	Mar. 28, 1921	1,750,000	1,750,000				1,104,000	646,000			
	2	Mar. 18, 1921	250,000	Jan. 1, 1923–1932	6	Mar. 28, 1921	250,000	250,000				156,000	94,000			
Glenn-Colusa[7]							2,887,000	2,687,150	$182,850	[18]17,000	$283,000	641,950	1,762,200	None	None	67,800
	1	Oct. 1, 1920	2,587,000	Jan. 1, 1922–1941	6	July 18, 1922	2,587,000	2,404,150	182,850		283,000	641,950	1,479,200			
	1-Ref.	Nov. 1, 1924	300,000	Jan. 1, 1935–1941	6	Dec. 1, 1924	300,000	283,000		17,000			283,000			
Grenada	1	July 1, 1921	240,000	July 1, 1926–1940	6	Sept. 20, 1921	240,000	240,000	None	None	None	None	240,000	$48,000	$33,960	15,024
Hemet													None			4,409
Hot Spring Valley							160,000	160,000	None	None	None	48,000	112,000	None	None	6,400
	1	May 1, 1920	100,000	Jan. 1, 1923–1936	6	Oct. 13, 1921	100,000	100,000				44,000	56,000			
	2	Oct. 15, 1921	60,000	Jan. 1, 1927–1939	6	Oct. 13, 1921	60,000	60,000				4,000	56,000			
Imperial							16,000,000	16,000,000	None	None	None	650,000	15,350,000	None	None	225,614
	1	Jan. 1, 1915	3,500,000	Jan. 1, 1936–1955	5	June 22, 1916	3,500,000	3,500,000					3,500,000			
	2	July 1, 1917	2,500,000	July 1, 1938–1957	5	Sept. 17, 1917	2,500,000	2,500,000					2,500,000			
	3	Oct. 1, 1919	2,500,000	July 1, 1925–1934	5½	Nov. 6, 1919	2,500,000	2,500,000				650,000	1,850,000			
	4	July 1, 1922	7,500,000	July 1, 1935–1956	6	June 30, 1922	7,500,000	7,500,000					7,500,000			
Island No. 3													None			None
Jacinto	1	Dec. 1, 1920	238,000	Jan. 1, 1923–1942	6	Nov. 26, 1920	238,000	238,000	None	None	None	50,000	188,000	None	None	4,446
James	1	May 15, 1920	1,000,000	Jan. 1, 1928–1947	6	June 11, 1920	1,000,000	1,000,000	None	None	None	None	1,000,000	100,000	145,800	2,100
La Canada							328,000	328,000	None	None	None	None	328,000	None	None	None
	1	July 1, 1925	154,000	July 1, 1936–1960	5	July 23, 1925	154,000	154,000					154,000			
	2	July 1, 1928	174,000	July 1, 1949–1968	5	July 13, 1928	174,000	174,000					174,000			
Ladera													None			None
Laguna	1	July 1, 1921	265,000	July 1, 1923–1932	6	July 22, 1921	265,000	265,000	None	None	None	162,000	103,000	None	None	None
Lakeland													None			None
Lakeside	1	Feb. 1, 1925	35,000	Jan. 1, 1946–1965	6	Mar. 9, 1925	35,000	35,000	None	None	None	None	35,000	None	None	13,398
La Mesa, Lemon Grove, and Spring Valley								2,066,000	1,166,500	500,000	None	10,000	2,056,000	None	None	None
	1	July 1, 1914	1,232,500	June 30, 1935–1939	6			66,000	1,166,500			10,000	56,000			
	2	Jan. 1, 1925	2,500,000	Jan. 1, 1946–1965	6	Oct. 22, 1925	2,500,000	2,000,000		500,000			2,000,000			
Lemoore													None			None
Lindsay-Strathmore							1,650,000	1,650,000	None	None	None	28,000	1,622,000	None	None	74,482
	1	July 1, 1916	1,400,000	July 1, 1927–1946	6	Feb. 3, 1917	1,400,000	1,400,000				28,000	1,372,000			
	2	Oct. 1, 1918	250,000	Oct. 1, 1929–1948	6	Mar. 14, 1919	250,000	250,000					250,000			
Littlerock Creek								368,000	None	None	None	8,000	360,000	None	None	4,212
	3	July 1, 1914	60,000	Jan. 1, 1934–1954	5		[8]	60,000					60,000			
	4	Jan. 16, 1920	200,000	Jan. 1, 1941–1960	6	Aug. 19, 1921	200,000	200,000					200,000			
	5	May 1, 1921	48,000	Jan. 1, 1925–1942	6	Aug. 19, 1921	48,000	48,000				8,000	40,000			
	6	Jan. 1, 1925	60,000	Jan. 1, 1941–1960	6	June 3, 1925	60,000	60,000					60,000			
Lucerne													None			None
Madera	1		28,000,000				200,000	200,000	None	None	None	200,000	None	None	None	None
	1st Div.	Oct. 1, 1921		July 1, 1927–1928	6	Oct. 20, 1921	200,000	200,000				200,000				
Maxwell	1	Sept. 15, 1918	260,000	Jan. 1, 1922–1941	6	Jan. 11, 1919	260,000	260,000	None	None	None	26,000	[9]234,000	78,000	40,530	[9]44,190

SUMMARY OF STATISTICAL DATA RELATING TO BONDS AND OUTSTANDING WARRANTS OF ACTIVE CALIFORNIA IRRIGATION DISTRICTS,[1] JANUARY 1, 1929

(Totals for each district are shown in boldface type.)

Name of district	Numbers of bond issues	Dates of bonds	Face value of issues	Range of maturities	Coupon rates per cent	Validation report by Bond Certification Commission		Status of bond issues, January 1, 1929								Outstanding warrants and notes January 1, 1929
								Disposition of bonds certified			Dispositon of bonds sold			Bond payments in default		
						Date	Amount	Sold	Cancelled	Unsold	Refunded	Paid	Outstanding	Principal	Interest[2]	
Merced							**$16,250,000**	**$16,250,000**	**None**	**None**	**None**	**None**	**$16,250,000**	**None**	**None**	**None**
	1-1st Div.	Jan. 1, 1922	$3,120,000	Jan. 1, 1933–1950	6	Dec. 29, 1921	3,120,000	3,120,000					3,120,000			
	1-2d Div.	Jan. 1, 1922	1,800,000	Jan. 1, 1951–1953	5½	Aug. 31, 1922	1,800,000	1,800,000					1,800,000			
	1-3d Div.	Jan. 1, 1922	1,320,000	Jan. 1, 1954–1955	5½	Nov. 9, 1923	1,320,000	1,320,000					1,320,000			
	1-4th Div.	Jan. 1, 1922	5,760,000	Jan. 1, 1956–1962	6	June 9, 1924	5,760,000	5,760,000					5,760,000			
	2	May 1, 1924	3,250,000	Jan. 1, 1937–1964	6	June 9, 1924	3,250,000	3,250,000					3,250,000			
	3	April 1, 1926	1,000,000	Jan. 1, 1965–1966	5½	April13, 1926	1,000,000	1,000,000					1,000,000			
Modesto							**5,137,511**	**4,855,511**	**$46,000**	**$236,000**	**None**	**$470,779**	**4,384,732**	**None**	**None**	**None**
	1-Ref.	May 1, 1902	1,056,511	Jan. 1, 1923–1942	5	June 25, 1914	1,056,511	1,010,511	46,000			369,779	640,732			
	2	Jan. 1, 1903	18,000	Jan. 1, 1914–1923	6	June 25, 1914	18,000	18,000				18,000				
	2-Ref.	Jan. 5, 1904	332,000	Jan. 1, 1925–1944	5	June 25, 1914	332,000	332,000				83,000	249,000			
	3	July 1, 1909	200,000	July 1, 1930–1939	5	June 25, 1914	200,000	200,000					200,000			
	4	Jan. 1, 1911	50,000	Jan. 1, 1932–1941	5	June 25, 1914	50,000	50,000					50,000			
	5	July 1, 1914	500,000	July 1, 1935–1954	6	June 25, 1914	500,000	500,000					500,000			
	6	July 1, 1914	110,000	July 1, 1935–1954	6	June 25, 1914	110,000	110,000					110,000			
	7	July 1, 1920	1,180,000	July 1, 1931–1950	6	Oct. 25, 1920	1,180,000	1,180,000					1,180,000			
	8	July 1, 1920	181,600	July 1, 1931–1950	6	Oct. 25, 1920	181,600	181,600					181,600			
	9	July 1, 1920	150,000	July 1, 1931–1950	6	Oct. 25, 1920	150,000	150,000					150,000			
	10	July 1, 1920	190,000	July 1, 1931–1950	6	Oct. 25, 1920	190,000	190,000					190,000			
	11	July 1, 1920	298,400	July 1, 1931–1950	6	Oct. 25, 1920	298,400	298,400					298,400			
	12	Oct. 1, 1923	135,000	July 1, 1934–1953	5	Sept. 19, 1923	135,000	135,000					135,000			
	13	Jan. 1, 1924	500,000	July 1, 1944–1953	5	Feb. 11, 1924	500,000	500,000					500,000			
	14	Jan. 1, 1927	236,000	Jan. 1, 1942–1951	5	Dec. 13, 1926	236,000			236,000						
Mojave River	1		5,600,000				**2,175,000**	**None**	**None**	**2,175,000**	**None**	**None**	**None**	**None**	**None**	**$2,625**
	1st Div.	Aug. 15, 1922		Jan. 1, 1933–	6	Aug. 31, 1922	25,000			25,000						
	2d Div.	Jan. 1, 1924		Jan. 1, 1935–1954	6	Feb. 11, 1924	2,150,000			2,150,000						
Montague[10]	1	Jan. 1, 1926	1,395,000	Jan. 1, 1947–1966	6	May 17, 1926	**1,395,000**	**1,395,000**	**None**	**None**	**None**	**None**	**1,395,000**	**None**	**None**	**None**
Naglee Burk							**392,000**	**195,000**	**None**	**197,000**	**None**	**9,000**	**186,000**	**$10,000**	**None**	**8,802**
	1	Oct. 1, 1921	200,000	July 1, 1926–1940	6	Sept. 20, 1921	200,000	195,000		5,000		9,000	186,000	10,000		
	1-Ref.	July 1, 1927	192,000	July 1, 1933–1967	6	May 24, 1927	192,000			192,000						
Nevada							**7,942,000**	**7,250,000**	**None**	**692,000**	**None**	**None**	**7,250,000**	**None**	**None**	**442,500**
	1-1st Div.	July 1, 1925	6,000,000	July 1, 1936–1965	5½	July 27, 1925	6,000,000	6,000,000					6,000,000			
	1-2d Div.	July 1, 1926	1,250,000	July 1, 1933–1965	5½	May 17, 1926	1,250,000	1,250,000					1,250,000			
	2	July 1, 1928	2,592,000	July 1, 1949–1962	5½	Dec. 15, 1928	692,000			629,000						
Newport Heights	1	Jan 1, 1920	160,000	Jan. 1, 1941–1960	6	Jan. 9, 1920	**160,000**	**160,000**	**None**	**None**	**None**	**None**	160,000	**None**	**None**	**None**
Newport Mesa	1	June 1, 1919	50,000	July 1, 1940–1959	6	June 12, 1919	**50,000**	**50,000**	**None**	**None**	**None**	**None**	**50,000**	**None**	**None**	**None**
Oakdale							**3,675,000**	**3,675,000**	**None**	**None**	**None**	150,000	**3,525,000**	**None**	**None**	**77,677**
	1	July 1, 1910	1,600,000	July 1, 1931–1940	5	June 25, 1914	1,600,000	1,600,000					1,600,000			
	2	Jan. 1, 1913	400,000	Jan. 1, 1934–1943	5	June 25, 1914	400,000	400,000					400,000			
	3	July 1, 1915	400,000	July 1, 1936–1955	6	Feb. 18, 1915	400,000	400,000					400,000			
	4	Jan. 1, 1924	175,000	Jan. 1, 1925–1931	5½	Dec. 4, 1923	175,000	175,000				125,000	50,000			
	5	June 21, 1925	1,100,000	Jan. 1, 1927–1965	5	June 3, 1925	1,100,000	1,100,000				25,000	1,075,000			
Oroville-Wyandotte	1	Jan. 1, 1923	2,000,000	Jan. 1, 1944–1963	6	Jan. 27, 1923	**2,000,000**	**[12]1,029,000**	**None**	**971,000**	**None**	**None**	**[12]1,029,000**	**None**	**None**	**19,765**
Owens Valley[13]	1	Jan. 1, 1924	1,650,000	Jan. 1, 1940–1959	5½	Oct. 15, 1923	**1,650,000**	**471,500**	**None**	**1,178,500**	**None**	**None**	**471,500**	**None**	**$64,831**	
Palmdale							**545,000**	**445,000**	**None**	**100,000**	**None**	**None**	**445,000**	**None**	**93,450**	**15,296**
	1	Jan. 16, 1920	382,000	Jan. 1, 1941–1960	6	July 12, 1921	382,000	382,000					382,000		80,220	
	2	May 1, 1921	63,000	Jan. 1, 1933–1942	6	July 12, 1921	63,000	63,000					63,000		1,3230	
	3	June 1, 1925	100,000	Jan. 1, 1941–1960	6	June 3, 1925	100,000			100,000						
Palo Verde								**4,838,330**	**·32,000**	**173,000**	**213,000**	**369,000**	**4,256,330**	**None**	**None**	**90,000**
Mutual Water Company	1	Feb. 1, 1916	500,000	Feb. 1, 1922–1935	6	[14]		500,000			90,000	150,000	260,000			
Levee District	1	May 1, 1918	1,285,951	May 1, 1919–1958	6½	[14]		1,253,951	[15]32,000		96,000	192,000	965,951			
Levee District	2	Nov. 1, 1922	371,379	Nov. 1, 1923–1962	6½	[14]		371,379			27,000	27,000	317,379			
Drainage District	1	Dec. 1, 1921	850,000	Jan. 1, 1933–1942	6	[14]		850,000					850,000			
Irrigation District	1-1st Div.	Sept. 1, 1925	1,650,000	July 1, 1937–1955	6	Oct. 22, 1925	1,650,000	1,650,000					1,650,000			
Irrigation District	1-2d Div.	Sept. 1, 1925	173,000	July 1, 1938–1955	6	Jan. 6, 1928	173,000			173,000						
Irrigation District	2-Ref.	Sept. 1, 1925	213,000	July 1, 1937–1955	6	June 29, 1926	213,000	213,000					213,000			
Paradise							**490,000**	**490,000**	**None**	**None**	**None**	**4,000**	**486,000**	**None**	**None**	**None**
	1	May 1, 1917	350,000	May 1, 1938–1957	6	May 16, 1917	350,000	350,000					350,000			
	2	July 1, 1920	140,000	July 1, 1925–1956	6	Mar. 18, 1921	140,000	140,000				4,000	136,000			

SUMMARY OF STATISTICAL DATA RELATING TO BONDS AND OUTSTANDING WARRANTS OF ACTIVE CALIFORNIA IRRIGATION DISTRICTS,[1] JANUARY 1, 1929

(Totals for each district are shown in boldface type.)

Name of district	Numbers of bond issues	Dates of bonds	Face value of issues	Range of maturities	Coupon rates per cent	Validation report by Bond Certification Commission		Status of bond issues, January 1, 1929								Outstanding warrants and notes January 1, 1929
								Disposition of bonds certified			Dispositon of bonds sold			Bond payments in default		
						Date	Amount	Sold	Cancelled	Unsold	Refunded	Paid	Outstanding	Principal	Interest[2]	
Potter Valley	1	July 1, 1928	$100,000	July 1, 1933–1952	5½	July 13, 1928	$100,000	$80,000	None	$20,000	None	None	$80,000	None	None	None
Princeton-Codora-Glenn	1	July 1, 1918	175,000	July 1, 1939–1958	6	Oct. 16, 1918	175,000	175,000	None	None	None	None	175,000	None	None	$8,491
Provident							1,190,000	1,190,000	None	None	None	$143,000	1,047,000	None	None	None
	1	Aug. 15, 1918	$1,000,000	Aug. 15, 1930–1949	6	Aug. 28, 1918	1,000,000	1,000,000					1,000,000			
	2	Aug. 9, 1921	190,000	July 1, 1922–1933	6	Aug. 15, 1921	190,000	190,000				143,000	47,000			
Ramona	1	July 1, 1926	91,000	July 1, 1947–1966	6	Dec. 13, 1926	91,000	91,000	None	None	None	None	91,000	None	None	10,015
Red Rock Creek[13]	1-1st Div.	Jan. 1, 1926	175,000	Jan. 1, 1947–1966	6	May 17, 1926	175,000	None	None	175,000	None	None	None	None	None	12,000
Riverdale	1	Oct. 1, 1922	123,000	July 1, 1925–1933	6	Mar. 14, 1923	123,000	123,000	None	None	None	44,000	79,000	None	None	None
San Dieguito	1	April 1, 1923	400,000	Jan. 1, 1931–1950	6	Mar. 14, 1923	400,000	400,000	None	None	None	None	400,000	None	None	None
Santa Fe	1	Nov. 1, 1923	700,000	July 1, 1933–1952	6	April 8, 1924	700,000	700,000	None	None	None	None	700,000	None	None	None
San Ysidro	1	Jan. 1, 1913	25,000	Jan. 1, 1934–1943	5	Sept. 12, 1912	25,000	25,000	None	None	None	None	25,000	None	None	32,485
Scott Valley	1	July 1, 1920	125,000	July 1, 1923–1937	6	Nov. 17, 1920	125,000	125,000	None	None	None	38,000	87,000	None	None	5,000
Serrano													None			None
South Montebello	1	June 30, 1923	125,000	Jan. 1, 1926–1945	6	Sept. 19, 1923	125,000	125,000	None	None	None	25,000	100,000	None	None	None
South San Joaquin							5,985,000	5,985,000	None	None	None	25,000	5,960,000	None	None	None
	1	July 1, 1910	1,875,000	July 1, 1931–1940	5	Sept. 17, 1913	1,875,000	1,875,000					1,875,000			
	2	April 18, 1913	1,170,000	April 18, 1934–1942	5	Sept. 17, 1913	1,170,000	1,170,000					1,170,000			
	3	July 1, 1913	790,000	July 1, 1934–1943	5	Sept. 17, 1913	790,000	790,000					790,000			
	4	Sept. 1, 1919	500,000	July 1, 1940–1959	5½	Mar. 11, 1920	500,000	500,000					500,000			
	5	Nov. 6, 1923	550,000	July 1, 1944–1963	5½	Nov. 9, 1923	550,000	550,000					550,000			
	6	June 21, 1925	1,100,000	Jan. 1, 1927–1965	5	June 3, 1925	1,100,000	1,100,000				25,000	1,075,000			
Stinson	1	April 1, 1923	360,000	Jan. 1, 1931–1950	6	April 16, 1923	360,000	360,000	None	None	None	None	360,000	None	None	22,772
Table Mountain							187,000	187,000	None	None	None	None	187,000	None	None	
	1	July 1, 1923	125,000	July 1, 1944–1963	6	Oct. 17, 1924	125,000	125,000					125,000			
	2	Mar. 1, 1927	62,000	Jan. 1, 1948–1967	6	Mar. 31, 1927	62,000	62,000					62,000			
Terra Bella	1	Nov. 1, 1916	1,000,000	Nov. 1, 1927–1946	6	May 1, 1917	1,000,000	1,000,000	None	None	None	18,000	982,000	None	None	None
Thermalito							320,000	320,000	None	None	None	None	320,000	None	None	2,236
	1	Mar. 1, 1923	270,000	Jan. 1, 1934–1953	6	Feb. 26, 1923	270,000	270,000					270,000			
	2	May 1, 1926	50,000	Jan. 1, 1947–1966	6	April 27, 1926	50,000	50,000					50,000			
Tia Juana River													None			None
Tracy-Clover	1	May 1, 1923	52,170	Jan. 1, 1939–1963	6	May 3, 1923	52,170	52,170	None	None	None	None	52,170	None	None	None
Tranquillity	1	Jan. 1, 1920	260,000	Jan. 1, 1924–1955	5½	Jan. 19, 1920	260,000	260,000	None	None	None	8,000	252,000	None	None	2,000
Tulare	1							500,000				500,000	None			None
Tule	1	July 1, 1921	806,000	Jan. 1, 1926–1943	6	July 22, 1921	806,000	806,000	None	None	None	None	806,000	$63,000	$166,848	
Turlock							7,870,000	7,870,000	None	None	None	682,100	7,187,900	None	None	None
	1-Ref.	July 1, 1902	1,156,000	Jan. 1, 1922–1941	5	June 25, 1914	1,156,000	1,156,000				480,000	676,000			
	1	Jan. 1, 1905	200,000	Jan. 1, 1926–1935	5	June 25, 1914	200,000	200,000				52,100	147,900			
	2	July 1, 1910	100,000	July 1, 1931–1940	5	June 25, 1914	100,000	100,000					100,000			
	3	Jan. 1, 1911	1,206,000	Jan. 1, 1932–1941	5	June 25, 1914	1,206,000	1,206,000					1,206,000			
	4	July 1, 1920	2,570,000	July 1, 1936–1951	6	Oct. 25, 1920	2,570,000	2,570,000					2,570,000			
	5	July 1, 1920	1,028,000	July 1, 1936–1951	6	Oct. 25, 1920	1,028,000	1,028,000					1,028,000			
	6	July 1, 1920	510,000	July 1, 1941–1960	5½	Sept. 1, 1920	510,000	510,000					510,000			
	7	Jan. 1, 1924	500,000	Jan. 1, 1927–1936	5	Dec. 29, 1923	500,000	500,000				150,000	350,000			
	8	Dec. 31, 1926	600,000	July 1, 1932–1946	5	Jan. 6, 1927	600,000	600,000					600,000			
Vandalia	1	April 1, 1924	210,000	Jan. 1, 1928–1947	6	April 8, 1924	210,000	210,000	None	None	None	10,500	199,500	None	None	None
Vista	1	Jan. 1, 1925	1,700,000	Jan. 1, 1946–1965	6	Jan. 22, 1925	1,700,000	1,700,000	None	None	None	None	1,700,000	None	None	None
Walnut													None			38,000

SUMMARY OF STATISTICAL DATA RELATING TO BONDS AND OUTSTANDING WARRANTS OF ACTIVE CALIFORNIA IRRIGATION DISTRICTS,[1] JANUARY 1, 1929

TABLE V
Continued

(Totals for each district are shown in boldface type.)

Name of district	Numbers of bond issues	Dates of bonds	Face value of issues	Range of maturities	Coupon rates per cent	Validation report by Bond Certification Commission		Status of bond issues, January 1, 1929								Outstanding warrants and notes January 1, 1929
								Disposition of bonds certified			Dispositon of bonds sold			Bond payments in default		
						Date	Amount	Sold	Cancelled	Unsold	Refunded	Paid	Outstanding	Principal	Interest[2]	
Waterford							**$670,000**	**$670,000**	**None**	**None**	**None**	**$9,775**	**$660,225**	**None**	**None**	**None**
	1	Oct. 1, 1916	$465,000	Oct. 1, 1927–1946	6	Feb. 13, 1917	465,000	465,000				4,650	460,350			
	2	July 1, 1919	205,000	July 1, 1927–1946	5½	Aug. 25, 1919	205,000	205,000				5,125	199,875			
West Side							**595,000**	**545,000**	**None**	**$50,000**	**None**	**None**	**545,000**	**None**	**None**	**$64,389**
	1	Jan. 1, 1917	295,000	Jan. 1, 1938–1957	6	May 16, 1917	295,000	295,000					295,000			
	2	July 1, 1918	100,000	July 1, 1939–1958	6	May 10, 1918	100,000	100,000					100,000			
	3	Jan. 1, 1920	150,000	Jan. 1, 1930–1939	6	Dec. 30, 1919	150,000	150,000					150,000			
	4	Feb. 1, 1929	50,000	Jan. 1, 1950–1969	6	Jan. 17, 1929	50,000			50,000						
West Stanislaus	1	July 1, 1927	1,216,376	July 1, 1932–1957	6	Aug. 19, 1927	**1,216,376**	**[16]740,000**	**None**	**476,376**	**None**	**None**	**[16]740,000**	**None**	**None**	**None**
Williams[7]								**964,000**	**None**	**234,000**	**$332,000**	**61,000**	**571,000**	**$8,000**	**$92,580**	**41,597**
	1	July 1, 1921	600,000	Jan. 1, 1923–1937	6			453,000		147,000	332,000	61,000	60,000	8,000		
	2-1st Div.	Jan. 1, 1924	466,000	Jan. 1, 1942–1959	6	June 14, 1924	466,000	379,000		87,000			379,000			
	2-2d Div.	Jan. 1, 1924	115,000	Jan. 1, 1959–1961	6	June 14, 1924	115,000	115,000					115,000			
	3	June 1, 1924	17,000	Jan. 1, 1945–1961	6	June 14, 1924	17,000	17,000					17,000			
Woodbridge	1	Mar. 1, 1928	325,000	Jan. 1, 1930–1954	5½	Mar. 8, 1928	**325,000**	**[15]300,000**	**None**	**25,000**	**None**	**None**	**[17]300,000**	**None**	**None**	**None**
Totals			$146,849,620[11]				**$111,325,057**	**$105,186,661**	**$1,502,350**	**$10,675,876**	**$1,125,000**	**$6,774,724**	**$97,286,937**	**$348,000**	**$808,969**	**$1,536,287**

[1] Summary contains data on Owens Valley and Red Rock Creek districts which are classified elsewhere in this publication as inactive or partially active.
[2] Does not include interest on bonds after date of maturity.
[3] Bonds issued before Bond Certification Commission established.
[4] Bonds sold subsequent to January 1, 1929.
[5] Interest payments due from July 1, 1927, to January 1, 1932, inclusive, deferred by agreement made with bond holders.
[6] East Contra Costa District formed in 1926 by consolidation of Brentwood, Knightsen, and Lone Tree Irrigation districts.
[7] By agreement, bonds of Williams Irrigation District, now consolidated with Glenn-Colusa District, are an obligation against lands in Williams District only.
[8] This bond issue was validated by the Superior Court of Los Angeles County.
[9] These bonds and warrants have since been compromised. See statement regarding Maxwell Irrigation District, page 100.
[10] Organized as an irrigation district, but name changed to Montague Water Conservation District in September, 1926.
[11] Total does not include levee district, drainage district and water company bonds amounting to $3,007,330 which were assumed by Palo Verde Irrigation District.
[12] Includes $29,000 in bonds sold subsequent to January 1, 1929.
[13] District now inactive.
[14] These bonds issued before organization of Palo Verde Irrigation District. See statement regarding Palo Verde Irrigation District, page 327.
[15] Bonds matured prior to date of sale.
[16] Includes $125,000 sold subsequent to January 1, 1929.
[17] Includes $10,000 sold subsequent to January 1, 1929.
[18] Includes $10,000 in bonds subject to cancellation.

CHAPTER VIII

DISCUSSION OF TABLES

Areas, land ownerships, and population.—As shown by Table I, the gross area in the 89 active California irrigation districts is 3,540,852 acres, the total irrigable area is 3,035,927 acres, and the total area irrigated is 1,634,183 acres. The irrigable area is approximately 86 per cent of the gross area, and the irrigated area is approximately 54 per cent of the irrigable area.

Of the 1,401,744 acres of irrigable land which is not yet irrigated, approximately 800,000 acres could be irrigated with existing irrigation works and water supplies. It is obvious, therefore, that normal expansion in the irrigated area of California could take place without the building of any more projects for at least a number of years to come. It should be remembered, however, that irrigation districts are normally not organized to meet any well-pronounced demand for land. On the contrary, they are generally formed either to bring about the general community betterment which usually follows more intensive utilization of farm land through irrigation, to improve the saleability of land in large holdings, or to transfer to community ownership irrigation systems operated as public utilities. Under these conditions it is inevitable in a state like California that the margin of land available for development under irrigation will always be large—possibly too large for the good of those projects which offer the least favorable opportunities for settlement.

An examination of Table I will make it clear that the amount of unirrigated irrigable land varies widely in the different districts. In some of the older districts, and in a few of the smaller ones, from 70 to 80 per cent or more of the irrigable area is now irrigated and more or less intensively cultivated. Unfortunately, the percentage of irrigated land in some of the other districts is relatively small, and is in some cases mainly or largely the cause either of financial distress or of hardship to the district enterprise.

Exact standards for determining the area of unirrigated land which a district can carry without distress are not available, but it can be generally stated that the number in which this percentage is sufficiently high to cause anxiety does not exceed from twelve to fifteen, and that the additional number in which the percentage is high enough to cause some hardship does not exceed about an equal number.

The conditions which have resulted in the higher percentages of unirrigated land vary so widely that no satisfactory all-inclusive general statement can be made in explanation of them. In a few the cause is a too limited crop adaptability. In a few it is lack of adequate

water supply. In some it is due to the necessity for clearing land before it can be put into production. In some it is due to the unattractiveness of the land to buyers considering the prices charged and the probable income. There are, of course, other causes. The most general causes, of course, have been the relatively unsatisfactory economic condition in most branches of agriculture, and the lack of sufficient buyers with enough capital to carry farm development through to the point of returning an income on the needed investment.

Finally, in seeking an explanation for the differences in the extent of development in the various districts, the governing characteristics of each district should be recognized. Some of the older districts, like Turlock, Modesto, Alta, South San Joaquin, and Oakdale, have grown gradually and in the main consistently, with one exception each starting with a relatively low bonded debt per acre and each doing a large part of its major development work when construction costs were on the pre-war basis, although most of these districts traded their original bond issues at large discounts. Another type, of which Imperial District is the most conspicuous example, were organized to take over and complete irrigation enterprises started by promoters. Districts like Glenn-Colusa and several others on the west side of Sacramento Valley, formed in the process of reorganizing a private irrigation enterprise which had failed, constitute a third class; districts like Paradise, Oroville-Wyandotte, and El Dorado, which were formed as the only alternative to a stoppage in community development, a fourth; districts like the Kings River group, which were organized for the purpose of creating local units of a larger water conservation plan, a fifth, and so forth. A complete grouping of the districts as to their dominant characteristics does not seem necessary, as the nature of each district is quite fully set forth in the statement regarding it.

Table I also gives figures regarding land ownerships and population within active California irrigation districts. The estimated number of farm holdings in 1927 was 57,525. According to the agricultural census of 1925, the total number of farms in California was 136,409. This number has undoubtedly increased since then. Assuming such increase, it appears that, broadly speaking, more than one-third of the farms in California are within the 89 active irrigation districts. The total estimated population within the districts is given as 330,920, of whom 213,908 live outside of cities and towns. The total farm population of California according to the census of 1925 was 531,008. Even assuming a substantial increase in this number between 1925 and 1928, it appears that more than one-third the farm population of California lives within these 89 irrigation districts.

Assessments and water tolls.—Cost of water to irrigators in California irrigation districts may be made up of annual district assessments, of water tolls only, or of annual assessments combined with water tolls. Generally speaking, where total annual water charges are relatively low, they are made up entirely of annual district assessments, and in districts where water costs are high, both annual assessments and water tolls are collected.

Table II presents the statistical data regarding assessments and water tolls. Annual assessments are levied on the basis of valuations fixed by the district assessors. Although the California irrigation district act, in section 35, requires that district assessors shall assess all real estate "at its full cash value," this is seldom done. The various district assessors follow no uniform practice, as the statements regarding assessments, given in connection with each district, show. In numerous cases, districts find it convenient to value land for purposes of district assessment more or less arbitrarily at a flat sum per acre, this frequently being fixed at $100. However, there is generally a variation in valuations, depending upon such factors as the market value of land, location with reference to main centers or paved highways, or the uses to which the land is best suited.

In the last three columns of Table II an attempt is made to show the annual assessments per acre on land of usual valuation for the years 1925–26, 1926–27, and 1927–28, these not including the water tolls that are collected in some of the districts. There are a few districts in which special conditions have required an assessment which is high as compared with other districts. For instance, in one district which is confined very largely to the growing of alfalfa and grain, the annual assessment was $15 per acre on land of usual valuation in 1927–28—clearly a prohibitive price. In one 'rice' district it was $23.80 per acre, also clearly prohibitive. In a third district, devoted largely to cotton growing, the assessment rate was $13.84. In the first two cases named, the districts are in process of financial reorganization, and the assessments were levied according to law without expectation of their being paid. In the third case, the rate included costs of levee protection, as well as irrigation and drainage assessments. Obviously the assessment rates in these three cases should not be considered in attempting to determine the cost of irrigation water in California irrigation districts. Frequently, however, rates comparable with these are not unusual, because they are applied in areas where crops yielding a high gross return are being grown, such as citrus or deciduous fruits, or where the residential factor is an important one.

Generally speaking, the annual cost of irrigation water per acre on land of usual valuation in the general farming irrigation districts of California varies between about $2 and about $6. However, in some

cases the cost reaches $8 or $9 and in a few cases drops below $2. In most instances where the districts are devoted very largely to deciduous or citrus fruits or both, the combined water tolls and annual assessment on land of usual valuation exceeds $10 per acre, and in a few cases approaches or exceeds $30 per acre. However, water tolls are charged on so many different bases, and quantities used vary so widely, that generally representative annual costs can not be computed, and this has not been attempted. Those interested in the probable total annual charges in districts which collect water tolls should therefore consult the paragraphs headed "Assessments and water tolls" in the statements regarding each of the districts.

The assessment rates and water tolls given in Table II can not be fully interpreted without reference to the type of service given. The column headed "Basis of water delivery, irrigation service" presents this matter briefly. It will be noticed that deliveries are sometimes made from the main laterals only, and sometimes to holdings as small as four or five acres. Most frequently they are made from main laterals, regardless of the areas, but vary generally to each farm or holding, or to holdings of 10, 40, or 160 acres. Obviously the type of service is an important factor in the annual cost to the irrigator, in addition to the assessments or tolls paid.

Total amounts of assessments, delinquencies, and water tolls.—Table IV sets forth in detail the sources and amounts of the current income of the active irrigation districts, and, when taken together with Table V, shows quite clearly their financial status.

Table IV indicates that the combined assessment levies of the active California irrigation districts approximate $10,500,000 each year, and that the additional income from water tolls aggregate approximately $1,250,000 annually, a total of nearly $12,000,000. This shows that California irrigation districts, in the aggregate, are operating on a large scale.

Columns 8, 9, and 10 give the amount of unredeemed tax certificates as of January 1, 1928, for the assessment years 1924–25, 1925–26, and 1926–27, and a subsequent column gives the total tax certificates sold at the dates of tax sales in 1928.

The California irrigation district act, in section 60, states that in computing the annual assessment rate necessary to raise the amount of money required, delinquencies amounting to 15 per cent shall be anticipated.* The amounts of the delinquencies for each of the districts for the assessment years named are given in the table, both in total

* "The rate of assessments levied under the provisions of this act shall be ascertained by deducting 15 per cent for anticipated delinquencies from the aggregate assessed value of the property in that district as it appears on the assessment roll for the current year, and then dividing the sum to be raised by the remainder of such aggregate assessed value." (From Section 60 of the California irrigation district act.)

delinquencies and in percentages. The latter are given for 1924–25, 1925–26, and 1926–27, both for dates of tax sales and for January 1, 1928. The percentage of delinquencies on dates of tax sales exceeded 15 per cent in one or more of three assessment years in 27 districts, and it exceeded 15 per cent as of January 1, 1928, for one or more of the three years in 16 districts. For the assessment year 1927–28 the percentage of delinquencies on dates of tax sales exceeded 15 per cent in 19 districts.

Delinquencies somewhat in excess of 15 per cent are not necessarily evidence of financial weakness of a district, but may merely reflect the financial condition of some of the landowners. The table, however, shows seven districts in which the percentage of delinquencies on January 1, 1928, for one or more of the three assessment years 1924–25, 1925–26, and 1926–27, equaled or exceeded 45. Reference to Table V will show that each of these seven districts, as well as one district which showed a delinquency of 31.6 per cent on January 1, 1928, for the assessment year 1926–27, was in default in either bond interest or principal on January 1, 1929.*

Another matter which bears on the delinquencies in irrigation districts is the area taken by the districts by tax deeds, since no assessments are obtained by a district from lands so held by it. Tax deeds may be issued at the expiration of the three-year redemption period, but the districts do not follow a common practice in taking tax deeds to property struck off to them for delinquent assessments. The extent to which tax deeds have been taken by the districts, is shown in Table I, and in 1927 they covered an area of 26,721 acres. Now, however, the districts are more generally taking deeds and selling the property.

Bonds and warrants.—Table V shows that up to January 1, 1929, California irrigation districts had issued bonds in the total amount of $146,849,620, of which $111,325,057 had been validated by the Bond Certification Commission, $105,186,661 had been sold, $1,502,350 canceled, and $10,675,876 remained unsold. Of the bonds sold, $1,125,000 had been refunded, $6,774,724 paid, and $97,286,937 were outstanding. Bond principal in default January 1, 1929, amounted to $348,000, or about one-third of one per cent of the total bonds sold, and about 4.9 per cent of the par value of bonds that have come due. Accumulated

* In undertaking to analyze the assessment delinquencies of irrigation districts it needs to be recalled that the California irrigation district act, in sections 41 and 41c, provides that district assessments are delinquent on the last Monday in December if paid in one installment, or on the last Monday in December and the last Monday in the following June, if paid in two installments. As soon as the assessments are delinquent, the collector must immediately add a penalty of 10 per cent, and unless the delinquent assessments are paid prior to dates fixed by the collector, the property is sold or struck off to the district, but may be redeemed within three years from date of its sale, or at any time thereafter before a deed has been made and delivered, on payment of the original assessment, the 10 per cent penalty and costs, and a further penalty of 1.5 per cent per month from the date of sale until redemption. The last mentioned penalty was 2 per cent per month until changed by the legislature in 1927. Experience of California irrigation districts is not yet conclusive as to whether the reduction in the penalty has increased or decreased delinquencies.

bond interest in default amounted to $808,969. Outstanding warrants and notes totaled $1,536,287.

Counting 75 of the 92 districts listed in Table V, which number includes all of the active and inactive existing districts that have issued bonds, defaults in meeting bond interest or principal, or both, as of January 1, 1929, were confined to ten districts.

Two of the districts which were in default January 1, 1929, are so-called 'rice' districts. They were both speculative enterprises based on rice growing, and when formed, the rice industry in California was relatively new, and the conditions necessary for profitable culture of rice were not very clearly understood. Practically all of the land in one of these districts has been purchased by gun clubs and is now used for duck shooting, and its indebtedness has been compromised, while those interested in the other are at present undertaking to work out a basis of reorganization, which will reduce the outstanding debt to a figure the land can carry. In the case of two districts, defaults were immediately due to assessment delinquencies of the interests which had been most active in promoting organization, the large extent of their landholdings making their failure to pay district assessments a serious matter for the districts. In one case the district took over what was already practically a defunct project, in which the carrying charges were too great for the type of agriculture possible. In three others default resulted mainly from lack of settlement and development, due largely to local difficulties in establishing profitable agriculture, and from temporary water shortage. Default in one of the others was due to a too early retirement period of the first issue, to tax delinquencies, and to failure of the board of directors to levy necessary assessments for bond redemption and retirement of warrants. The district had expected to refund its early issues. Default in the last of the ten districts referred to is not significant, since the validity of the bond issue is under attack in court, the issue having been involved in irregularities, as explained in the statement regarding the district in question. In all of these cases of default, the recent agricultural depression was, of course, a contributing factor of impelling force, and one which no practical state control could have overcome.

The last column in Table V presents the outstanding district warrants as of January 1, 1929. Thirty-seven districts list such outstanding warrants. Reference to Table IV will show that the percentage of the 1927–28 assessments delinquent on date of tax sale for 1927–28 exceeded 15 per cent in 17 of these 37 districts, and that in 20 cases delinquencies on that date were 10 per cent or more. In a number of cases there are some delinquencies, also, in water tolls, but these do not figure largely in explaining outstanding warrants. As a matter of fact, the outstanding warrants of irrigation districts are not necessarily

always conclusive as to their financial condition, and should not be interpreted without reference to the preceding detailed statements regarding the individual districts. For instance, nearly one-third of the outstanding warrants of all districts on January 1, 1929, had been issued by a single district to cover expenditures which the district had contemplated covering by a bond issue which had been voted, the sale of which, however, was later held up by litigation. In another district, which has excellent agricultural possibilities, the entire 1927–28 assessment went delinquent because the owners of the smaller holdings thought it best not to pay their assessments after the interests controlling considerably more than half of the land in the district became financially involved and failed to pay their's. In a third case, what appears like a large amount of outstanding warrants consists entirely of notes issued by the district in lieu of bonds to cover capital expenditures, and these are being met promptly as due. In some cases a rather large amount of warrants is outstanding on January 1 because bond principal payments are due on that date and the second installment of district assessments levied to meet those and other district expenditures is not delinquent until the following June.

CHAPTER IX

CONCLUDING COMMENTS

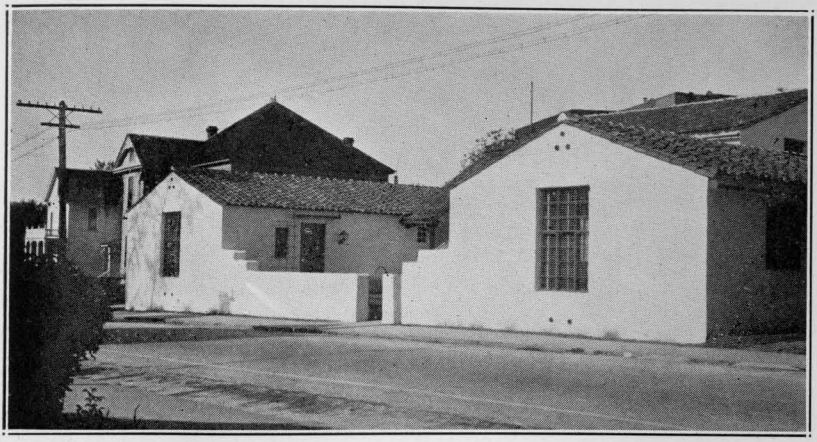
While the main purpose of this publication is to present facts regarding California irrigation districts and the California irrigation district movement, the information gathered during the study on which the report is based seems to justify certain conclusions. Those which appear to be of the most importance are briefly presented below. They relate mainly to measures which seem necessary if irrigation development under the district form of organization is to be confined to projects that are economically as well as physically sound.

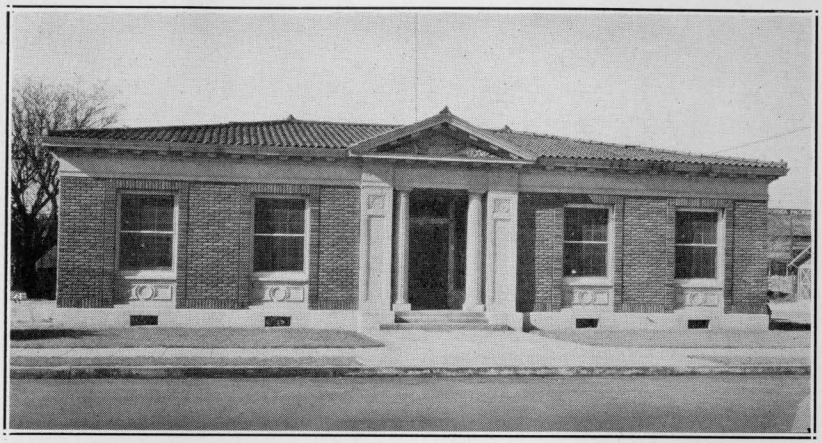
(1) A conclusion which it is appropriate to state at the outset is that the essential principles of the California irrigation district law are sound and workable, and that state administrative control of irrigation district organization and financing, as evolved in California during the last two decades, is stabilizing irrigation development in the state.

The underlying principles of the California irrigation district act are the same as those of the original Wright act of 1887, but procedure in organization, financing, and management has been so changed and amplified that the present and the former acts are really no longer comparable. Although owing much of both its form and its substance to the original act of 1887 and to the revised act of 1897, the present California irrigation district act, in its practical working details and in its provisions for state control, reflects far more the experience of the last twenty years.

As the statements regarding the individual districts, and the tabulations, show, there have been some failures of irrigation districts which have been organized, or financed, or both, since state control was established. Perhaps the entire elimination of failure is not to be expected under any degree of state control that is practical, because irrigation districts are essentially community enterprises, dependent on community initiative and community management. Obviously, the information presented fails to show the failures state control has prevented, or even the benefit which has resulted to individual districts through the investigations and advice of the state officials who have been administratively concerned with California irrigation districts. Some idea of this aspect of the situation, however, can be obtained from reading some of the information presented regarding inactive or partially active districts; also from the statements regarding water conservation and water storage districts.

The soundness of irrigation districts and other irrigation projects depends first of all upon an adequate water supply, favorable climatic conditions, and good land capable of producing agricultural crops of





A group of irrigation district office buildings.

sufficient value to pay the cost of irrigation works, the expenses of farm development and operation, and a profit to the farmers. Adequacy of water supply and general suitability of land are matters readily susceptible of determination, and costs of development can be reasonably well estimated by competent engineers. As a general rule, also, the adaptability of particular soils to crops can be predicted although usually this is not given adequate consideration. The profitableness of agricultural production, however, is dependent on economic factors and trends that can not always be foreseen, nor can the human factor be counted on to conform to predetermined standards or directions. Irrigation districts must always be expected, therefore, to be subject to the economic hazards of agriculture, and to the business uncertainties and human frailties encountered from time to time by other important industries. It is believed that a general realization of this fact will be exceedingly helpful to all concerned with irrigation districts in California; it should especially lead to caution in organizing, outlining the policies of, and managing new irrigation district enterprises which have for their purpose the irrigation of large areas of undeveloped and unproven land.

(2) No irrigation district can afford to lay out its irrigation system or construct its works without the advice of a professional engineer in each important phase of the work to be undertaken. This is true not only of the main construction, but also of the less important engineering features, and the agricultural economic problems involved. Consulting specialists are available and some of the larger districts have made a practice of employing them, at least along technical engineering lines. It is believed that the practice of employing consulting specialists could well be extended, and that such procedure would lessen rather than add to the cost of those who farm the land to be benefited. The fact that irrigation districts now fail more frequently from economic than from engineering causes emphasizes the need for competent economic advice.

(3) Irrigation districts primarily promoted by others than the owners of the lands to be directly benefited, require special scrutiny at the hands of reviewing authorities. It is not important who initiates an irrigation district project, but it is important that the landowners within the proposed enterprise shall from the beginning exercise guiding control in its organization and development; also that the problems of those who are to farm the land to be benefited shall be given their due consideration in connection with the indebtedness and operating charges that are incurred. The need for such guiding control by land-

owners has been shown in more than one California irrigation district enterprise.

(4) While the first essentials of a sound irrigation district are good land, favorable climatic situation, a certain and adequate water supply, and reasonable construction costs, an irrigation district project is courting disaster if it fails to confine its development to that which is likely to be economic from the standpoint of the land to be benefited.

It is fully recogized that all of the factors that determine the success of an irrigation project can not always be foreseen. It is also recognized that, with few exceptions, no irrigation project in this country has yet been completely planned out in advance of construction, at least along other than strictly engineering lines. The usual practice has rather been to proceed on the basis of general experience, and generally to assume that with the main irrigation works constructed, means would be found for paying for other works as needed; also, that the cultural, engineering, and economic problems of the landowners and farmers of the project could safely be left to them. Recent California irrigation district experience, however, indicates that a more careful and more complete planning in advance would have prevented losses to many landowners, farmers, and investors in irrigation district securities; it would also, of course, have prevented the building of some of our irrigation district projects. Whether future irrigation district projects in California will be more carefully thought out in advance of financing and construction can not be predicted. Nevertheless, one of the unescapable conclusions from the study reported in this bulletin is that such a course is desirable. In this connection, the more important matters to consider are the following:

(a) The character of the soils in sufficient detail to show the location and areas of alkali and other unprofitable or marginal lands. These are always the first to go delinquent and thus pass their burden of assessments on to the better lands. A soil map, prepared by a competent soil specialist, is the most effective way to present this information.

(b) The best use that can be made of the land after irrigation water is available, with a showing of the yield of different crops to which the land is suited, and evidence that the market for those crops has a favorable outlook, at least during the period of settlement and development.

(c) The capital cost of the proposed irrigation system for each of the principal grades of land to be included, with a showing in each case that these costs are justified. No estimate of capital cost is a safe guide that does not include all important items, whether needed immediately or at some future time, unless it is certain that such items can be post-

poned beyond the main development period, and this is practically never the case. The cost of lateral distribution, whether included in the district system or to be built at the expense of landowners, is as much a part of the total capital cost as is the cost of the main canal and other principal works. Another needed capital item that irrigation districts have frequently left out of their calculations is drainage, or such types of construction as will lessen the need for it; a third is storage for late summer supply, now, however, less frequently left out of consideration because most new projects are predicated on storage.

(d) The cost of farm irrigation distribution systems and structures and of the preparation of the land for planting and irrigation, to be determined by surveys of typical areas generally representative of the whole project. The irrigation district that starts its construction program without this information, definitely obtained through field study by a competent irrigation or agricultural engineer experienced in such matters, lacks the answer to one of the first of the settlement problems that must be met before the project becomes successful.

(e) The probable annual irrigation cost to water users, including interest and principal of bonds. This information is satisfactory only if it is shown for each of the principal grades of land included. Average project costs of maintenance and operation in districts in which the range of land valuations for purposes of district assessment is considerable are obviously misleading and unsatisfactory.

(f) The size of farm units necessary for successful farming within the district, with due regard to the economic types of farming to which it has been found the project is suited.

(g) The probable cost of land to those who are to farm it and the terms on which it can be purchased. The speculative increase in the price of unirrigated land which almost always follows the organization and development of an irrigation project adds greatly to the difficulties of the project, and frequently results in the failure of many of the settlers who might otherwise have succeeded. There is need for some means by which this speculative increase can be prevented. The present federal reclamation policy is to require binding agreements from landowners to sell to settlers at fixed, nonspeculative prices. A similar effort has been made in one California irrigation district which recently completed its irrigation system.

(h) The probable cost of farm development, including the cost of such major items as the farm irrigation system, preparation of the land for planting and irrigation, planting, live stock, building, equipment, interest on deferred payments, and irrigation and other assessments, both general and special, and annual water tolls, if any.

(i) Where it is proposed to obtain the 'settlers' with the necessary capital (as well as the experience and agricultural temperament needed

for success in farming) to utilize the land for which water is to be made available. In this connection it is justifiable to require a definite showing by the promoters of the new irrigation district enterprise which will open for settlement large areas of land that with completion of construction, enough land will be promptly brought under irrigation and be planted to crops that can be grown at a profit to insure payment to the district of district carrying charges. General assurances that the land will be promptly utilized are not sufficient.

The amount of land in a district that can remain unutilized and still pay the added costs resulting from the development and operation of an irrigation system is of course dependent on the financial resources of its owners. In some California irrigation districts the amount has been fairly large, but in many of them it has been relatively small, if the amount of delinquencies in 'new' districts after interest and operation costs have begun to accrue can be taken as a criterion.

(j) The capital and credit facilities needed for settlement and development of the land and where they are to be obtained. The amount of money or credit required to carry farms of different types to the point of sustaining themselves can now be estimated with reasonable accuracy, and the failure to consider this factor inevitably results in disaster to many individuals and to some projects.

(5) The efficiency with which an irrigation district has been managed is clearly reflected in the cost of its work and the relation which that cost bears to their true value. There are striking examples of good management in California irrigation districts, just as there are examples of poor management. Those districts have been well managed in which the major executive responsibility has been lodged in a competent and experienced engineer-manager. Such an arrangement has not generally been adopted, and perhaps is not always practical during the construction period, especially in the smaller districts. It is to be noted that the Irrigation Districts Association of California has recently taken steps to improve district management by the outlining of standard accounting methods, forms of resolutions, etc.

(6) The number of California irrigation districts that have met with financial difficulties is considered to be relatively small in view of the fact that much, if not the major part, of the indebtedness of an irrigation district is incurred during the earlier period of its life when seasoned business judgment is most needed, but hardest to obtain; also, when it is remembered that state control, which at best can only be limited, is mainly a development of the last fifteen years, and that the most rapid period of irrigation district organization in California was but part of the after-war expansion which brought some measure of

disaster to practically all branches of American industry, and particularly, perhaps, to agriculture.

(7) The fact that half the farm holdings and one-third the farm population in California are within the active irrigation districts of the state is reassuring as to the stability of the irrigation district as a medium of community agricultural advancement. This and the further fact that a very large part of the irrigation development of the future in California will be brought about through some form of irrigation districts, publicly organized and to some extent publicly controlled, emphasizes beyond contradiction the desirability of progressive continuation of the stabilizing influences and safeguards that increasingly are being thrown around them.

Nothing can be gained by attempting to forecast the particular form or forms some of the larger conservation and reclamation movements of the future will take in California, but so far as local community irrigation movements are concerned, the irrigation district, organized and financed under a measure of public administrative control, is a proven institution.

APPENDIX

IRRIGATION DISTRICTS THAT HAVE BEEN DISSOLVED

A number of irrigation districts have been dissolved in California since the publication of Bulletin 2 of the State Department of Engineering in 1916. Among these are a number that were organized under the original Wright Act of 1887, and a number that were organized since 1897. No reference is made in the preceding pages to these districts which have been dissolved, with the exception of two. The following brief notes regarding these districts are therefore inserted for the sake of completeness:

Districts Organized Under the Original Wright Act of 1887.

For the early history of these districts see Bulletin 2 of the State Department of Engineering.

Happy Valley Irrigation District.—Reorganized in 1916 and bonds in the amount of $765,000 issued, of which $740,000 were sold and used for construction of an irrigation system. The district defaulted and was dissolved June 27, 1925, under an agreement between most of the bondholders and the landholders. Delinquent lands and the water system were acquired by the bondholders, and a land company and a water company were formed. The water company took a lien of $60 per acre on all first and second grade land in the district, this to be paid off in thirty annual installments at the rate of $2 per acre. Stock in the water company was issued to the bondholders on a dollar for dollar basis. The reorganized system is now being operated and efforts are being made to colonize the land. See also decisions 15,417 and 15,871 of the Railroad Commission of California.

Poso Irrigation District.—The investment company which acquired most of the bonds obtained a judgment and caused an assessment to be levied on all of the lands, the company protecting the owners of all those lands to whom title insurance policies had previously been issued at the rate of $11 per acre. The district was thereafter dissolved.

Big Rock Creek Irrigation District.—The socialist colony which was operating this district at the time of publication of bulletin 2 failed during the war. At an election September 7, 1918, it was unanimously voted to dissolve, and later a petition for dissolution was filed in the superior court of Los Angeles County. This petition set forth a plan of compromise and payment of the outstanding indebtedness, and a final decree of dissolution was entered by the court May 2, 1919. Prior to this decree, the property and assets of the district had been conveyed to Big Rock Mutual Water Company.

Vineland Irrigation District.—An effort was made to revive this district shortly after the war, but later a board of directors opposed to reorganization was elected, and the district was dissolved.

Perris Irrigation District.—Dissolved March 5, 1917 .

Grapeland Irrigation District.—The suits pending at the time of publication of Bulletin 2 were settled for about $4,000. An assessment was levied by the county supervisors to pay this judgment, thus cancelling all indebtedness. It is understood that this district has been dissolved, but definite information is not available.

Rialto Irrigation District.—The latest data available regarding this district do not go beyond 1922. At that time an appeal was pending on a judgment against the district for about $7,000. A petition for dissolution had been granted subject to the $7,000 judgment.

Districts Formed Since 1897.

Surprise Valley Irrigation District.—Organized March 2, 1918, with a gross area of 17,600 acres represented on the organization petition, and with 6430 acres of patented land on the assessment roll. Organization of the district was refused approval by the state engineer. The proposed water source was Cowhead Lake in California, and streams originating in Nevada, Oregon and California. An assessment at the rate of $2.29 on each $100 valuation was levied in 1918, the amount of the levy on the patented land being $4,282, of which $1,548 was collected. Immediately after organization, warrants were issued in the amount of $8,500, and later additional warrants for $2,060 were issued. These were sold to an individual who later brought suit to recover payment. On November 21, 1923, the superior court of Modoc County held that the warrants were originally obtained through fraudulent representation and were void. Judgment was given in favor of the district, and an appeal to the supreme court was dismissed on motion of the district. The district was dissolved by court action June 8, 1925, at which time the court held that the district had no assets and no liabilities.

Honcut-Yuba Irrigation District.—Formed November 17, 1919, with a gross area of approximately 30,000 acres, in Butte and Yuba counties, east of Feather River. Assessments were levied in each year from 1920 to 1924, inclusive, total collections approximating $48,000. Both Yuba and Feather rivers were considered as a source of water supply. Numerous engineering reports were made and the matter of approval was before the state engineer on a number of occasions, but approval was not given. Throughout the life of the district there was much internal dissension. On June 5, 1925, an election was held on the question of dissolution of the district, but the necessary vote for dissolution was not given. On January 9, 1926, however, on complaint filed by the Attorney General of the state, a decree of dissolution was

entered by the superior court of Yuba County. The warrants of the district, amounting to $40,947, were paid by the county treasurer, and $7,179 remaining in the treasury was refunded to the taxpayers of the district.

Suisun Irrigation District.—This was located in Solano County and embraces 26,173 acres. Petition for formation of the district was filed with the supervisors of Solano County October 4, 1920, a previous effort having been made to organize under the California irrigation act. The proposed source of water supply was Lindsay Slough, a delta branch of the lower Sacramento. At the first meeting of the board of directors July 26, 1921, engineers were appointed to report on the feasibility of bringing water from Sacramento River. They reported April 4, 1922, that the estimated cost exceeded the benefits and suggested Putah Creek as a more logical source of future water supply. The directors adopted the report of the engineers and forwarded it to the Bond Certification Commission, which agreed with the conclusion of the engineers. On September 12, 1922, an assessment of $1 on each $100 valuation was levied to provide for the payment of outstanding warrants, amounting to $12,773. On April 1, 1924, the directors passed a resolution in favor of dissolution, and on September 15, 1924, levied an assessment, amounting to $2,021, to pay the remaining indebtedness. At the request of the directors, action was instituted by the Attorney General on January 27, 1926, for the dissolution of the district, and a decree of dissolution was filed May 27, 1926. All indebtedness of the district was paid.

Klamath-Shasta Valley Irrigation District.—Dissolved January 23, 1924. See statement regarding Montague Conservation District, page 56.

Honey Lake Valley Irrigation District.—Dissolved February 23, 1922. See statement regarding Southern Lassen Irrigation District, page 352.

Long Valley Creek Irrigation District.—Dissolved June 8, 1920. See statement regarding Southern Lassen Irrigation District, page 352.

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*Bulletin No. 2—Formation of Irrigation Districts, Issuance of Bonds by Irrigation Districts, Expenditure of Construction Funds, etc.
Bulletin No. 3—Water Resources of Tulare County and Their Utilization, 1922.
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Bulletin No. 5—Flow in California Streams.
Bulletin No. 6—Irrigation Requirements of California Lands.
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*Bulletin No. 8—Cost of Water to Irrigators in California.
Bulletin No. 9—Supplemental Report on Water Resources of California.
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Bulletin No. 12—Summary Report on the Water Resources of California and a Coordinated plan for Their Development.
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(II) Reprinted in 5th Biennial Report. (Out of print.)
(v) Reprinted in 6th Biennial Report. (Out of print.)

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