SAN LUIS UNIT

CENTRAL VALLEY PROJECT
C A L I F O R N I A

A Report on the feasibility of Water Supply Development

DEPARTMENT OF THE INTERIOR
March 3, 1849

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

GPO 968842

C O P Y

EXECUTIVE OFFICE OF THE PRESIDENT

BUREAU OF THE BUDGET

WASHINGTON 25, D.C.

November 9, 1956

Dear Mr. Secretary:

This is in response to your letter of August 1 concerning the San Luis Unit, West San Joaquin Division, Central Valley Project of California.

The proposal that the Federal Government join with the State of California in the development of this unit is entirely in accord with the administration's overall policy of cooperative development of the Nation's water resources. We would urge you, at your earliest convenience to explore this possibility in greater detail with the State of California to see if mutually satisfactory arrangements can be made.

We would be pleased to review such plans when they have been formulated.

Sincerely yours,

/s/ Robert E. Merriam

Robert E. Merriam
Assistant Director

The Honorable

The Secretary of the Interior

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
Washington 25, D. C.

August 1, 1956

Through: Bureau of the Budget

My dear Mr. President:

My report on the San Luis Unit, West San Joaquin Division, Central Valley Project, California, is transmitted herewith, pursuant to the provisions of Section 9 (a) of the Reclamation Project Act of 1939 (53 Stat. 1187).

The Unit will provide a full water supply to 440,000 acres of land along the west side of the San Joaquin valley. Most of this area is presently irrigated from ground water, but due to the rapidly lowering water levels, it is estimated that less than 150,000 acres can be sustained in permanent irrigated agriculture under present conditions. The Unit will also provide some domestic and municipal water supplies as well as important benefits to recreation and the preservation and propagation of fish and wildlife.

The major works involved include the San Luis Reservoir of 1,000,000 acre-foot initial capacity, the San Luis pumping plant to pump water from the Delta-Mendota Canal to the San Luis Reservoir or directly to the irrigation canal system, and a system of main canals to serve the project area. The capacity could be increased by another 1,000,000 acre-feet or more to be available when needed by the State of California for its further development of water utilization. In addition to these major works, certain other features consisting of a distribution system, drainage system, and deep wells for ground water pumping will be required. The latter of these three items is proposed for non-Federal construction while the first two are proposed for either Federal or non-Federal construction.

The estimated cost of the major works, based on January 1954 prices, which are close to present prices, is $229,143,000. The estimated cost of the other features is $170,067,000, making a total Unit cost of $399,210,000. Modification of plans to integrate the Unit into the proposed Feather River Project will, of course, alter these costs to some extent, but it is not expected that they would be changed significantly.

Our studies indicate that the Unit is economically justified and that all reimbursable costs will be returned within 50 years. The Unit is urgently needed to prevent a progressive recession of farming, the major economic activity in the service area. The local people have shown interest in and support for the development.

The report has been transmitted to officials of the State of California and to the Secretary of the Army for their consideration and recommendations as required by the provisions of Section 1 (c) of the Flood Control Act of 1944 (53 Stat. 887). It was sent also to the State of California for the comments of the head of the agency exercising administration over the wildlife resources of that State as required by the provisions of the Act of August 14, 1946 (60 Stat. 1080) and to the Departments of Agriculture, Commerce, Labor, and Health, Education, and Welfare, and the Federal Power Commission in accordance with interagency agreements. Comments have been received from all agencies, and copies are enclosed with the report.

The comments of all Federal agencies received are either favorable or without objection to the San Luis Unit.

The State of California, in its comments, recommended that the San Luis Unit, modified to fit the State's proposed Feather River Project, be authorized for immediate construction by the Bureau of Reclamation and for operation by the State as part of its Feather River Project. The State proposed also that it acquire and pay for all lands, easements, and rights of way for the San Luis Unit, contract for the use and repayment of Central Valley Project power facilities, repay to the United States from project revenues the reimbursable project costs on an interest-free basis, and upon completion of repayment receive title to all of the Unit works. All of these provisions, under the State's recommendations, would be accomplished by contract between the Secretary of the Interior and the State of California which would require approval by the Congress prior to construction of the San Luis Unit.

The basic objectives of the State in its proposals to share in project costs, assume project operation, and construct the larger Feather River Project are all consistent with the partnership approach sponsored by this Administration, which I fully support. As the Commissioner of Reclamation points out, however, there are several facets of the State's recommendations that will require detailed study and negotiation before final agreement can be obtained.

Initial construction of the Unit as an extension of the Central Valley Project, modified to fit ultimately into the Feather River Project, and accompanied by concurrent negotiations with the State of California looking to terms of integration of the Unit with the Feather River Project, is one way in which the immediate basic objectives of the State of California could be achieved. This would avoid the delay that would be involved in securing firm agreements with the State concerning integration with the Feather River Project and in obtaining the approval of the Congress prior to initiation of construction. Negotiations with the State could result in agreement prior to completion of the project. The Department desires to cooperate with the people of California and its government. This is in accord with your policy to promote to the ultimate degree cooperation with the people affected. The Department of the Interior is ready to begin these negotiations immediately upon request by the proper State officials.

The report is being transmitted to you as an interim report for your information in advance of recommendations for legislative action. Upon receipt of your comments it, likewise, will be transmitted to the Congress for its information.

Sincerely yours,

(Sgd.) Fred A. Seaton

Secretary of the Interior

The President
The White House
Washington 25, D. C.

Enclosures

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
Washington 25, D. C.

730 June 18, 1956

The Secretary

of the Interior

Sir:

This is my report on the San Luis Unit, West San Joaquin Division, Central Valley Project, California. It is based on and includes the proposed report on this project which you approved for transmittal to States and Federal agencies on December 1, 1955.

Copies of your proposed report were transmitted to the State of California and to the Secretary of the Army in accordance with provisions of section 1(c) of the Flood Control Act of 1944 (58 Stat. 887) and to the State of California for comments of the head of the agency exercising administration over the wildlife resources of that State in accordance with provisions of the Act of August 14, 1946 (60 Stat. 1080). Copies of the report were also sent to the agencies represented on the Inter-Agency Committee on Water Resources for comments.

Comments have been received from all agencies and are attached. The views of the Federal agencies are generally favorable and such as to require no revision of your proposed report.

The views of the State of California are extensive and raise several points that may not be susceptible to early resolution. In essence the State recommends that the San Luis Unit, modified to fit the State's proposed Feather River Project, be authorized for immediate construction by the Bureau of Reclamation and for operation by the State of California as part of its Feather River Project. The State would acquire and pay for all lands, easements, and rights of way for the San Luis Unit, would repay to the United States from project revenues the reimbursable construction costs on an interest-free basis, and upon completion of repayment would receive title to all of the Unit works. Further, the State would contract for the use and repayment on an interest-free basis of Central Valley Project power facilities to the extent and at the cost at which those facilities would have been associated with the San Luis Unit if constructed and operated by the Federal Government as an extension of the Central Valley Project.

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Although this last provision is not entirely clear, it appears, from the discussion in the State's comments, to involve repayment by the State of $67,304,000 of capital investment in the Central Valley Project power system over a 40-year period. In return 200,000 kilowatts of power would be made available to the State in the vicinity of Tracy and energy up to 830,000,000 kilowatt-hours per year would be available at 2.5 mills per kilowatt-hour. It is not apparent whether or not such repayment of capital investment in the Central Valley Project power system would be expected to entitle the State to a continuing right to power from the Central Valley Project after expiration of the 40 years and upon what terms.

I am fully in accord with the State's objective of integrating the San Luis Unit with the Feather River Project and am confident that mutually satisfactory means can be found to accomplish this. I cannot conclude at this time, however, that the proposals of the State are entirely acceptable or constitute the best means of obtaining this integration. Several aspects of its recommendations involve precedent making policies in Federal-State relationships which should receive careful study and consideration. Most important of these are the following:

1. Acquisition and retention by the State of lands, easements, and rights of way upon which Federal structures would be built. This would require special legislation exempting the San Luis Unit in this respect from the existing requirements of Reclamation law.

2. Assumption by the State of the role of contracting entity for repayment of Unit costs. There is no precedent in Reclamation experience for this arrangement, at least for an undertaking of this magnitude. Negotiations new in scope and character and encompassing new problems would be involved; for example, provisions relating to acreage limitation and other requirements of Reclamation law and examination of the existing authority of the State to assume the obligations that would be imposed on it including the guaranteeing of repayment of Federal costs.

3. Adoption of special conditions for furnishing pumping power from a Federal to a State project. Here again there is no precedent, and the State proposal opens a new field of policy in Federal-State relationships.

Power from the Trinity River Division is contemplated as the major source for the San Luis Unit pumping requirements, and hence, in addition, final arrangements for construction of Trinity power facilities now under negotiation with non-Federal interests could well affect the nature of any contract to supply power to the State for the San Luis Unit pumping purposes.

Without rather extensive policy guidance on the above and other points in the authorizing legislation, which would be difficult for the Congress to furnish prior to exploration and study of the issues involved in their many ramifications, negotiations leading to an acceptable contract could be quite time consuming. The need for additional water supply in the San Luis area is urgent, the local interests are urging an early start of construction, and there appear to be no material obstacles to agreement on the physical structures required. If construction were started in 1957, it would be at least 1963 before water would be available to the area.

On the other hand, initial construction of the Unit as an extension of the Central Valley Project, modified to fit ultimately into the Feather River Project, would be a way to meet the immediate basic objectives of the State. During construction, and as the plans for the Feather River Project and the Trinity River development become crystallized, negotiations could be carried out between the Secretary of the Interior and the State of California for integration of the San Luis Unit with the Feather River Project. Adequate time would thus be available to study fully the problems involved and reach agreement free of the time pressure that would be present if final agreement and subsequent congressional approval were prerequisite to initiation of construction. Any arrangement or contract thus developed should be subject to approval by the Congress.

As indicated hereinbefore, the various matters raised by the State of California present many problems. Nevertheless, the Governor of California in hearings before both the House and Senate Committees on Interior and Insular Affairs, indicated his belief and intent that these problems could be worked out. We are currently exploring these problems with the State Engineer and are seeking clarification of some details of the State's position. Although a legislative recommendation will depend on further analysis and resolution of some of the problems herein outlined, I urge that you approve and adopt this report as an interim report on the project and that you transmit it, together with the attached comments, to the President and the Congress.

Respectfully,

(Sgd.) E. E. Nielson
Acting Commissioner

Attachments

August 1, 1956

Approved and Adopted:

(Sgd.) Fred A. Seaton

Secretary of the Interior

1926 Interior—Duplicating Section, Washington, D. C.

DEPARTMENT OF AGRICULTURE
WASHINGTON 25, D. C.

June 11, 1956

The Honorable
The Secretary of the Interior

Dear Mr. Secretary:

This is in reply to the Acting Commissioner of Reclamation's letter of December 5, 1955, transmitting for our review and comment a copy of your proposed report on the San Luis Unit, West San Joaquin Division, Central Valley Project, California.

To provide water for the San Luis Unit the off-irrigation season excess capacity of the existing Tracy Pumping Plant and Delta-Mendota Canal would be used to deliver surplus Delta water to the forebay of the proposed San Luis Pumping Plant. That plant would be used to pump water for storage into the proposed 1,000,000 acre-feet capacity San Luis Reservoir to be formed by construction of San Luis Dam on San Luis Creek. When possible during the irrigation season, water would be pumped directly into a proposed 104 mile long San Luis Canal for delivery to the Unit distribution system. At mile 76 on the San Luis Canal, the proposed Pleasant Valley Pumping Plant would lift water into the proposed Pleasant Valley Canal to serve higher elevation lands at the south end of the Unit area. An electrical distribution system to serve Unit pumps, channels, levees, flood works to protect project features, and relift pumps on both sides of the main canals would also be Unit works. In addition to these major works a distribution system, a drainage system, and deep wells for groundwater pumping would be required.

The estimated Federal cost of the major works is $229,143,000 and the non-Federal cost of other features is $170,067,000, total $399,210,000 based on 1954 prices. Considering primary benefits only, the benefit-cost ratio based on a 100-year period of analysis is 1.07 to 1.0 and on a 50-year period is 0.94 to 1.0. The project would be completed in about seven and one-half years.

The proposed project would deliver an estimated 1,126,000 acre-feet of water annually from the main San Luis Canal. In addition, 540,000 acre-feet would be obtained from groundwater pumping. This total of 1,666,000 acre-feet annually would provide a full irrigation water supply for 440,000 acres out of an irrigable area of 458,000 acres and would supply 22,600 acre-feet and 17,400 acre-feet, respectively, for municipal and domestic farm uses.

Of the more than 400,000 acres in the Unit now developed for irrigation only a portion (273,000 acres in 1950) are served from overdrawn wells. The area that can be served from groundwater alone is estimated to stabilize at 148,000 acres. An imported supply is required to maintain the present economy. Construction of the Unit works would make possible the irrigation of 292,000 acres more in the service area than would be possible without the project. On the basis of this acreage, the indicated Federal and non-Federal investment cost for irrigation would be about $1,576 per acre.

Financial feasibility for the San Luis Unit is shown through its integration with other units of the Central Valley Project. This combination of units by 1974, when the San Luis Unit would be using the planned full supply of irrigation water, is expected to be producing an annual net increase in revenue of $2,878,400 over that expected in absence of the San Luis Unit. Project revenue from irrigation would be increased by $4,447,600 and from municipal and industrial water by $168,800 with net income from power decreased by $1,738,000. The report indicates that operation of the San Luis Unit would require the use of large amounts of electric energy for pumping which otherwise would be sold commercially. In evaluation of the economic effects of expanding the Central Valley Project by addition of San Luis Unit, the annual equivalent value of the electric power foregone was estimated to be $5,942,000.

The project is estimated to increase cotton acreage from 49,200 to 132,000 acres, increase truck crops and alfalfa from 0 to 88,000 acres, increase irrigated pasture from 0 to 44,000 acres, increase tree and vine crops from 0 to 22,000 acres, increase other field crops from 0 to 66,000 acres and to decrease hay and grain crops from 98,700 to 44,000 acres.

We appreciate your courtesy in making the report available to us for review.

Sincerely yours,

(Sgd.) E. L. Peterson

E. L. Peterson
Assistant Secretary

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LAND-302

THE UNDER SECRETARY OF COMMERCE
FOR TRANSPORTATION
Washington 25

March 2, 1956

Mr. E. G. Nielsen
Acting Commissioner
Bureau of Reclamation
Department of the Interior
Washington 25, D. C.

Dear Mr. Nielsen:

Reference is made to your letter of December 5, 1955, requesting comments of the Department of Commerce on the proposed report of the Department of the Interior on the San Luis Unit, West San Joaquin Division, Central Valley Project, California.

Although there appears to have been sufficient geodetic control for preliminary studies, the present control is not adequate for the detailed engineering construction required for a project of this magnitude; nor is there provision for geodetic control for investigations relative to drainage, irrigation and subsidence. It is estimated that geodetic control providing adequate coverage over the entire service area, plus the releveling program over the subsidence area for one year, will cost about $65,000, including processing and adjustment. Thereafter, $20,000 will be needed annually for releveling over the subsidence area.

It appears that initial construction will create a reservoir at elevation of about 450 feet, and that subsequent enlargement of the reservoir will raise the water level to about 535 feet. As indicated on page 58 of the proposed report the reservoir will require relocation of a State highway. The affected highway also is identified as California Federal-aid primary Route No. 19.

The replacement road will traverse a relatively rugged terrain on indirect and curved alignment, in comparison with the easy terrain and the high standards of alignment along and on the existing road. With the existing highway traversing flat terrain affording easy construction for multilane development, it is the contention of the California Department of Public Works that the replacement road should provide a graded facility of sufficient width to permit the expansion of additional lanes relatively commensurate with any like work which could be done in the future on the existing road without regard to the water project.

The improvement being proposed by the State as a replacement road consists of grading to a sufficient width to accommodate an ultimate 6-lane highway divided by a 10-foot median strip, with the

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probability of initially including four lanes of pavement. Standards for such construction would be based upon a design speed of 50 miles per hour, and a maximum grade of 5 percent. Except for the water project, the existing road could be improved as a 6-lane divided highway to design standards for 70 miles per hour, at substantially less cost than the indicated 6-lane divided highway on the new elevation resulting from the water project. Hence, the State contends that it is reasonable and equitable to expect that Federal water project funds will finance the cost of grading for the ultimate 6-lane improvement on the adverse location resulting from the water project and the cost of two lanes of pavement.

Assuming a replacement road constructed above elevation of 450 feet, preliminary investigations indicated that the water project funds would bear about $3,000,000 in highway relocation costs on the foregoing basis. It is our understanding that the water project financing contains this item. According to the California Department of Public Works, preliminary investigations also indicated that such a replacement road constructed above elevation 535 feet would require water project financing of $5,000,000. Subsequent investigations disclose that a replacement road at the higher elevation may require water project financing ranging from $7,000,000 to $10,000,000.

Since the elevation at which the replacement road is to be constructed is not clearly shown in the report, it is suggested that field representatives of the Bureau of Reclamation may wish to discuss the proposed relocation with field representatives of our Bureau of Public Roads, and with the California Department of Public Works, before a request is made for funds to initiate construction of the water project. On the basis of such discussions, all parties in interest can obtain a clear understanding of each other's plans, and budgetary provision can be made in advande for having the water project adequately finance the highway relocation costs. This Department has made no effort to determine the extent to which the added cost of constructing the relocated road above elevation of 535 feet might affect the benefit cost ratio of the water project.

As an indication of Department of Commerce views on highway relocations made necessary by water resources projects, I am enclosing a copy of Department of Commerce, Bureau of Public Roads, Policy and Procedure Memorandum 50-4.2.

Sincerely yours,

(Sgd) Paul F. Royster

Paul F. Royster
Assistant to Under Secretary

Enclosure

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96015 Interior -- Duplicating Section, Washington, D. C.

FEDERAL POWER COMMISSION
Washington 25

April 5, 1956

Honorable Douglas McKay
Secretary of the Interior
Washington 25, D. C.

Subject: San Luis Unit, Central Valley Project, California

Dear Mr. Secretary:

The comments herein with respect to the proposed report of your Department on the San Luis Unit, Central Valley Project, California, are transmitted in response to the letter of December 5, 1955 from the Acting Commissioner of Reclamation. Transmitted with that letter were copies of the Commissioner of Reclamation's proposed report of August 4, 1955, approved by you on December 1, 1955 for transmittal to States and Federal agencies, the Regional Director's report of May 6, 1955, and appended material.

The report recommends a plan for utilizing surplus flows in the Delta area to provide supplemental irrigation water for about 440,000 acres of land on the west side of the San Joaquin Valley and a small amount of municipal water for nearby communities. The plan would make use of off-irrigation season excess capacity of the existing Tracy pumping plant and Delta-Mendota canal to deliver the surplus water to the proposed San Luis pumping plant. From there the water would be pumped into the proposed San Luis reservoir to be stored and later released into the proposed 104 mile long San Luis canal for delivery to the unit distribution system. When possible during the irrigation season, water would be pumped directly from the proposed pumping plant into the proposed canal. An estimated 1,126,000 acre-feet of water would be delivered annually from the main San Luis Canal.

The cost of the major Federal works is estimated in the report at $229,143,000, based on January 1954 prices. The cost of other features is estimated at $170,067,000, making a total estimated cost of $399,210,000, exclusive of interest during construction. The cost of the major Federal works would be integrated into the overall Central Valley Project costs for repayment purposes. The report states that the unit would be economically justified.

As noted in the report, the State of California's proposed water plan for the Feather River Project includes facilities which are similar to those recommended for the San Luis Unit. It appears that under your Department's proposed plan the San Luis reservoir would be constructed with an initial storage capacity of 1,000,000 acre-feet, with provisions for future enlargement to a capacity of about 2,000,000 acre-feet. It is understood that the State's plan

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includes a reservoir at the same site with the latter storage capacity. Both plans also require canal capacity from the Delta area to the proposed San Luis pumping plant and from the proposed San Luis reservoir southward, eventually furnishing water to southern California in the case of the State's plan. The report indicates that there appear to be no irreconcilable engineering or financial problems involved in coordinating the construction of the San Luis Unit and features of the California water plan. An application from the State of California for a license to develop hydroelectric power at the Oroville site on the Feather River, which development is an integral part of the State's proposed Feather River Project, is pending before the Federal Power Commission.

The Commission has no comment to make regarding the coordination of the plans of your Department with those of the State of California, but has limited its studies to a consideration of the possibility of developing hydroelectric power in connection with the San Luis Unit plans. It is noted that the water released from the proposed San Luis reservoir to the canal would fall through a variable head which would reach 100 feet as a maximum. It is estimated that under the operation plans set forth in the report, these releases could be utilized to produce an average of approximately 35,000,000 kilowatt-hours of electric energy annually. Although seasonal in character, this energy could be used to supply a portion of the project pumping requirements. However, studies by the Commission staff indicate that such a development of power would not be economically justified under present conditions.

In connection with the above, it appears that the amount of energy that could be produced with flows released from the San Luis reservoir to the canal would be substantially greater under future conditions, possibly amounting to as much as 200,000,000 kilowatt-hours annually, with the reservoir enlarged to ultimate capacity and with possibly larger releases in connection with the State's plan to supply **water** to southern California. It is not known whether such a future power development would be economically justified.

Brief consideration has also been given by the Commission to the possibility of a pumped-storage development, utilizing the head between the San Luis reservoir and a forebay at the proposed pumping plant. Under such a plan, some of the pumps would be replaced with reversible pump-turbine units to permit off-peak pumping to the reservoir and on-peak generation with return flows. Preliminary studies by the staff indicate that such a development may have possibilities of economic feasibility. It is noted that the head available for

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pumped-storage development would be increased with the enlargement of the San Luis reservoir to its ultimate storage capacity.

On the basis of the foregoing, the Commission believes it desirable that at such time as the detailed plans for the San Luis Unit are prepared, including any modifications resulting from integration with the State plans, the possibilities for hydroelectric power development discussed herein should be investigated further.

Sincerely yours,

(Sgd) Jerome K. Kuykendall

Jerome K. Kuykendall
Chairman

DEPARTMENT OF THE ARMY
Office of the Chief of Engineers
Washington 25, D. C.

9 March 1956

Honorable W. A. Dexheimer
Commissioner
Bureau of Reclamation
Department of the Interior
Washington, D. C.

Dear Mr. Dexheimer:

Reference is made to your letter dated 5 December 1955 to the Secretary of the Army and the Chief of Engineers transmitting for review and comment the proposed report of the Department of Interior on the San Luis Unit, Central Valley Project, California.

A review of your report indicates that there is no apparent conflict between the proposed imporovements and existing projects or plans of the Corps of Engineers in the Central Valley Drainage Basin.

Although the report indicates that no part of the cost of the San Luis Unit would be allocated to either navigation or flood control, the report contains the results of a cost allocation for the Central Valley Project including the San Luis Unit which assigns costs to both navigation and flood control. No information is available in the report for reviewing that cost allocation. In view of the interest of the Corps of Engineers in navigation and flood control, we would appreciate the opportunity to review these cost allocations before they are finalized.

The opportunity to review your report is appreciated.

Sincerely yours,

(Sgd.) S. D. Sturgis Jr.

S. D. STURGIS, JR.
Lieutenant General, USA
Chief of Engineers

W/MPR 000953

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
Washington 25, D. C.

March 15, 1956

Refer to: WS&WPC

Mr. W. A. Dexheimer, Commissioner
Bureau of Reclamation
Department of the Interior
Washington 25, D. C.

Reference: Code 736

Dear Mr. Dexheimer:

This is in response to Acting Commissioner Nielsen's request of December 5, 1955, transmitting the proposed report to the Department of the Interior on the San Luis Unit, West San Joaquin Division, Central Valley Project, California. The report has been reviewed with attention to this department's responsibility and interest in the national water resources program. Our comments are attached.

We appreciate the opportunity to review the proposed project plan at this stage of its development. We shall be happy to assist the Bureau of Reclamation in working out any health-related measures that may be needed in connection with the project.

Sincerely yours,

(Sgd) M. D. Hollis

M. D. Hollis
Chief Sanitary Engineering Officer, PHS
Department of
Health, Education, and Welfare

Attachments

COPY

LAND-302

UNITED STATES
DEPARTMENT OF THE INTERIOR
WASHINGTON 25, D. C.

DEC 17 1956

My dear Mr. Speaker:

My report on the San Luis Unit, West San Joaquin Division, Central Valley Project, is transmitted herewith pursuant to the provisions of section 9(a) of the Reclamation Project Act of 1939 (53 Stat. 1187). The report is being transmitted as an interim report for the information of the Congress in advance of recommendations for legislative action. Negotiations with the State of California concerning possible means of integrating the San Luis Unit with the proposed Feather River Project of the State are proceeding at the present time and their outcome will be instrumental in shaping the recommendations that this Department will make when authorizing legislation for the San Luis Unit is considered by the Congress.

Copies of this Departmnet's proposed report were transmitted to the State of California and to the agencies represented on the Interagency Committee on Water Resources for comment. Comments have been received from all to which the report was sent, and copies are enclosed.

The report and copies of all comments were transmitted to the President. Enclosed is a copy of the letter of comments of November 9, 1956, from Assistant Budget Director Robert E. Merriam.

Sincerely yours,

(sgd) Fred A. Seaton

Secretary of the Interior

Hon. Sam Rayburn
Speaker of the
House of Representatives
Washington 25, D. C.

Enclosures

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COMMENTS ON
SAN LUIS UNIT, CENTRAL VALLEY PROJECT, CALIFORNIA
(Bureau of Reclamation, Department of the Interior)

Project Description

The San Luis Unit is located in the western part of the San Joaquin Valley. It consists of a strip approximately sixty-five miles in length and thirteen miles wide, the central part being about thirty miles southwest of the city of Fresno. The unit is primarily intended to preserve and expand irrigation in the unit area by means of importing water from the Sacramento-San Joaquin Delta. The estimated total unit cost is $399,210,000. The estimated total benefit-cost ratio based on a fifty-year period of analysis would be 2.2 to 1.

Comments

The report takes into account the necessary priority of domestic water supply and provides for the delivery of municipal and domestic water as recommended by our field staff when the report was in draft form. At the same time, field office comments were provided on vector and vector-borne disease problems. Although the format of the final draft of the substantiating report does not allow for incorporation of these comments, it is understood that they will be considered at the time of project construction.

The major mosquito-producing areas associated with the proposed project are likely to be those related to the application of water to the land and the removal of excess water from the land. Mosquito production on irrigated fields has been found to occur most often on pastures and other fields used for close-growing forage crops. Comparatively few mosquitoes are produced on fields planted to row crops since these crops cannot survive flooding long enough for the larvae to complete their development.

Past experience in the San Joaquin Valley has shown that tremendous numbers of pest mosquitoes are produced in the temporary pools that occur on irrigated forage crops and pastures. It is anticipated that the proposed increase in acreage of irrigated close-growing forage crops will result in considerable mosquito production unless good irrigation practices are employed. All possible measures should be employed for minimizing mosquito breeding in accordance with the attached recommendations.

Attachment: (Recommendations for Mosquito Control Measures)

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RECOMMENDATIONS FOR MOSQUITO CONTROL MEASURES
(San Luis Unit, Central Valley Project, California)

In order to prevent or minimize mosquito problems, it is recommended that the following basic principles be adhered to in the development of more detailed plans for the design, construction, maintenance, and operation of the proposed San Luis Unit. By incorporating preventive measures into the plan of development, the magnitude of mosquito problems that require repetitive control will be greatly reduced. In cases where the preventive measures outlined below cannot be utilized, full provision should be made for chemical or other supplemental measures to provide adequate control of mosquito problems associated with the project.

The following principles apply to mosquito problem areas within one and one-half miles of urban population centers, rural population groups, or recreational areas frequented by significant numbers of persons during the mosquito breeding season.

1. San Luis Storage Reservoir, Detention Basins and Regulating Reservoirs:

   (a) Clearing:

      (1) Dispose of all trees, brush, logs, or other material below the normal summer pool elevation which might float or collect flotage and drift when the water is impounded. (For mosquito control purposes it is not necessary to clear the timber from the deeper portion of the reservoir where it will be completely submerged at minimum normal operating pool elevation. Timber rooted below the normal minimum pool level but extending above the elevation may be felled and securely anchored in lieu of disposal. This practice sometimes has advantages in fisheries management.)

      (2) Clear the fluctuation zone completely, except for isolated trees or small growths of trees on abrupt shore lines exposed to wave action. The term "clearing" includes disposal of trees, underbrush, vines, fences, bridges, houses, barns, shed, etc.

      (3) Remove secondary vegetative growth from shallow areas prior to impoundment, and as necessary after the reservoir has been impounded.

   (b) Drainage:

      (1) Locate borrow areas where they will be permanently inundated, if possible. Borrow areas located in the fluctuation zone or outside the reservoir basin should be self-draining.

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(2) Provide adequate drainage for seepage areas below or back of dikes.

(3) Provide drainage for all depressions, sloughs, swamps and marshes in the fluctuation zone which would result in mosquito production after impoundage. The objective of such drainage is to insure that these areas will drain or fluctuate with the main lake.

(c) Release of water from the detention basins should be started within five days, if possible.

(d) Deepen or fill shore lines of regulating basins to preclude shallow water areas that would favor mosquito production.

2. Irrigation Canals and Laterals:

(a) Maintain grade and provide facilities for the removal of residual water from canals, laterals, and their appurtenances when they are not in use.

(b) Place underdrains, culverts, etc., on grade to insure complete drainage.

(c) Install drains on the high side of the canal where necessary to prevent ponding of surface runoff.

(d) Locate borrow ar as where they will not be flooded, or provide drains to insure complete removal of water.

(e) Provide lining where necessary to prevent seepage which would result in conditions favorable for mosquito production.

(f) Make provision for additional seepage control work during the post-construction period to meet actual needs as they develop.

(g) Provide for the removal of vegetation, debris, and flotage, and other necessary maintenance to insure free flows.

3. Irrigated Lands:

The production of encephalitis--transmitting and other pestiferous mosquitoes is frequently a by-product of poor irrigation and cultural practices. These practices also cause serious damage to agricultural lands, excessive loss of water, and a reduction in crop yields. Irrigation farmers should be encouraged to employ the following basic principles that will be of mutual benefit to agriculture and mosquito control:

(a) Avoid application of water to lands having unsuitable soil, topographic or drainage characteristics.

(b) Employ field layouts and irrigation methods that pertain to land, crops, and water supply situation.

(c) Prepare fields so that water can be applied with maximum efficiency.

(d) Avoid a plication of water in excess of crop demands.

(e) Avoid the practice of allowing cattle to run on pastures and grassed waterways when the soil is too wet.

(f) Install drains to insure adequate removal and disposal of waste water and natural runoff from all lands on the farm.

(g) Provide adequate maintenance to insure free flows in all drains.

4. Main Drainage System:

(a) Provide an overall drainage system for the removal of waste water and natural surface runoff from all irrigated farms and to remove seepage water.

(b) Make provision to prevent ponding of water in grassed waterways and natural channels that are utilized for the disposal of excess irrigati n water and natural surface runoff.

(c) Make provision for additional construction of drains during the post-construction period to meet actual needs as they develop.

(d) Provide for the removal of vegetation, debris, silt, and flotage, and carry out necessary maintenance to insure free flows.

It is recommended that the Public Health Service be kept currently advised regarding any change in plans and any proposed construction schedules so that guidance and consultation may be provided with regard to mosquito problems associated with the project.

W/MPR 000953

U. S. DEPARTMENT OF LABOR
Office of the Assistant Secretary
WASHINGTON

March 5, 1956

Mr. W. A. Dexheimer
Commissioner
Bureau of Reclamation
U. S. Department of the Interior
Washington 25, D. C.

Dear Mr. Dexheimer:

In my letter of December 29, 1955, I agreed to examine the proposed report on the San Luis Unit Project, California and transmit my comments within the specified time period.

Our review of the report indicates that if the project is authorized and undertaken, it will have a beneficial effect on employment in the area and on the economy of other parts of the State, as well as that of the immediate area. The increased supply of water should make small farm operation in the area feasible and should result in more stable farm employment.

In view of the above considerations, the Department of Labor is pleased to endorse the San Luis Unit Project report. This recommendation presupposes, of course, that the project is economically sound and feasible, and that it meets the standards set forth in the pertinent laws.

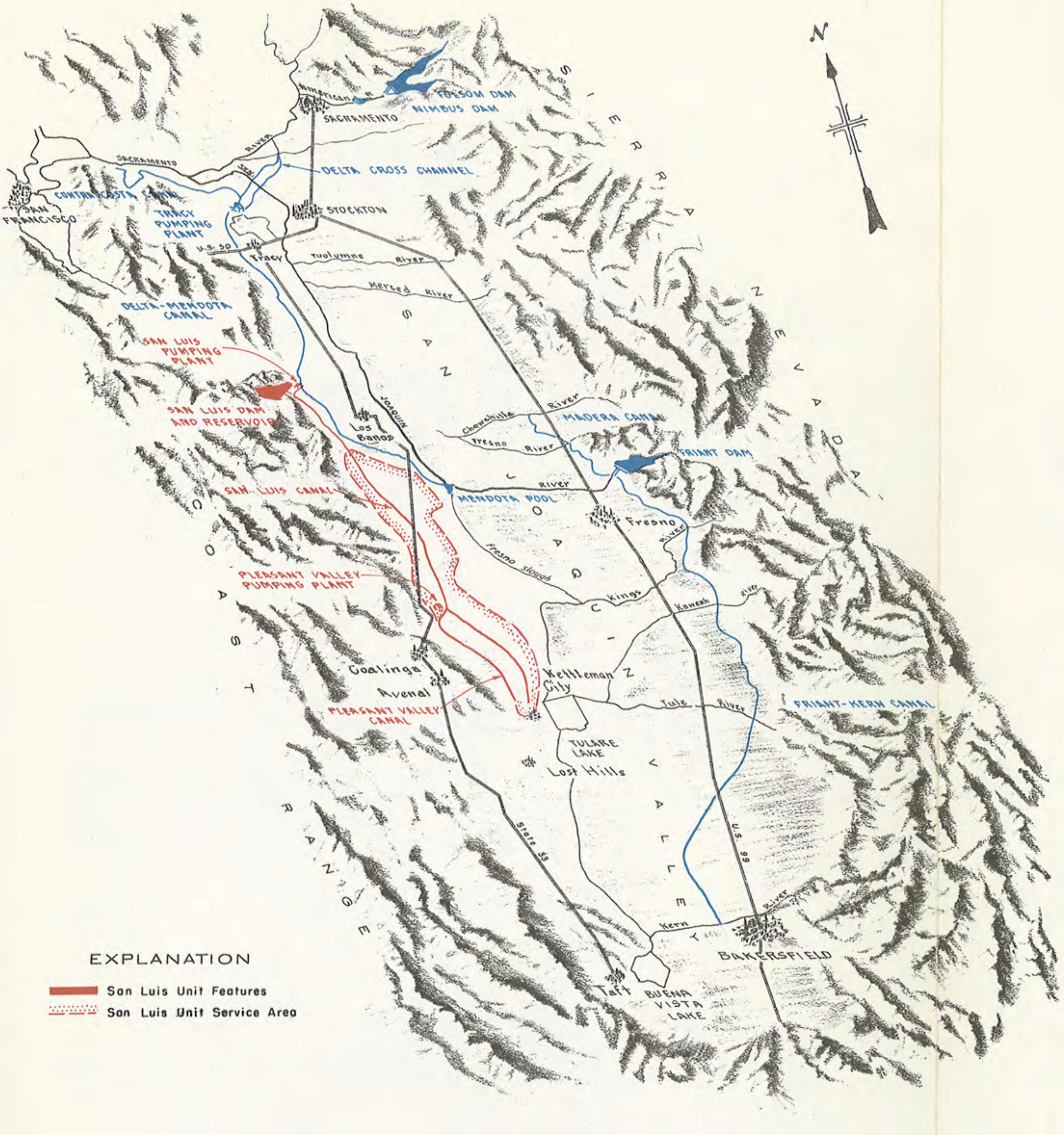
The Department appreciates the opportunity to review this report.

Sincerely yours,

(Sgd) Rocco C. Siciliano

Rocco C. Siciliano
Assistant Secretary of Labor

W/MPR 000953



SAN LUIS UNIT

CENTRAL VALLEY PROJECT
ULTIMATE PLAN
CALIFORNIA

NOVEMBER 1954

GPO 968842

105-208-33

SAN LUIS UNIT

CENTRAL VALLEY PROJECT
CALIFORNIA

UNITED STATES

DEPARTMENT OF THE INTERIOR

DOUGLAS McKAY, SECRETARY

BUREAU OF RECLAMATION

WILBUR A. DEXHEIMER, COMMISSIONER

CLYDE H. SPENCER, REGIONAL DIRECTOR

REGION 2

SACRAMENTO, CALIFORNIA

MAY 1955

A C K N O W L E D G E M E N T S

Individuals, local groups, and State and Federal agencies have furnished valuable assistance during the course of the investigations leading to this report. Particular acknowledgement is due the West Side Landowners Association and its successor, the Westlands Water District. Other landowners on the west side of the San Joaquin Valley and their organizations, including the San Luis Water District, and Panoche Water District have furnished field data. The City of Coalinga has supplied information on its water needs for municipal and industrial purposes. The Pacific Gas and Electric Company and the North Dome Association of Oil Companies were helpful in providing well data. The Merced County Planning Commission was instrumental in forming recreational plans.

The California State Division of Water Resources, the Division of Highways and the State Department of Fish and Game have assisted in providing basic information. The Department of the Interior agencies, the Geological Survey, Fish and Wildlife Service and National Park Service have assisted in their respective fields; basic topographic data having been supplied by the Geological Survey, and reports on fish and wildlife and recreation by the two Services.

In accordance with established policies governing the coordination and distribution of reports, the preliminary draft of this report was transmitted to other Federal, State and local agencies for informal review and comment. This report was prepared after giving careful consideration to the many helpful comments received from reviews by the following:

Department of Agriculture

- Forest Service
- Soil Conservation Service

Department of the Army

- Corps of Engineers

Department of Commerce

- Civil Aeronautics Administration
- Weather Bureau

Department of Health, Education and Welfare

- Public Health Service

Department of the Interior

- Fish and Wildlife Service
- Geological Survey
- Bureau of Land Management
- Bureau of Mines
- National Park Service

Federal Power Commission

State of California

- Division of Water Resources
- Division of Highways
- Department of Natural Resources
- Department of Fish and Game
- State Lands Commission
- (Informal comments of various State agencies consolidated by the State Engineer)

Westlands Water District

REPORT OF THE REGIONAL DIRECTOR

C O N T E N T S

SUBSTANTIATING REPORT

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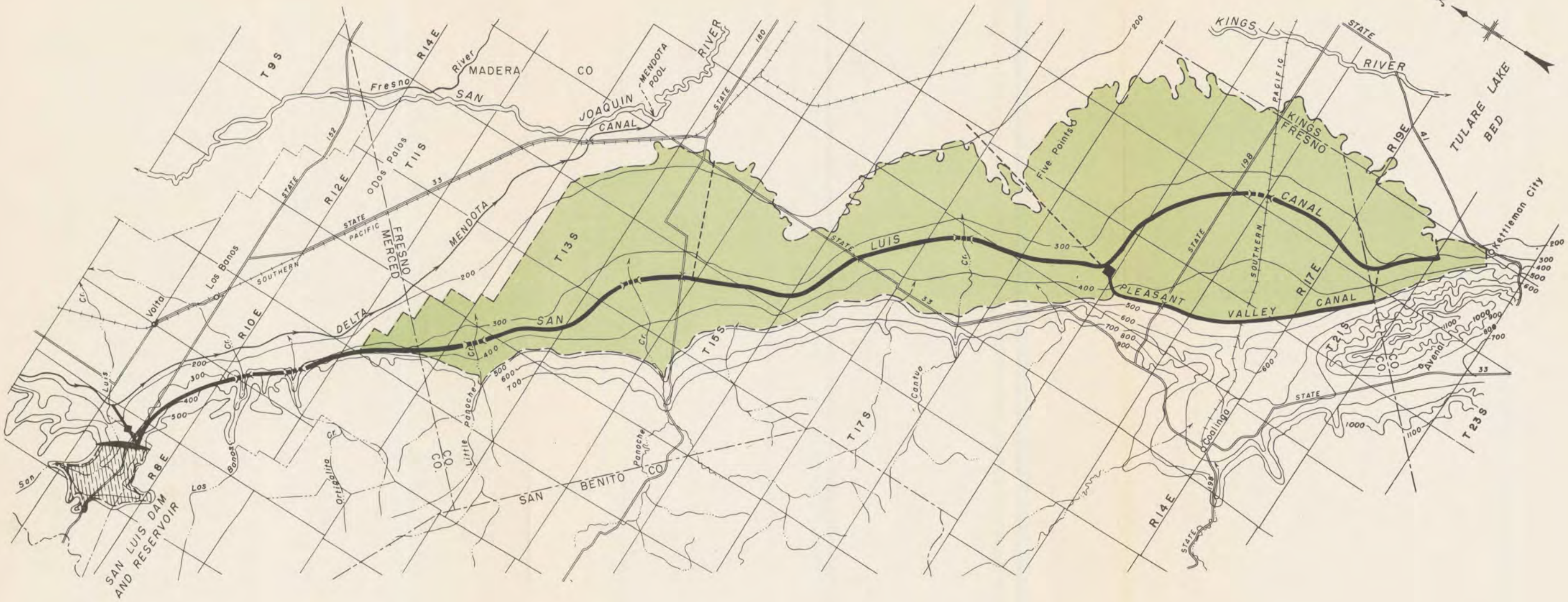

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CENTRAL VALLEY PROJECT - ULTIMATE PLAN
WEST SAN JOAQUIN DIV. - SAN LUIS UNIT - CALIF.

SERVICE AREA

EXPLANATION

- Service area
- Major pump lift
- Canal
- Siphon

SCALE OF MILES (0 – 5 – 10)

Contour interval 100 ft.

NOTE: The western service area boundary is fixed by available water supply. Present location is at about El. 485.

JUNE 22, 1954 - REV. 3-23-55

805-208-14

GPO 968842

S U M M A R Y

Project:	San Luis Unit, Central Valley Project, California.
Location:	Central California: western Merced, Fresno and Kings Counties.
Principal purposes:	Importation of irrigation water supply with minor domestic and municipal supply to supplement declining ground-water sources.
Principal features:	San Luis Dam and Pumping Plant, San Luis Canal, Pleasant Valley Canal, and Pumping Plant.
Water to be provided:	1,250,000 acre-feet annually at the head of the San Luis Canal.
Acreage to be served:	440,000 productive acres in any one year.
Capital cost:	Federal $229,143,000 - Non-Federal $170,067,000.
Annual equivalent costs:	$16,564,000.
Annual equivalent benefits:	Primary, $17,705,000; total $41,393,000.
Benefit-Cost ratio:	Primary, 1.07 to 1.00; total 2.50 to 1.00.
Repayment:	All reimbursable costs could be repaid along with those of the Central Valley Project by the year 2014.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
REGIONAL OFFICE, REGION 2
SACRAMENTO, CALIFORNIA

May 6, 1955

To: Commissioner

From: Regional Director

Subject: Report on San Luis Unit--Central Valley Project, California

Introduction

1. This report[1/] on a proposed San Luis Unit of the Central Valley Project, California outlines a plan to provide supplemental irrigation water to an area of about 496,000 acres on the west side of the San Joaquin Valley in California plus a small amount of municipal water for nearby communities. Water supply facilities proposed in the report would serve to supplement and improve an existing supply obtained from ground-water sources that are being extensively overdrawn. The project works, additions to the Central Valley Project, involve an estimated Federal cost of $229,143,000. This report demonstrates that the proposed development has engineering and economic feasibility and that the costs of the Unit, operated as an integral part of the Central Valley Project, can be recovered in accordance with the Federal Reclamation laws. Under certain conditions, the report recommends authorization and construction of the Unit.

1/ Authorized to be made by the Federal Reclamation laws (Act of June 17, 1902, 32 Stat. 388 and acts amendatory thereof or supplementary thereto).

San Luis Unit and the California Water Plan

2. It is appropriate, before discussing detailed plans for the San Luis Unit, to consider a broader subject; the place of the San Luis Unit in a long-range water plan for California. Such a plan was presented to the California Legislature of 1931 2/ and is now being restudied on a more comprehensive basis by the California State Division of Water Resources. The place of the San Luis Unit in the California Water Plan, which the new studies of the State will evolve, involves a question on whether the San Luis plan of the Bureau of Reclamation fits in physically and financially with the more extensive plan of the State.

3. There appear to be no irreconcilable engineering or financial problems involved in coordinating the construction of the San Luis Unit and of other features of the California Water Plan. The long-range, multiple-purpose plan developed by the State Division of Water Resources provides for water storage on the Feather River, flood control on that stream, power generation, and transportation of water to the San Francisco Bay area, the San Joaquin Valley and Southern California. As far as service to the San Luis area is concerned, the State and Bureau plans are basically similar. Both propose a pumping diversion from the Sacramento-San Joaquin Delta, use of San Luis Reservoir site 3/ and a high-level canal from the

2/ Bulletin No. 25, Report to the Legislature of 1931 on State Water Plan.

3/ San Luis Reservoir does not develop a water supply of its own, but stores surplus winter water conveyed from Delta for release in the summer irrigating season.

reservoir to convey water throughout the service area. The principal physical difference between the two plans is that the Bureau plan would make use of the existing Tracy Pumping Plant and Delta-Mendota Canal for initial service whereas the State plan would require separate facilities, and that the State plan would require more expanded facilities for transportation of water southward. Thus, physical coordination of the two plans should present no insurmountable engineering problems. Since the physical facilities and the plan of operation are so similar it seems reasonable to expect that construction of the facilities by the United States for subsequent operation as a unit of the contemplated Feather River Project should assist the State in its larger endeavor--this without necessarily requiring higher water charges to users in the San Luis service area.

The Service Area

4. Description.--The service area of the San Luis Unit is located in the Central Valley of California along the eastern flank of the Coast Range as shown on the frontispiece. The center of the Unit is about 150 miles southeast of San Francisco and about 30 miles southwest of Fresno. Lands to be irrigated are located at elevations between about 200 and 485 feet on a broad, gently sloping plain extending eastward from the Coast Range. The area totals about 496,000 acres in a strip about 65 miles long and 13 miles wide.

5. The area climate is semiarid. Summers are hot and dry and

winters cool and moderate. Annual rainfall is about seven inches in an average year and ninety percent of it occurs between the first of November and the last of April so that crop raising is dependent upon irrigation. The few small rain-fed creeks which constitute the entire natural surface water supply of the area flow only intermittently during winter storms. The frost-free growing season in the area averages 280 days per year.

6. Development.--Irrigation in the area did not begin until development of electrically-driven pumps and electric transmission systems gave access to the deeper and better ground-water zones. Subsequent growth responded to increases in crop prices and the general economic level. In 1922 about 33,000 acres were irrigated. A 1950 crop survey indicates that about 400,000 acres were developed for irrigation, of which 273,000 were irrigated at the time of the survey and the remainder was in fallow. To pump ground water under present conditions requires large investments ranging up to $60,000 for a well and pump. Since the water supply is expensive and precarious, large farm operations are the general rule in the area. Approximately 73 percent of the service area is in farms over 320 acres in size.

7. Present town development in the area was based on petroleum discoveries that preceded farming. About 1896 the Coalinga oil field was brought in, and by 1910 a stable petroleum-based community was established at Coalinga.

8. Need for water.--Because the local surface water resources are totally inadequate and unreliable the present irrigation development relies entirely on ground water. The ground-water basin is recharged by an estimated average annual underground flow of about 180,000 acre-feet, from the eastern side of the San Joaquin Valley. Intermittent west side creeks contribute an estimated average of about 30,000 acre-feet annually toward ground-water replenishment. In contrast to the total annual recharge of about 210,000 acre-feet, the annual withdrawal by wells, which is increasing every year, totalled about 1,000,000 acre-feet in 1951-1952. The resultant overdraft on the ground-water basin has caused a steady decline in the water levels in deep wells. Since the mid-1920's the pump lifts have increased more than 200 feet. Between 1946 and 1951 the lifts increased at an average rate of 25 feet per year. The average pump lift in the area in 1951 was about 400 feet.

9. Loss of wells through casing failures due to corrosion or land subsidence are common. The increasing pump lifts have continually increased the cost of lifting the water. Wells have gone dry in increased numbers, and pump bowls must be lowered frequently to maintain well output. The average life expectancy of a well is only about 15 years, and many wells fail in 5 or 10 years. In the face of initial high costs and the described risks only large operators can afford to practice irrigated farming. Unless the ground-water overdraft is stopped there is a finite limit on the time that even

the large operators may be able to continue farming operations dependent upon ground-water pumping. To maintain and increase the productivity of the fertile land of the area a supplemental water supply must be provided. This supply, though supplemental, will in fact constitute some 80 percent of the water required for full development of the area.

10. Need for water has been recognized by the local interests and emphasized in many ways by landowners and civic bodies in and adjacent to the service area. Expressions by these interests include letters of inquiry, publicly-adopted resolutions, contributions of money for investigations by the West Side Landowners Association, and assistance in data-gathering by individuals and organizations.

Plan of Development

11. The recommended plan of development lends itself to discussion in two parts--the five basic elements which led to the operational plan; and the new physical facilities required for execution of the plan. The first basic element considered was the fact that the flows which waste to the Pacific Ocean each winter and spring from the Sacramento-San Joaquin Delta are sufficient, if reservoir storage is provided, to furnish an adequate water supply for the San Luis Unit. The second basic element considered was that the San Luis Reservoir site exists on San Luis Creek within a few miles of the service area. The site is suitable for a reservoir to store and regulate the wintertime surpluses of the Delta so that

they may be used to satisfy summertime irrigation demands.

12. The third basic element considered was that existing Central Valley Project features, the Tracy Pumping Plant and Delta-Mendota Canal, could be used to transport the required portion of the Delta surpluses to San Luis Reservoir for regulation. The Delta-Mendota Canal receives water lifted from the Sacramento-San Joaquin Delta by the Tracy Pumping Plant for conveyance 117 miles southeastward to Mendota Pool on the San Joaquin River. Sixty-seven miles from the Tracy Pumping Plant, the canal passes within two and one-half miles of the proposed San Luis Reservoir. The primary operational requirement of the canal is to supply irrigation water to northern San Joaquin Valley lands. This operation requires the entire canal capacity only at the peak of the irrigation season in the summertime. Consequently, the pumping plant and canal have capacity available during all other months to divert and transport the Delta surpluses to the San Luis Reservoir.

13. A fourth basic element considered was the large block of electric energy that would be required each year if the water surpluses of the sea-level Delta are to be lifted to the San Luis Unit service area at elevations of from 200 feet to 485 feet above sea level. Facilities of the Central Valley Project represent an economic source from which to obtain the needed huge block of energy, either directly or by arrangements in connection with the sale of falling water for power generation by a non-Federal agency in

connection with the Trinity River Division of the Central Valley Project. As stated in your January 19, 1955 report[4/], which was adopted by Secretary McKay as his proposed report on the Trinity River Division, assurance of power for San Luis pumping, on advantageous terms, would be basic in such arrangements. Since there are no existing arrangements to sell falling water in connection with the Trinity River development, estimates in this report are based on power supplies from Federally-constructed powerplants.

14. Even with low-cost power, the cost of providing an adequate water supply to the area would be high. Thus the final basic element considered was that San Luis Unit would need the financial assistance that could be obtained through financial integration with other units of the Central Valley Project, including the Trinity River Division described in your January 19 report.

15. The plan of development has several advantages. Through the use of Central Valley Project facilities the cost of pumping on the San Luis Unit is reduced. The irrigators are provided with needed repayment assistance in the form of commercial power revenues from the Central Valley Project. Interference with the water supply of any downstream users is minimized because of the timing of diversions and the location of the point of diversion. The recommended plan of development is consistent with the comprehensive

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4/ Letter to the Secretary of the Interior from the Commissioner of Reclamation dated January 19, 1955, on Trinity River Division, Central Valley Project.

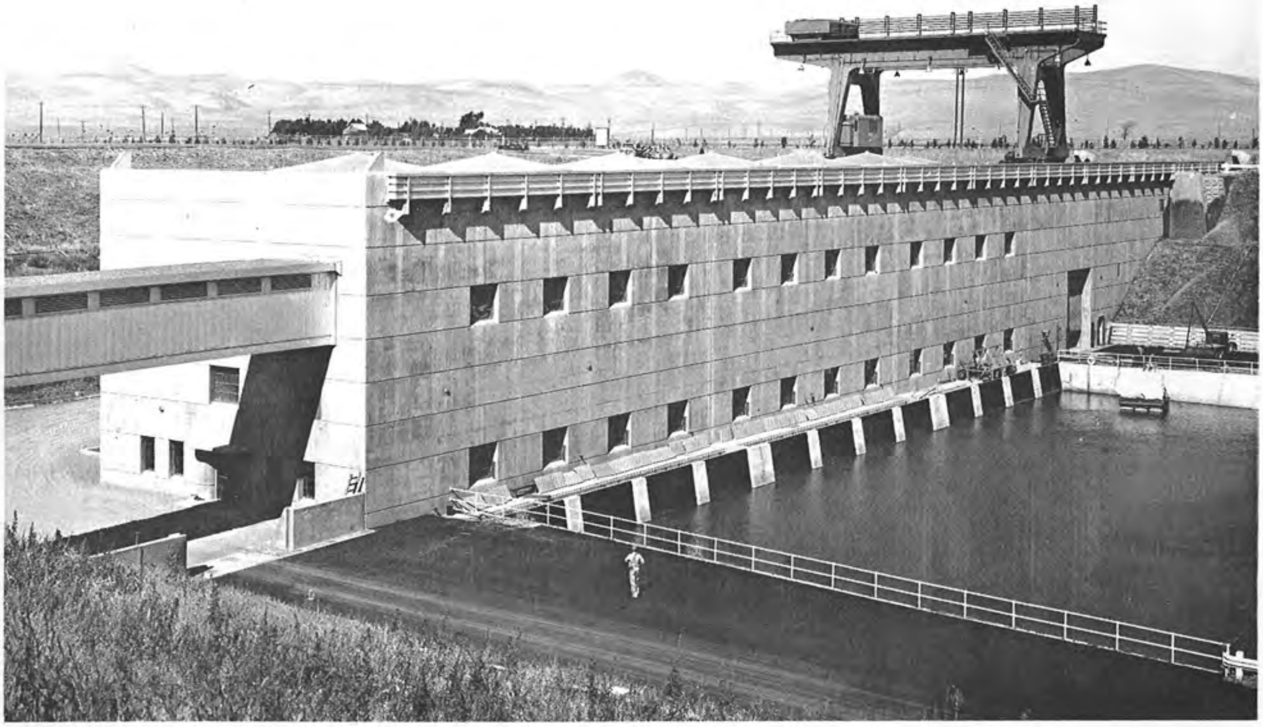
plan of development for the entire Central Valley Basin as presented in Senate Document 113, 81st Congress, 1st Session. It represents a step forward in the logical and orderly development of the water resources of the State of California. As mentioned previously, it easily could be adapted to operate as a part of the State's Feather River Plan which could serve southern San Joaquin Valley and Southern California areas.

16. Proposed new facilities of the San Luis Unit.--The imported water for the San Luis service area would be transported in the existing Delta-Mendota Canal of the Central Valley Project for a distance of 67 miles to San Luis Creek. New works are needed beyond that point to lift the water, store it, and convey it over the service area. It is proposed that major storage and conveyance features be constructed by the United States and that the distribution and drainage systems, wells for recovery of ground water, and other needed features, be financed and constructed by the landowners. (A possible alternate to this plan would provide for construction of the distribution system by the United States.) The features proposed for construction by the United States are San Luis Reservoir, San Luis Pumping Plant, San Luis Canal, Pleasant Valley Pumping Plant, Pleasant Valley Canal, a series of small relift pumps, an electric system for transmitting power to the project pumping facilities, and miscellaneous structures required for proper operation and maintenance of project works. Final determination of the power transmission

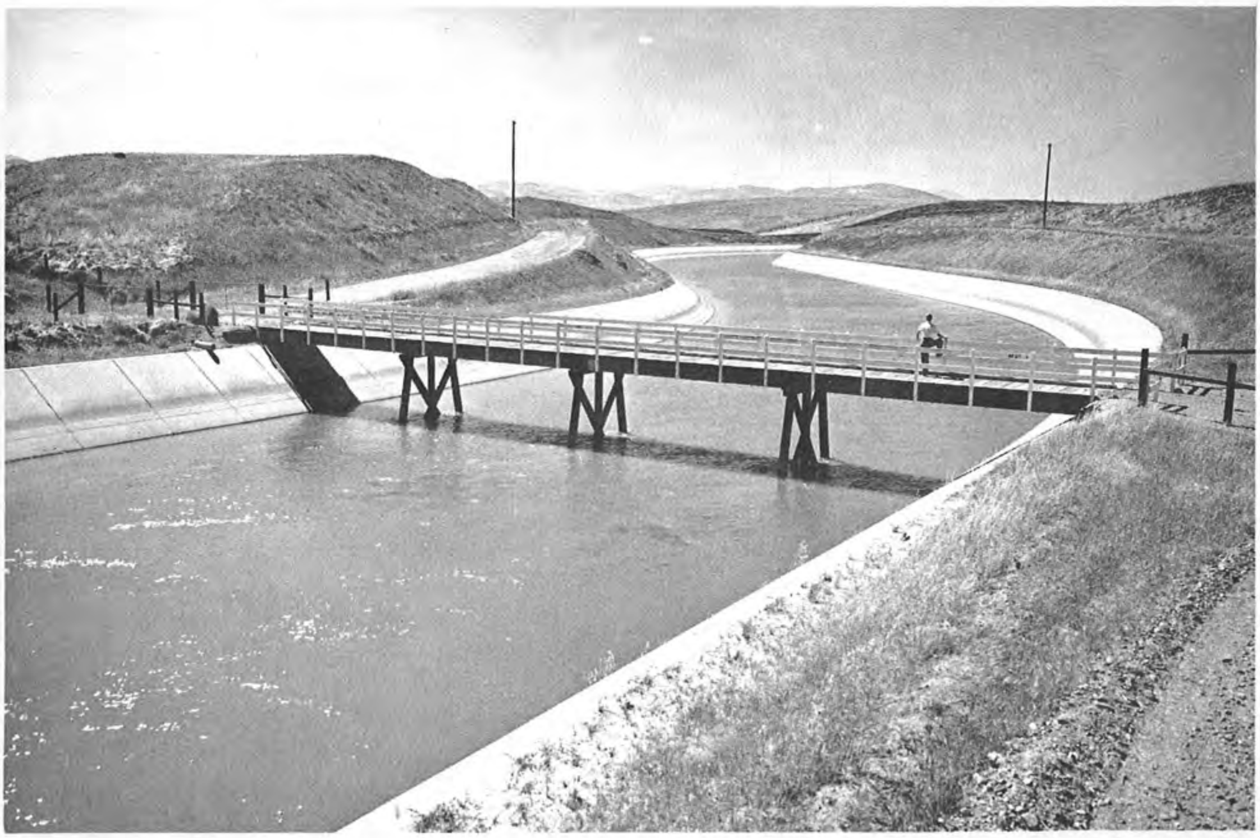
features needed would, of course, depend upon the arrangements for power supply.

17. Water for San Luis Unit would be taken from the existing Delta-Mendota Canal near Los Banos by the San Luis Pumping Plant. This 199,000 horsepower plant would lift the water either into San Luis Reservoir or directly into San Luis Canal as required by operating conditions. San Luis Reservoir, with a capacity of 1,000,000 acre-feet (with provisions for later raising to 2,000,000 acre-feet) would store the winter and early spring water deliveries for release into San Luis Canal during the irrigation season. The San Luis Canal would extend southeasterly for 104 miles. At its head, elevation 350 feet, the capacity of the canal would be 6,800 cubic feet per second, and at its terminus the capacity would be 700 cubic feet per second. Turnouts would be provided at frequent intervals both above and below the canal for the proposed service area. At a point on San Luis Canal 76 miles from its head a maximum flow of 600 cubic feet per second would be diverted to Pleasant Valley Pumping Plant which would lift it into the Pleasant Valley Canal at an elevation of 462 feet.

18. In addition to the principal features needed to lift, store, and transport the water, other structures appurtenant to the major works will be required. These will include the electric facilities needed to transmit power to the pumps of the San Luis Unit; floodways and flood retention basins to confine storm runoff which would



TWO EXISTING FEATURES OF THE CENTRAL VALLEY PROJECT, TRACY PUMPING PLANT (ABOVE) AND DELTA–MENDOTA CANAL (BELOW), WOULD LIFT WATER FROM THE SACRAMENTO – SAN JOAQUIN DELTA AND CONVEY IT 67 MILES SOUTHWARD TO THE SAN LUIS AREA



GPO 968842

otherwise become damaging because of canal cross-drainage structures; and miscellaneous general property required for operation of the project.

19. To carry out the plan of development the landowners will need certain works of their own. Among these will be some 500 wells to tap the present ground-water supply and the increased ground-water supply which will naturally result from deep percolation of the imported water. These wells, many of which are now in existence, will be privately operated, or may be operated by local districts. Distribution systems also will be needed. The necessary pumps to serve the distribution system above the canal, however, are considered in this plan to be part of the Federal project. The United States would install the pumps, and serve them with project power. At some time in the future, drains, including an intercepting drain, will be required along the lower edge of the service area. These drains as they are required would be non-Federal features installed by the landowners, or, in the alternative, would be constructed by the Bureau of Reclamation if the landowners desire. It is expected also that municipal and industrial users such as the towns of Coalinga, Avenal, and the adjacent oil fields, would provide their own conveyance systems, including pumping facilities and pumping energy.

20. Water rights.--The operation of the San Luis Unit will be predicated upon the principle that existing water rights will be fully recognized and protected, as required by the Federal Reclamation

laws. If the San Luis Unit is authorized for construction, the Bureau of Reclamation, on behalf of the United States, will, to the extent possible, modify existing applications on file with the State Engineer for Central Valley Project uses to include San Luis Unit within the scope of the Project, file new applications, or obtain assignments of applications filed by others for use of water in the area. In addition, an application for off-stream storage in San Luis Reservoir and diversion will be filed with the State Engineer. There appears to be little doubt as to the availability of water that could be used to operate the unit as planned. However, it is considered wise that construction, if authorized, not be initiated until water rights satisfactory to the Secretary of the Interior have been acquired or assured.

21. The maximum water quantity for direct diversion from the Delta for beneficial use within the San Luis Unit will be approximately 1,700,000 acre-feet during high-runoff years. Such water would be diverted from Delta surplus flows. The annual quantity of water pumped from the Delta for typical nondeficient years will be approximately 1,380,000 acre-feet of which about 1,126,000 acre-feet will be for canalside deliveries. The maximum rate of diversion from the Delta will be about 4,500 cubic feet per second.

<u>Evaluation of the Unit</u>

22. <u>Water to be provided and lands to be supplied.</u>--The facilities described above will deliver 1,126,000 acre-feet of water

annually from San Luis Canal. To this will be added water to be pumped from the wells. Of the total thus provided, about 98 percent will be for irrigation, one percent for use on farmsteads, and one percent for municipal and industrial use. The water supply would provide for irrigation of about 440,000 acres in any one year. The principal crops expected to be grown in the area are cotton, alfalfa, irrigated pasture, truck and miscellaneous field crops.

23. Recreation, fish and wildlife.--The National Park Service report[5/] notes that San Luis Reservoir would meet a primary recreational need by providing a place at which residents of the adjoining valley could enjoy boating, angling, and picnicking and find relief from the summer heat. The National Park Service estimates such use may amount to 126,000 visitor-days annually on the basis of 1960 population projections and that the cost of minimum recreational facilities, which would be nonreimbursable, would be $90,000.

24. The Fish and Wildlife Service report[6/] points out that with the San Luis Unit the increased duration and time of occurrence of pumping from the Sacramento-San Joaquin Delta at the Tracy Pumping Plant increases the hazard to the Delta fishery. The Service estimates the value of the Delta fishery, without the San Luis Unit, at $29,917,000 and value with the San Luis Unit, including benefits from a San Luis Reservoir fishery, at $29,617,000. This is a reduction of

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5/ Bound at the back of this volume.
6/ Bound at the back of this volume.

$300,000 or about one percent. Wildlife values are expected to increase by $37,000 with the increased waterfowl habitat provided by San Luis Reservoir and by wasteways in the service area. Recommendations in the report of the Fish and Wildlife Service have been noted and they will be followed to the extent feasible and compatible with the purposes of the project and the policies of local land and water managing agencies. Opportunities to aid in waterfowl conservation seem particularly worthy of consideration in cooperation either with the State Department of Fish and Game or with the Federal Fish and Wildlife Service.

25. Capital cost.--The estimated capital costs of the features proposed for construction by the United States as well as the costs of the distribution system are shown in the following tabulation. These costs are based on prices prevailing in January 1954.

Main storage and conveyance features[a]	
San Luis Dam	$ 52,116,000
San Luis Canal	78,487,000
San Luis Pumping Plant	37,333,000
Pleasant Valley Canal	4,629,000
Pleasant Valley Pumping Plant	4,579,000
Channels, levees and floodworks	23,534,000
Relift pumps on distribution system	18,472,000
Electric system	8,920,000
General property	1,073,000
Subtotal	$229,143,000
Distribution system features	
Distribution system conduits[b]	$129,748,000
Deep wells[c]	19,681,000
Drains[b]	20,638,000
Subtotal	$170,067,000
Total	$399,210,000

a/ These features are proposed for Federal construction.
b/ These features are proposed for non-Federal or Federal construction, as the local interests may elect.
c/ These features are proposed for non-Federal construction.

26. Annual equivalent costs and benefits.--Annual equivalent costs and benefits have been computed for a 100-year period using an interest rate of 2.5 percent, with adjustments for construction and development periods. The point of measurement is at the farm headgate. In computing both costs and benefits, the effect of the increased use of Central Valley Project power for the San Luis Unit irrigation pumping rather than for commercial sales has been included. This was done by deducting costs associated with commercial sales

and likewise deducting the benefits which would have accrued.

Annual equivalent costs calculated on this basis are as follows:

Amortization of investment	$11,450,000
Operation, maintenance and replacement	6,728,000
Power costs not incurred	-1,614,000
Total	$16,564,000

Annual equivalent benefits are summarized as follows:

Function	Primary annual equivalent benefit	Total annual equivalent benefit
Irrigation	$23,219,000	$46,907,000
Municipal and industrial water service	636,000	636,000
Recreation	55,000	55,000
Wildlife	37,000	37,000
Fish	-300,000	-300,000
Power benefits foregone	-5,942,000	-5,942,000
Total	$17,705,000	$41,393,000

27. Comparing total annual equivalent benefits of $41,393,000 and costs of $16,564,000, the ratio of benefits to costs is found to be 2.50 to 1.00. If only primary benefits are considered, the benefit-cost ratio is 1.07 to 1.00. This relationship demonstrates the economic justification and desirability of the San Luis Unit from the national standpoint.

28. Allocation and repayment.--Since the San Luis Unit is planned as part of the Central Valley Project both operationally and financially, repayment prospects have been tested by analyzing the Central Valley Project as a whole. The capital cost allocation and

probable repayment by project functions for the Central Valley Project with San Luis Unit added are summarized below. The cost allocation was made by the use of the separable cost-remaining benefits method. Distribution systems are not included as they are repaid, if Federally constructed, by separate contracts and not from the net operating revenues shown in the tabulation.

Function	Cost allocation	Net operating revenues through fiscal year 2014: For repayment	Net operating revenues through fiscal year 2014: Interest and earned surplus
Nonreimbursable			
Navigation	$18,472,000	--	--
Flood control	52,749,000	--	--
Fish and wildlife	6,065,000	--	--
Recreation	305,000	--	--
Total nonreimbursable	$77,591,000	--	--
Reimbursable			
Irrigation	$696,149,000	$493,725,100	--
Commercial power	195,956,000	372,446,000	$137,198,300 a/
Municipal and industrial water service	18,612,000	44,545,900	11,028,400 b/
Total reimbursable	$910,717,000	$910,717,000	$148,226,700
Total	$988,308,000		

a/ Includes $38,419,400 interest and $98,778,900 in earned surplus.
b/ All interest--not applied toward repayment.

29. The repayment analysis has indicated that a water rate of $7.50 per acre-foot will be required for the San Luis Unit, a rate well within the ability of the water users to repay. The delivery

point would be at the canalside, but service would include pumpage for the portion of the service area above the canal. With this water rate for San Luis Unit service, revenues from the Central Valley Project will be sufficient for full repayment of the reimbursable costs of the Central Valley Project by the year 2014, fifty years after completion of San Luis Unit. In contracting to repay water costs, suitable arrangements would be necessary to conform to provisions of Reclamation Law which now generally limit water deliveries to 160 acres in a single ownership (or 320 acres in case of joint ownership).

30. If the water users choose to contract with the United States for construction of the distribution system the estimated $170,067,000 cost could be repaid in 40 annual installments. With equal installments, this would amount to about $4,252,000 per year.

Conclusions and Recommendations

31. Conclusions.--Conclusions resulting from the investigation are:

(a) An immediate need for supplemental water for the San Luis area has been demonstrated by the great decline of groundwater levels and is emphasized by the requests of the local people for assistance;

(b) The proposed San Luis Unit, in conjunction with existing and authorized Central Valley Project features, can meet the need by supplying an adequate amount of supplemental water;

(c) The benefit-cost ratio for the proposed plan of development is 2.50 to 1.00, or if only primary benefits are considered, 1.07 to 1.00. The development, operated as an integrated element of the Central Valley Project, has engineering and economic feasibility. All reimbursable costs can be repaid in full from power and water revenues;

(d) The proposed plan of development is the best of several alternates, and it can be coordinated readily with the Feather River Plan of the State of California, when constructed;

(e) Substantial recreational benefits will accrue to the general area surrounding San Luis Reservoir if appropriate facilities are provided; and

(f) Considering the magnitude of the fishery resources in the Sacramento-San Joaquin Delta, the adverse effect of the Unit upon them is not expected to be significant. Wildlife resources, on the other hand, and waterfowl in particular, should be benefited, although not sufficiently to offset the fishery loss.

32. Recommendations.--It is recommended that:

(a) The following works constituting the San Luis Unit be authorized to be constructed, operated, and maintained by the Bureau of Reclamation, Department of the Interior, as an integral part of the Central Valley Project, California in accordance with Federal Reclamation laws[7/], substantially in accordance with plans set forth in this report and with such modifications

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7/ Act of June 17, 1902 (32 Stat. 388 and acts amendatory thereof or supplementary thereto).

as may be recommended by the Commissioner of Reclamation and approved by the Secretary of the Interior; or in lieu thereof, that the San Luis Unit, with such modifications as may be required, be authorized to be constructed by the Bureau of Reclamation and upon agreement between the Secretary of the Interior and the State of California and with the approval of the Congress, be operated and maintained by the State of California as an integral part of the proposed Feather River Project:

San Luis Dam and Reservoir

San Luis Canal

San Luis Pumping Plant and Intake Canal

Pleasant Valley Canal

Pleasant Valley Pumping Plant and Intake Channel

Related operating structures, floodways, channels and levees, and relift pumps for distribution systems

Electric features sufficient for transmission of Central Valley Project energy to such points as required for operation of the canals, relift pumping plants, dam and reservoir;

provided: that no construction be undertaken until and unless (1) water rights have been acquired or assured and permits have been issued by the State of California for the appropriation of unappropriated water with reasonable assurances for the ultimate issuance of appropriate licenses--all in a form and substance satisfactory to the Secretary of the Interior; and (2) satisfactory assurances of repayment have been received;

(b) Necessary distribution and drainage systems be authorized for construction by the Bureau of Reclamation in order that local interests may be afforded an opportunity to arrange for construction by the Bureau of Reclamation if they so desire;

(c) Minimum recreational facilities be included in the project on a nonreimbursable basis provided that a local agency will assume the responsibility for their operation and maintenance;

(d) Additional detailed studies of fish and wildlife resources affected by the San Luis Unit be conducted as necessary, after project authorization, in accordance with Section 2 of the Act of August 14, 1946 (60 Stat. 1080); and that such reasonable modifications in the authorized facilities be made as may be found appropriate to preserve and propagate these resources; and

(e) Studies be made of the feasibility of furnishing irrigation water to land to the south of San Luis Unit in order that the Bureau may be fully informed thereon at the time of any negotiations with the State of California in regard to joint construction of San Luis Unit and the Feather River Project.

C H Spencer

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SUBSTANTIATING REPORT

CHAPTERS

CHAPTER I

GENERAL DESCRIPTION

This report is concerned with plans to supply water to the western portion of the Upper San Joaquin Valley between the Coast Ranges and the valley trough. This portion of the valley lies in the "rain-shadow" of the Coast Ranges and the surface water channels are intermittent creeks. In this respect, it contrasts strongly with the east side of the valley where major rivers emerge from the Sierra Nevada. This great difference in water supply explains why irrigation development, which began early on the east side of the valley with diversion from surface streams, awaited deep well development on the west side. It also furnishes an indication of the reasons for the insufficiency of the ground-water supply, and the need for an imported supply for the west side lands. The first chapter of this report provides general information on the service area. Subsequent chapters provide details on the plan of development and its engineering and economic aspects.

Physical Geography

Location.--The service area of the San Luis Unit of the Central Valley Project contains a gross area of 496,000 acres on the west side of the San Joaquin Valley of California. The center of the service area is about 150 miles southeast of San Francisco and about 30 miles southwest of Fresno. The irrigated lands parallel the trough of the San Joaquin Valley, and the western edge of the service area lies almost at the base of the foothills on the western edge of the San Joaquin Valley.

General Description

The San Luis Unit (pronounced loo'is) derives its name from San Luis Creek on which the main storage dam would be located. Plate 1 shows the service area location.

Physical characteristics.--The portion of the San Joaquin Valley to be served by the San Luis Unit has an approximately rectangular shape with a north-south length of 65 miles and a east-west width of 13 miles. It is a broad plain sloping gently northeasterly to the valley trough. The western edge of the service area varies only 30 feet in elevation from 485 feet at its northern end to 455 feet at its southern end. The eastern edge of the service area has an elevation of about 200 feet along its entire length. Generally, the land has smooth slopes and only a few undulations. Most of the area drains to the sea by way of the lower San Joaquin River and San Francisco Bay, but the southern portion drains southward to the closed Tulare Lake Basin.

Where the watercourses enter the service area along the western edge there are narrow gullies with maximum depths from 20 to 40 feet and widths from 50 to 100 feet. All of these gullies disappear within the service area as stream channels are obliterated by alluvial fans of their own making. During a large storm these channels may carry high flows containing much sediment. After the storm, however, these flows decrease rapidly, and the streams remain dry most of the time.

A major portion of the service area has been developed for some type of cropping. On the undisturbed portions native vegetation consists of sagebrush, tumbleweed and similar vegetative cover common to semiarid regions. Some wild oats and native grasses prevail near the foothills in years of average or better rainfall.

Climate.--Annual rainfall on the service area averages about seven inches, ninety percent of which falls between the first of November and the last of April. Average temperatures (Farenheit) range from the middle forties in January to the low eighties in July. Daytime temperatures in summer frequently are over 100 and nighttime temperatures in winter occasionally fall below 32. Temperature extremes vary from a high of about 120 to a low of about 10. The frost-free growing season lasts about 280 days in an average year.

Geology.--The Coast Range mountains immediately to the west of the service area are composed predominantly of marine sandstones and shales. The oldest rocks belong to the Franciscan formation of Jurassic age. In the Sierra Nevada to the east of the valley, the rocks are largely granitic types with lesser amounts of volcanic and metamorphosed sediments. The hard, consolidated rock formations found in the mountain areas extend under the valley where they are buried beneath younger sediments. Some of these younger sediments are marine types but the youngest ones now forming the top blanket of the valley sediments are continental; that is, they were laid down on land areas by streams or in lakes. Continental sedimentation began in late Pliocene time when the region rose above sea level.

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The valley is of structural origin; being formed by the rise of the surrounding mountain areas and in-filling of the structural basin. The valley floor has been built up by the deposition of sediments carried by streams from the mountains. Each stream builds a fan of its sediments which merge into the fans of adjacent streams. At times, during geologic history, fans on opposite sides of the valley merged to form a dam that blocks drainage from the more arid southern portion of the valley. Tulare Lake is a present example of blocked drainage similar to that occurring at other times during the accumulation of the valley fill.

The valley alluvial fill attains a thickness of nearly 3,000 feet of variably pervious sediments that comprise the ground-water basin, much of which is of importance as a source of irrigation water. A more detailed description of the ground-water basin will be found in the later chapter upon water supply.

History of Settlement

From the time of the gold rush until the turn of the century the west side of the San Joaquin Valley between San Luis Creek and Tulare Lake had an exceedingly small population. Most of it was concentrated in the Pleasant Valley area in the vicinity of what is now Coalinga. The few people occupied themselves by mining lignite (a low-grade coal substitute from which Coalinga took its name), by stock-raising, by early-day equivalent of wildcatting among the oil seeps and springs in

General Description

the area, and by sporadic and limited attempts at irrigated farming. About 1896 the Coalinga oil field was tapped, by 1905 the oil boom was at its hectic height, and by 1910 stability had been achieved with the production of oil as a year-round industrial base. Coalinga's population figures exemplify this growth pattern. M. L. Curtiss' homestead entry covered the present site of Coalinga in 1882. By 1910 the population had reached 4,199, and by 1950 it stood at 5,539.

Agriculturally there was almost no growth at all in the area until the development of electrically-driven pumps and the growth of electric distribution systems combined to give irrigators access to the deeper and more reliably productive ground-water zones. By 1922 about 33,000 acres were under irrigation. By 1939 about 90,000 acres were irrigated, and at present more than 400,000 acres are developed for irrigation. It was this irrigation development rather than the oil industry that brought residents to the portion of the valley floor which constitutes the San Luis Unit service area. At present the population is sparse and almost entirely rural. The total population in and adjacent to the service area has been estimated to be about 22,500 of which about 9,500 are in the oil-based communities of Coalinga and Avenal. Another 1,500 people live in Mendota east of the service area. Therefore, the 496,000 acres in the proposed service area have 11,500 residents or about one person for each 43 acres.

General Description

General Economy

Farming is the major economic activity in the project service area. Over 400,000 acres have been developed for irrigation, but the water supply is inadequate to irrigate it all in any one year. In 1950 about 273,000 acres were irrigated. Of this, grain occupied 162,000 acres, cotton 73,000 acres, and the remainder was devoted to forage, truck, and miscellaneous field crops. Nonirrigated areas in 1950 included about 12,000 acres of grain and 64,000 acres of native pasture.

Most of the area is in large landholdings, and large-scale types of farming prevail. Merchandising and servicing enterprises for support of the basic farm economy have not developed locally, and commercial communities are nonexistent. Except for packing sheds, cotton gins, auction yards, and similar activities directly related to the marketing of agricultural products there are no manufacturing or commercial enterprises of significance.

In the vicinity of the southern periphery of the project service area several oil fields have been developed. Salaried workers from these fields have brought into being the communities of Avenal and Coalinga. These towns exist chiefly to provide the oil workers and their families with the necessities and amenities of modern living. Oil production has been relatively stable in this area for many years and the known reserves are sufficient to keep it so for many more years.

General Description

Transportation

The project service area is served by road, rail and airlines. A single-track north-south line of the Southern Pacific Railroad parallels the service area just outside the eastern boundary, and a spur track branches off to Coalinga. The Atchison, Topeka and Santa Fe Railroad has a spur track which approaches from the east to within 10 miles of Five Points. The main San Joaquin Valley routes of both these railroads pass through Fresno about 30 miles east of the project service area.

Two State highways cross the service area from east to west and a third passes up San Luis Creek Valley just north of the service area. These highways connect the main north-south artery in the San Joaquin Valley with the principal north-south coastal routes. A fourth State highway traverses the area diagonally from the northeast to the southwest corner. With this rail and highway system freight shipments may be moved to or from either the San Francisco or Los Angeles trade centers in a matter of hours. Coalinga also has service from Pacific Greyhound Bus Lines and Southwest Airways.

Utilities

At the present time, the electric system of the Pacific Gas and Electric Company is the only utility of any kind which provides service over the entire area. Pacific Telephone and Telegraph and Western Union both serve Los Banos and Coalinga at either ends of the service area. Coalinga now has municipally owned natural gas and water systems, but furnishing water and gas to the remainder of the service area under project conditions probably would require provision of new systems in addition to the expansion of present facilities.

Water Districts

Three water districts, formed under California Water District Law, presently are operating adjacent to the proposed San Luis Canal. These districts, San Luis, Panoche, and Westlands, were formed for the primary purpose of distributing irrigation water. Two of the districts have begun negotiations for Central Valley Project water, and a third more remote from existing Central Valley Project facilities will be in a position to do so upon authorization of San Luis Unit. In accordance with the California Water District Law each district may obtain revenue from sale of water and, if revenue is inadequate, it may make assessments on its lands sufficient to meet district obligations. The districts hold general elections every two years, and voting is on the basis of one vote per dollar of assessed value of land.

The San Luis Water District was formed in January 1951 and is located along the Coast Range foothills in western Merced and Fresno Counties. It comprises 51,290 acres of land. For several years this district has been receiving a portion of its water from the Delta-Mendota Canal. This service has been provided under temporary contracts soon to be replaced by a long-term one now being negotiated. A portion of the district probably will not be served under the long-term contract because it lies above the proposed San Luis Canal and could be served more easily from it.

OVER A THOUSAND WELLS ARE OPERATING AT PRESENT IN THE SERVICE AREA SUPPLYING WATER TO IRRIGATE CROPS, SUCH AS THE BARLEY SHOWN BELOW.

General Description

The Panoche Water District was organized under the laws of California in November 1950. The district is situated adjacent to the San Luis Water District and most of its lands are in the northwestern part of Fresno County. The center of the district is about 55 miles west and slightly north of Fresno. The gross area of the district is 40,070 acres of which about 36,210 acres are irrigable. This district also has been receiving water on a temporary basis and is negotiating for long-term service. In this case full service initially is to be from the Delta-Mendota Canal, but the point of delivery may be changed to San Luis Canal at a later date if that seems advantageous.

The Westlands Water District was formed in August 1952 and is the largest of the three districts within the service area of the San Luis Unit. The district comprises 399,000 acres of land. Its boundaries extend about 60 miles from Panoche Water District to the Tulare Lake basin. On the west the district would be bounded by the San Luis Canal and on the east by the trough of the San Joaquin Valley. It overlies the existing but inactive Mendota Irrigation District. Such lands as are now irrigated within the district are supplied water from deep wells. This district cannot receive water from Central Valley Project because of lack of conveyance facilities until an addition such as San Luis Unit is completed. Upon authorization of such addition, however, negotiations for a major share of the water can be started immediately with Westlands Water District.

General Description

Previous Studies

The need for water to irrigate the arable lands of the West San Joaquin has been recognized for many years. During the last 80 years numerous studies were prepared by State and Federal agencies to determine the amount of water that would be needed for the full development of agriculture in the area and to devise plans for furnishing the required water supply. Consideration of these studies and other possibilities has led to development of the plan presented in this report.

As early as 1873, a board of engineers under the direction of the War Department made a study of irrigation in California.[1/] One of the conclusions reached by the board of engineers was that an irrigation water supply needed for the western side of the San Joaquin Valley, could be imported by means of long canals.

In 1919, Col. Robert B. Marshall, Chief Geographer of the Geological Survey, prepared the "Marshall Plan" for coordinated development of the water resources of the Central Valley. The plan included canals for irrigation of lands in the western San Joaquin Valley.

The "Marshall Plan" caught the imagination of Californians, and in 1921 the State Legislature authorized investigation of plans for the "...conservation, control, storage, distribution, and application of all the waters of the State..." Early results of this investigation were published in 1923.[2/] The 1923 report indicated that there was a

1/ House Executive Document No. 290, Forty-third Congress, First Session, March 23, 1874.

2/ State of California, Department of Public Works, Division of Water Resources, Bulletin No. 4 Water Resources of California, 1923.

deficiency in local water on the west side of the San Joaquin valley and recommended two canals to serve this area.

During the period 1921 to 1930, the State of California made extensive studies to develop a master plan for the utilization of the water resources of the State. As a result a report on the State Water Plan was published in 1930.3/ The report concluded that the water supply in the San Joaquin basin was insufficient to meet the ultimate water requirements in that basin and that importation of water would be necessary. The State Water Plan included two canals, and a series of pumping plants on the west side of the San Joaquin Valley which could serve the area considered in this investigation. Some of the major features included in the State Water Plan became the initial units of the Central Valley Project.

In 1945 the Bureau of Reclamation prepared a comprehensive plan for the multiple purpose development of the water resources of the Central Valley Basin.4/ The studies leading to the formulation of this comprehensive plan recognized the rapid growth of agriculture on the west side of the San Joaquin Valley and the need for importation of a water supply. The plan envisioned bringing water service to this area by utilization of storage reservoirs and the Delta-Mendota Canal of the

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3/ State of California, Department of Public Works, Division of Water Resources Bulletin No. 25, Report to Legislature of 1931 on State Water Plan, 1930.

4/ Senate Document 113, Eighty-first Congress, First Session.

Central Valley Project and the construction of a new storage reservoir, a pumping plant, and a gravity canal on the west side of the San Joaquin Valley. This plan was substantially the same as the one proposed in this report.

The need for water in the western San Joaquin Valley was re-emphasized in a report published in May 1951 by the State Water Resources Board.5/ The report presented a plan for serving the west San Joaquin Valley lands by means of a canal from the Sacramento-San Joaquin Delta utilizing some of the water regulated by the proposed Oroville Dam on the Feather River. Further information on this plan, with the inclusion of San Luis Reservoir as a feature, is given in a report of February 1955 by the State Department of Public Works.6/

Present Studies

The present investigations were initiated in 1943 when the West Side Landowners Association approached the Bureau of Reclamation regarding the possibilities of obtaining water from the Central Valley Project. A contract was executed on October 27, 1943, providing for joint financing of the investigation by the Association and the Bureau of Reclamation. Hydrologic studies, initiated under this contract, indicated that water supplies that could be made available from reservoirs created by Shasta

5/ State of California Water Resources Board, Report on Feasibility of Feather River Project and Sacramento-San Joaquin Delta Diversion Projects Proposed as Features of the California Water Plan, May 1951.

6/ State of California, Department of Public Works, Division of Water Resources, Program for Financing and Constructing the Feather River Project as the Initial Unit of the California Water Plan, February 1955.

General Description

and Friant Dams, and the Delta-Mendota Canal of the Central Valley Project were not sufficient to provide water on a permanent basis to the entire area. Therefore, it was necessary to explore the possibility of providing a supply through the expansion of Central Valley Project facilities. On expiration of the contract with the West Side Landowners Association, in June 1944, the Bureau of Reclamation continued general studies of this scheme as a part of Central Valley Basin studies.

A second contract between the United States and the West Side Landowners Association was signed on May 13, 1948 and detailed field studies were started, primarily crop mapping and ground-water measurements. In August 1948, however, the contract was terminated when it became apparent that, because of limitations in personnel, the Bureau of Reclamation could not continue the studies in Fiscal Year 1949.

The investigations were resumed in Fiscal Year 1950 and the program was carried to completion of this report.

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CHAPTER II

PLAN OF DEVELOPMENT

Need for Supplemental Water

As mentioned in chapter I, the acreage developed for irrigation in and adjacent to the San Luis Unit service area increased from 90,000 to over 400,000 acres during the period from 1939 to 1950. About 10 percent of the increase occurred in the last two years of this period. Although no crop surveys have been made in the area since 1950, continuing land levelling operations give ample evidence that new lands are being brought under irrigation. Most of the irrigation water has come from wells, but the ground-water basin has a long-term firm water supply for only about 148,000 irrigated acres. The irrigated land in excess of this amount has been maintained under cultivation by using ground water which will not be replaced under natural conditions. This overdraft cannot continue indefinitely, so a supplemental water supply will be needed to sustain the irrigated agriculture which exists now.

These west side lands, in common with most of California's better agricultural lands, enjoy many advantages in producing and marketing crops; including a long growing season, great fertility and an ever-expanding nearby market. In contrast, the nonagricultural potentialities of the west side lands are quite limited. Consequently the land owners desire to capitalize on their advantages of agricultural productivity with the result that the overdraft on ground-water supplies will be further aggravated. The area's future growth and prosperity therefore is dependent upon the availability of new or supplemental water supplies.

Plan of Development

Ground-water levels have declined steadily as a result of the overdraft. Between 1946 and 1951 the average rate of decline was 25 feet per year. This decline has increased the amount of pumping energy required to raise water through higher lifts and has necessitated frequent lowering of pump bowls. It also has forced abandonment of many wells. This has compounded an already serious situation wherein failures of well casings from corrosion damage or by land subsidence also necessitate frequent well abandonments. The average useful life for a well in the service area is about 15 years, but some wells fail in five or 10 years. Since these wells may cost as much as $60,000 to drill and equip, initiation of an irrigation venture requires a substantial capital outlay plus a sufficient reserve to guard against an untimely and unforseen well failure. As a practical matter the reserves often take the form of additional wells and acreage so that a single well failure will be less devastating. It appears that these are some of the basic reasons for the prevalence of large-scale farming in the area.

Municipal and industrial water also is a problem. The municipalities of Avenal and Coalinga have difficulty in obtaining potable domestic water. Avenal's supply comes about 10 miles by pipeline from wells near Kettleman City. Coalinga has local wells which supply water usable for sanitary and other domestic purposes, but unsuitable for drinking. Therefore a separate water system has been installed to distribute potable water brought in by railroad tank cars. Both communities hope to obtain water of improved quality at lower cost from the Central Valley Project through the San Luis Unit.

In summary, an adequate dependable supply of supplemental water would:

a. Allow continued cropping of presently irrigated land;

b. Facilitate expansion of irrigation to presently non-irrigated but fertile land;

c. Stabilize ground-water levels and costs of pumping;

d. Reduce the risks of irrigation farming in the area; and

e. Provide adequate municipal and industrial water of satisfactory quality at reasonable cost.

<u>Public Interest</u>

The need for more water has been expressed in many ways over the years by landowners and civic and governmental agencies in and around the service area. Official expressions of interest have been made by West Side Landowners Association and its successor, Westlands Water District; Panoche Water District; San Luis Water District; City of Coalinga; Kern County Chamber of Commerce; Los Banos Chamber of Commerce; Kettleman City Chamber of Commerce; Avenal Gap Chamber of Commerce; Merced County Planning Commission; and others. As stated in chapter I, the West Side Landowners Association contributed funds to investigate means of obtaining more water.

Plan of Development

Relation to Central Valley Project

San Luis Unit is planned as an addition to the Central Valley Project to be coordinated fully, both physically and financially, with the existing and authorized features of the parent project. A simplified picture of the physical relation of San Luis Unit to the Central Valley Project is shown in plate 2. By utilizing Central Valley Project storage and conveyance facilities in lieu of new structures, physical integration would minimize the capital expenditure required to bring supplemental water to the San Luis Unit service area. By financial integration a portion of the Central Valley Project power revenues would be made available to assist San Luis Unit repayment. This plan of development for San Luis Unit is a part of the comprehensive plan of development for the entire Central Valley Basin as presented in Senate Document 113, 81st Congress, 1st Session.

Operation of the Central Valley Project

Major Central Valley Project storage reservoirs include those created by Trinity, Shasta, Folsom and Friant Dams[1/] to catch and store surplus wintertime flows until the onset of the irrigation season in the summer or to retain water over a series of dry years. Water for irrigation is released during the summer growing season when natural streamflow is inadequate to meet the demand. Part of the irrigation water released

1/ Shasta and Friant Dams are existing Central Valley Project features; Folsom Dam on the American River now is nearing completion; and Trinity Dam has been authorized for construction.

from Trinity, Shasta, and Folsom reservoirs is used in the Sacramento Valley and part flows to the northern edge of the Sacramento-San Joaquin Delta. From there the Delta Cross-Channel conveys this released water, as supplemented by surpluses in the Delta, to the intake of the Tracy Pumping Plant at the southern edge of the Delta. The Tracy Pumping Plant lifts it into the Delta-Mendota Canal which conveys it to lands along the canal and to Mendota Pool. At this point it is released to the San Joaquin River for the use of downstream irrigation in exchange for San Joaquin flows that can be stored in Friant Reservoir. Water thus stored at Friant is then released into Madera and Friant-Kern Canals for irrigation on the east side of the San Joaquin Valley.

Operation of San Luis Unit

The proposed operating principle of San Luis Unit stems from three characteristics of the Central Valley Project operation just described. First, the Central Valley Project reservoirs in conjunction with existing privately and other publicly-owned reservoirs cannot control the wintertime runoff from Central Valley streams completely, and large surplus flows continue to waste to the Pacific Ocean each winter. Second, these surplus flows occur in the winter and early spring when there is little demand for irrigation water and, hence, little use for Tracy Pumping Plant and Delta-Mendota Canal. Third, before reaching the Delta, portions of the surplus water are available for generating energy at Central Valley Project hydroelectric plants at a time when other project pumping loads are low.

Plan of Development

Under the plan of development proposed for San Luis Unit portions of the wintertime surplus water will be pumped from the Delta by Tracy Pumping Plant and carried by the Delta-Mendota Canal to a point near the head of the service area. Because of the simultaneous availability of the surplus water, the pumping plant and canal capacities, and the electric energy, the Central Valley Project will be able to deliver this water with existing and authorized facilities. Water rights problems would be minimized since surplus water would be diverted from the Delta. These facts are the elements of the proposed plan of development.

Most of the water will be available only during the winter and early spring months when irrigation demands are low. Diverted water will be delivered from the Delta-Mendota Canal at about elevation 171 while project lands range in elevation from about 200 feet to 485 feet. Consequently it will be necessary to provide reregulatory storage and additional pumping before the surplus water can be usable to meet irrigation demands on the San Luis Unit. It also will be necessary to convey and distribute the water to all parts of the service area in such a manner as to allow continued use of ground water to the extent of the safe yield. Storage and conveyance of the water after it leaves the Delta-Mendota Canal will be a function of San Luis Unit features.

San Luis Unit Features

The locations of features of San Luis Unit are shown on plate 2. Import water for the San Luis Unit would leave the Delta-Mendota Canal

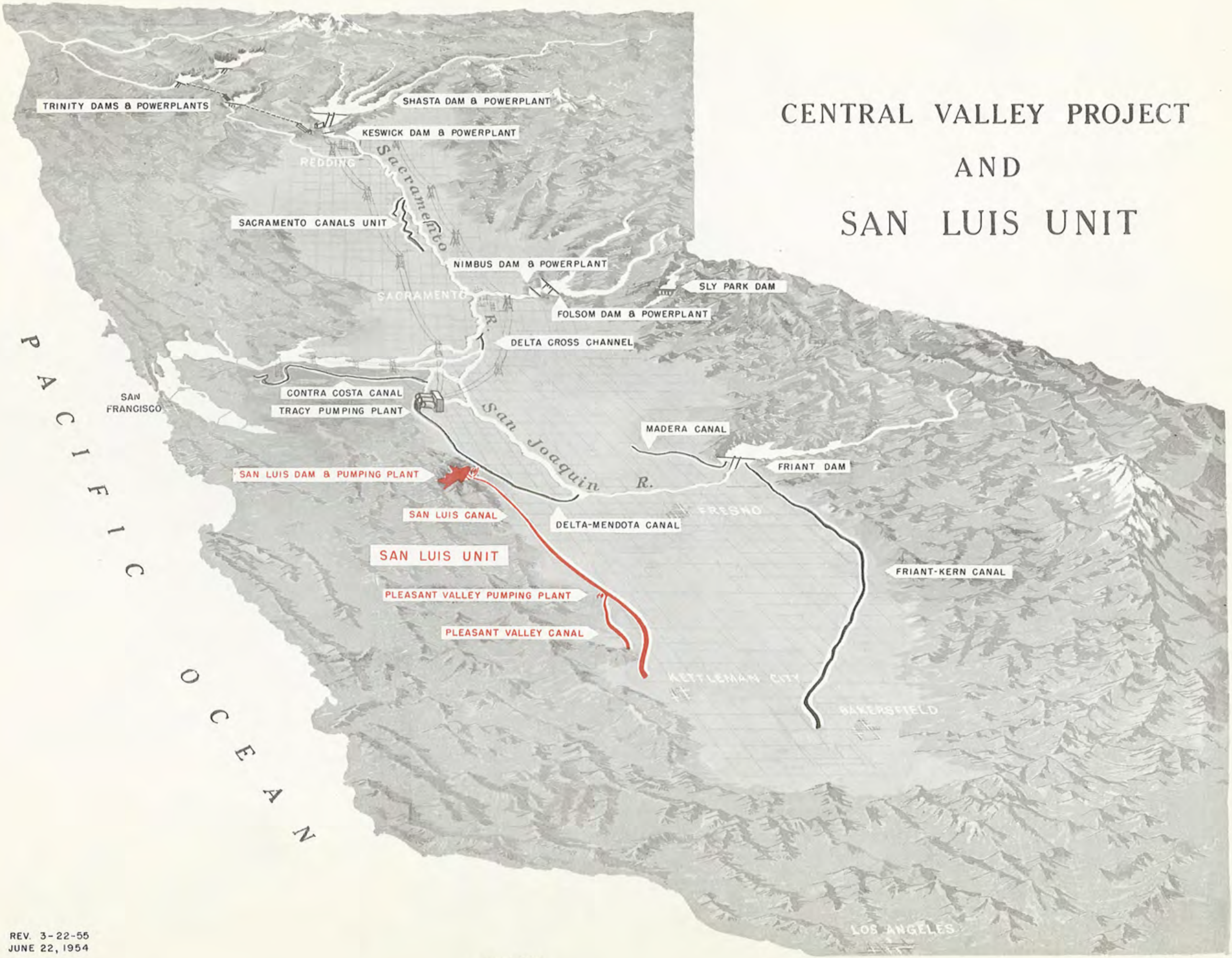

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PLATE 2

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near Los Banos and enter the intake channel of the proposed San Luis Pumping Plant. The pumping plant, with an intake water surface elevation of 171 feet, and an installed capacity of 199,000 horsepower would lift the water either into the San Luis Canal at elevation 350 or into San Luis Reservoir where the water surface elevation will vary from 305 to 450 feet.

San Luis Reservoir would be formed by an earthfill dam across San Luis Creek about 12 miles west of Los Banos. The dam would have a structural height of about 320 feet and a crest length of 1.4 miles. Four saddle dams also would be required. The reservoir would have a capacity of 1,000,000 acre-feet; covering an area, at maximum capacity, of 10,300 acres.

San Luis Canal would extend 104 miles from San Luis Reservoir to Kettleman City and diversion to laterals would be made at frequent intervals starting 20 miles from the reservoir. Capacity of the canal would vary from 6,800 cubic feet per second at its head to 700 cubic feet per second at the end. The water surface elevation would vary from 350 feet at the head of the canal to 315 feet at its terminus near Kettleman City.

About 76 miles from the reservoir, San Luis Canal would deliver water to the intake channel of Pleasant Valley Pumping Plant. This pumping plant would have an installed capacity of 12,000 horsepower and would lift water from elevation 325 and deliver it into Pleasant Valley Canal at elevation 462. This canal would have an initial capacity of 600 cubic feet per second and a length of about 20 miles.

Plan of Development

It has been considered that distribution of water from the canals would be accomplished by closed concrete pipe systems. Turnouts for these pipes would be provided about every two miles along San Luis and Pleasant Valley Canals. On the downhill side of the canals, gravity flow would be possible, but above the canals, pumps would be required.

Under project conditions an estimated 537 wells would be required to furnish ground water. Initially this water probably would come from existing wells. Since these wells have an average useful life of only 15 years, replacement wells would be needed. These replacements and all subsequent replacement wells could be drilled adjacent to the pipe distribution system laterals to facilitate the delivery of ground water.

It has been estimated that under project conditions the ground-water level would make a slow recovery and finally stabilize with an average lift of about 250 feet. This may create a general drainage problem along the lower, or eastern, edge of the service area and perhaps in a few isolated spots elsewhere. It appears probable, too, that this drainage water may be of such poor quality that it will have to be removed from the area. Consequently, a system of tile drains has been assumed for an area of 96,000 acres along the eastern edge of the area. These drains would empty into an interceptor drain which would convey the water 197 miles to the Delta for disposal.

In addition to the foregoing units, other miscellaneous but nonetheless important works would be required. Among these are the electric facilities needed to transmit Central Valley Project power from the existing Tracy Switchyard to San Luis Unit pumps; floodways and flood retention basins to confine storm runoff concentrated to an otherwise damaging degree by canal cross-drainage structures; and miscellaneous general property required for permanent operation of the project.

Water Service Provided

San Luis Unit would deliver 1,250,000 acre-feet of water annually to the head of the San Luis Canal. To this would be added 540,000 acre-feet of ground water to be pumped from wells each year. It is estimated that annually 1,543,000 acre-feet would be used for irrigation, 22,600 acre-feet for municipal and industrial use, 17,400 acre-feet for farmstead uses, and the remainder will be lost in conveyance. In about one year out of 30, on the average, the import supply would be deficient by about 50 percent, but the use of ground water would limit the overall irrigation deficiency to about 33 percent. In all other years the amounts indicated above would be delivered.

San Luis Service Area

The irrigated area of the San Luis Unit would contain about 458,500 irrigable acres. The western boundary of the service area would be elevation 485 as far south as the Pleasant Valley Canal, and, from there it would average 455 feet in elevation, the grade of the Pleasant Valley Canal. The eastern boundary of the proposed service area is an irregular line representing the eastern edge of the better quality soils.

Plan of Development

Before construction begins minor modifications in these service area boundaries would be possible, but the irrigable acreage to be served now cannot be increased because of water supply limitations. The service area boundary is shown on plate 1.

CHAPTER III

LAND

As a basis for determining the number of acres in the service area which actually will be cropped, the characteristics of the lands were considered and the lands classified according to their suitability for irrigation. Some of the gross area classified must be used for roads, and other noncrop purposes, and a small portion is unsuitable for cropping. The acreage which would not be available for cropping has been estimated and subtracted from the gross acreage of the service area, to find the productive acreage for which water is to be supplied. This productive acreage is estimated to be 440,000 acres. These topics are discussed in this chapter.

Characteristics of the Soils

Most of the lands of the San Luis Division occupy the gently sloping, coalescing alluvial fans laid down by creeks emerging from the Coast Range. Sediments on these fans have been derived from calcareous and gypsiferous shales, sandstones, and conglomerates. The resulting soils contain variable amounts of soluble salts, principally sulfates. In general, the higher parts of the fans are occupied by medium textured sediments. Lower on the fans are finer textured sediments in which slight amounts of the water soluble salts have accumulated. Along the outer edges of the fans and in the interfan areas fine textured sediments have been deposited and salts have accumulated in moderate amounts. In small areas near the foothills more undulating topography exists and old erosion surfaces are exposed.

Land

Land Classification

The land classification survey considered such factors as soil, topography, drainage, and the resultant effects upon crop adaptability, yields, and cost of production. As previously mentioned, much of the proposed service area has been developed to irrigation farming. Thus, results of operating experience were available for reference in completing the land classification. Additional basic information used in the land classification survey included:

a. A detailed soil survey of the Coalinga area made by the United States Department of Agriculture and University of California in 1943.

b. A soil survey of the Mendota area made by the Division of Soils, University of California and Division of Soil Survey, United States Department of Agriculture in 1941 and 1942;

c. A soil survey of the Los Banos area made by the Division of Soils, University of California and the Bureau of Plant Industry, United States Department of Agriculture in 1939;

d. A soil survey of Kings County made by the Division of Soils, University of California and Bureau of Plant Industry, United States Department of Agriculture in 1938; and

e. A reconnaissance land classification survey made by the Bureau of Reclamation in 1943 and 1944, embracing most of the lands involved in the service area of San Luis Unit.

Land

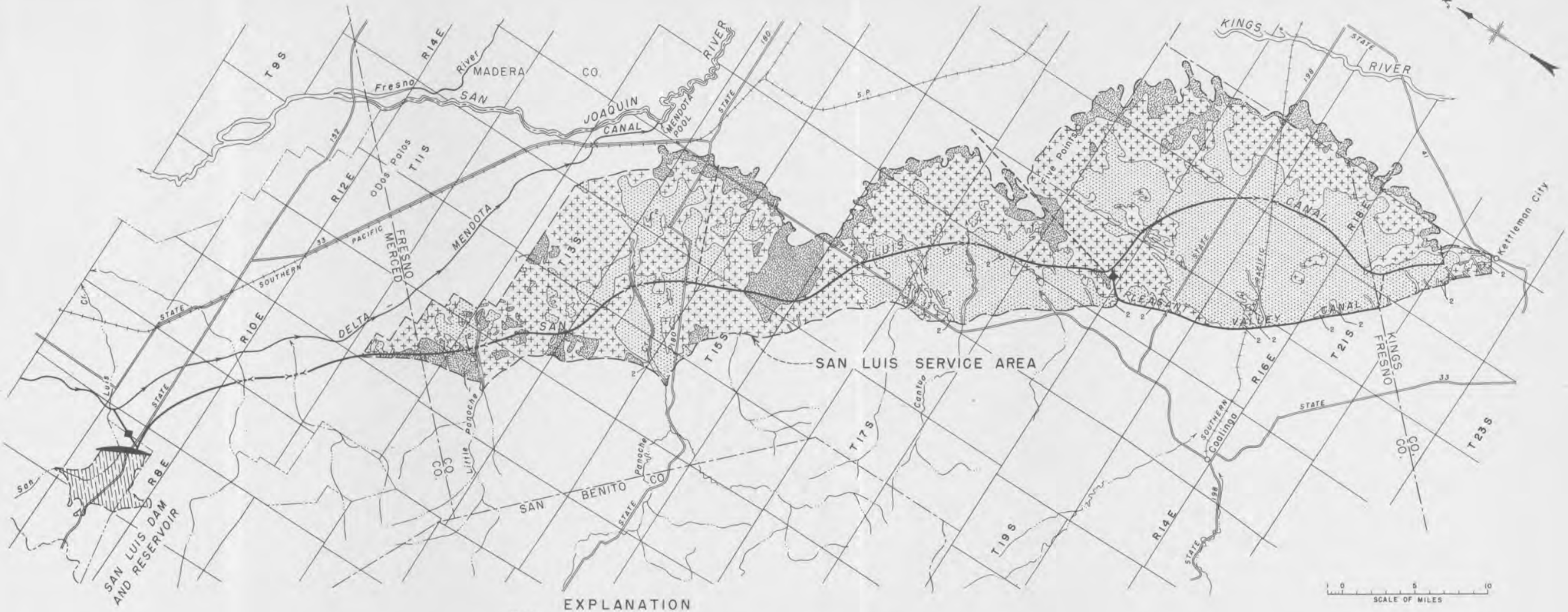
Additional field surveys and sampling, some as recently as 1952, were made to locate the lines segregating land classes to the prescribed degree of accuracy. Mapping of the area was accomplished on ratioed enlargements of the 1950 Production Marketing Administration aerial photographs of the area on a scale of 1:15,840, or one inch equals 1,320 feet. Inasmuch as uniform land classes occur in relatively large tracts, this scale was considered of sufficient accuracy to delineate adequately details of significance in the land classification determination.

During the course of the classification, the lands of the service area were segregated into three classes according to their degree of suitability for irrigated agriculture. The factors of soil, topography, and drainage for class 1 lands are favorable to high yields of a wide variety of climatically-adapted crops with relatively low production costs. Class 2 lands reflect moderately lower yields, slightly restricted crop adaptability, increased production costs or a combination of these limitations. Class 3 lands, while suitable for irrigation, reflect more severely the limitations outlined above. Lands with characteristics unsuited for irrigation agriculture were designated as class 6. In general, the class 1 lands are on the higher parts of the fans where the medium textured sediments have been deposited. The class 2 lands are lower on the fans where slight amounts of salts have accumulated or where fine sediments have been deposited. Class 3 lands are on the outer edge of the fans where fine textured sediments have been deposited and salts accumulated in moderate amounts, and also in a few areas of rougher micro-relief near the foothills. Table 1 summarizes the land classification specifications used in the Bureau of Reclamation survey. The following tabulation presents acreages by land classes for the service area and plate 3, "Land Classification" indicates the location of the land by classes:

	Class 1		Class 2		Class 3		Class 6		
Category	Acres	%	Acres	%	Acres	%	Acres	%	Total Acres
Gross area	199,000	40.1	231,000	46.6	64,000	12.9	2,000	0.4	496,000

Productive Land

Not all the land surface of San Luis Unit can be devoted to crops. A portion of it would be needed for such purposes as roads, buildings, and fences, and some of it is chemically or topographically unsuitable for cropping. Consequently, the gross service area must be reduced by the amount of this unavailable or unsuitable land to obtain the number of acres that actually can be cropped. This is the productive land. Table 2 summarizes the irrigable and productive acreages for the area involved in the proposed San Luis Unit. Of the 440,000 productive acres, 180,000, (41 percent), is estimated to be class 1; 203,000, (46 percent), class 2; 57,000, (13 percent), class 3.



EXPLANATION

Class

1 Suitable for sustained high production of any climatically adapted crop with minimum cost of management.

2 Slightly less productive, adapted to fewer crops, and more difficult and costly to manage because of slight to moderate limitations in soil, topography, or drainage.

3 Restricted productivity, requiring difficult and costly management because of moderate to severe limitations.

6 Unsuitable for irrigated cropping because of extreme limitations in soil, topography, or drainage.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CENTRAL VALLEY PROJECT — ULTIMATE PLAN
WEST SAN JOAQUIN DIV. - SAN LUIS UNIT - CALIF.

LAND CLASSIFICATION

JULY 7, 1954

805-208-25

Table 1.--Land classification specifications

San Luis Unit Sheet 1 of 2

Land characteristic	Class 1	Class 2	Class 3
		Soils	
Texture	Sandy loam to friable clay loam	Loamy sand to permeable clay	Fine sand to slowly permeable clay
Depth:			
To sand, gravel, or cobble	36" of fine sandy loam 42" of sandy loam	24" of sandy loam 30" of loamy sand	12" of loamy sand 24" of fine sand
To shale, raw soil from shale or similar material	60"	42"	30"
To compact horizon	48"	24"	16"
Alkalinity[a/]			
Surface	pH usually less than 8.3	pH usually less than 8.7	pH usually less than 9.0
Sub-soil	pH usually less than 8.5	pH usually less than 9.0	pH usually less than 9.4
Deep sub-soil	pH usually less than 8.5	pH usually less than 9.4	pH usually less than 9.6
Salinity			
Surface	Total salts less than 0.2%	Total salts less than 0.5%	Total salts less than 0.8%
Sub-soil	Total salts less than 0.2%	Total salts less than 0.5%	Total salts less than 1.00%
		Topography	
Slopes	Smooth slopes up to 4% general gradient. Field size tracts sloping in the same plane.	Smooth slopes of 8% in field size tracts sloping in the same plane, broken slopes of 4%.	Smooth slopes up to 12% in field size tracts sloping in the same plane; rougher slopes less than 8%.
Surface	Minor amounts of leveling not to exceed $50 per acre at present prices. Cost of clearing small.	Moderate leveling and grading costing $50-$100 per acre at present prices. Moderate cost of clearing.	Heavy leveling and grading costing $75-$150 per acre at present prices. Expensive but feasible clearing.

Table 1.--Land classification specifications

San Luis Unit — Sheet 2 of 2

Land characteristic	Class 1	Class 2	Class 3
		Drainage	
Soil and topography	No farm drainage requirement is anticipated.	Some farm drainage will be required but cost will be reasonable.	Farm drainage in moderate amounts will be required. The cost of supplying this is expensive but feasible.

Class 5

Lands having highly saline soils of low permeability.

Class 6

Rough, broken lands with shallow soil, drainageways and isolated hills.

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a/ Black alkali is not an extensive problem in the area. Where observed, these specifications were used.

Table 2.--Derivation of irrigable and productive acreages

San Luis Unit

Item		Acreage
Gross area		496,124
Less:		
Net class 6 (nonagricultural)	1,924	
Present miscellaneous nonagricultural	5,000	
Total		6,924
Arable land		489,200
Less:		
Expected increase in nonagricultural land other than farmsteads, farm roads, and farm ditches		30,740
Irrigable land		458,460
Less:		
Expected area in farmsteads	9,000	
Expected area in farm roads	5,600	
Expected area in farm ditches	3,860	
Total		18,460
Productive land		440,000

CHAPTER IV

WATER SUPPLY

This chapter discusses local ground-water supplies, estimated future water requirements for San Luis Unit, and the way in which these requirements would be met by an imported water supply; as well as power supplies required for pumping, and water rights.

Ground Water

Ground-water basin.--Practically all of the present water supply in the San Luis Unit service area comes from ground water. The ground-water reservoir will continue to be an important source of water under project conditions. This ground-water reservoir comprises an accumulation of variably pervious sediments with a maximum thickness of nearly 3,000 feet. The water-bearing sediments of the reservoir occur in coalescing alluvial fans laid down predominantly by Coast Range streams. Some sediments from the Sierra Nevada were washed westerly beyond the present valley axis and are interlayered with Coast Range-derived alluvium at considerable depth beneath the floor of the San Joaquin Valley. The Coast Range type sediments are mostly fine-textured and ill-sorted and thus yield less ground water than those from the Sierra Nevada which are mainly well-sorted and coarse materials.

A relatively impervious layer called the Corcoran clay occurs at depths of 200 to 800 feet below the surface. This lake-bed deposit effectually divides the ground-water reservoir into two distinct parts, a deep basin and a shallow basin. The shallow basin is occupied chiefly by Coast Range sediments with a predominance of interconnected pervious beds and is essentially unconfined. Sierran-derived sediments, below the Corcoran clay, are major aquifers in hydrologic continuity with aquifers underlying the east side of the San Joaquin Valley. Water in the deep basin is confined under artesian head.

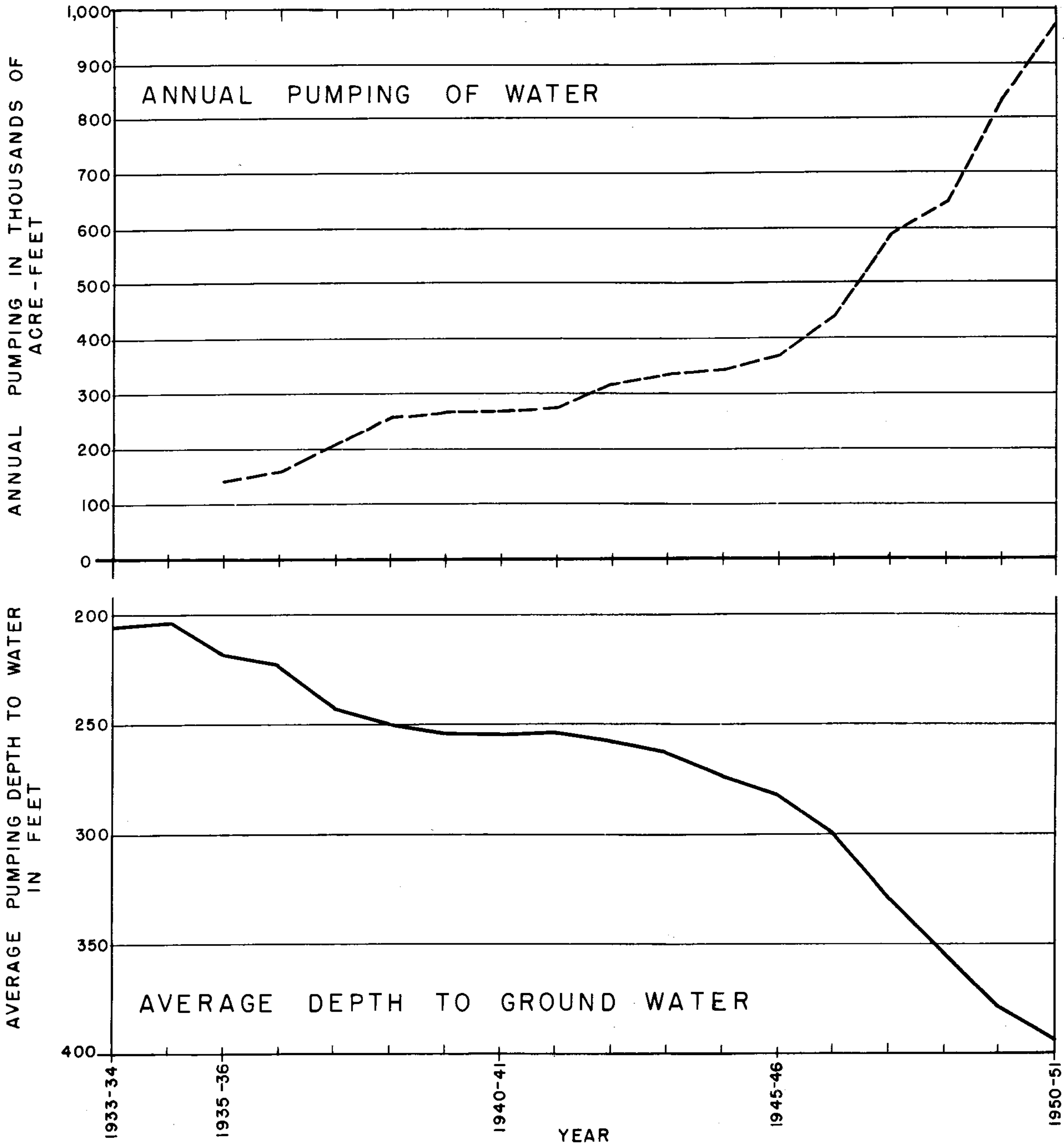
Wells.--The wells that tap the ground-water basin are drilled almost exclusively by rotary methods to depths of 1,500 or 2,000 feet. They are completely cased and gravel-packed. Casings generally are perforated from 100 to 200 feet above the Corcoran clay to the well's bottom. In this manner both the shallow and deep ground-water zones are tapped. Electrically driven pumps operated by 100 to 300 horsepower units produce water at a rate of from 1,000 to 2,000 gallons per minute. Often an individual well is utilized to irrigate areas as large as an entire section (640 acres). The electric service charges make it generally more economical to operate these large pumps as nearly continuously as possible.

Recharge.--The ground-water basin is recharged by seepage from west side streamflows, subflow from the east side of the valley and return flows from irrigation within the San Luis Unit. Rainfall usually is so light that it does not penetrate beyond the root zone in significant quantity to recharge the ground-water basin. It is estimated that 32,000 acre-feet annually, or approximately 90 percent, of the total runoff of west side streams tributary to the San Luis Unit percolates to ground water. Other recharge, amounting on the average to about 181,000 acre-feet annually is available as deep underground flow from the east side. Therefore, about 213,000 acre-feet is the long-term average annual ground-water supply from stream seepage and subsurface inflow to the San Luis Unit area. Return flow from present irrigation in the area is not considered in this estimate of recharge because such flow is almost wholly from pumped ground water and therefore is not new water added to the ground-water reservoir. An auxiliary factor in the recharge estimate is that this quantity of water can be consumptively used annually at relatively stabilized pumping levels within the San Luis and contributory east-side areas.

Present overdraft.--Water levels in the San Luis area have dropped more or less continuously since heavy irrigation began. This is illustrated in plate 4. In 1933 the average pump lift was about 205 feet. By the beginning of 1952 it had lowered to about 423 feet. The decline became steeper during the later years of the period, and it averaged about 25 feet per year between 1946 and 1951. This decline is due to the continued exploitation of the ground-water resource faster than it can be replaced. The annual ground-water withdrawal was approximately 1,000,000 acre-feet during the 1950-51 season, of which perhaps 700,000 acre-feet was consumptively used.

Safe yield.--Three factors limit the desirable long-term rate of withdrawal from a ground-water basin. These are: the recharge; the cost of pumping; and the quality of the water. The greatest perennial net withdrawal that can be made without exceeding any of the limits imposed by these factors is called the safe yield.

The present average natural recharge to the San Luis Unit is approximately 213,000 acre-feet per year. This equals an allowable gross pumpage of 284,000 acre-feet per year if an assumed 25 percent of the pumpage percolates to ground water again as an irrigation loss. The gross pumpage has exceeded this allowable figure by a greater and greater margin since 1942-43. It is because of this that the pumping lifts have been increasing steadily over the service area and probably in the contributory east-side areas. The amount of pumping, the number of wells, and the irrigated acreage have all been increasing, despite the fact that the increasing pumping lifts have meant increasing costs. Thus the economic cost-limit has not been reached for pumping as yet, nor has the limit of quality been reached because, even though generally poor, the water quality has been constant regardless of the amount pumped per year. However, this does not mean that the present rate of pumping can be maintained indefinitely; it cannot because there is far more water extracted annually than is replaced (recharged). This ground-water "mining" would lower levels not only in the San Luis Unit area but also in adjacent areas so as to force a reduction in pumping and in irrigated areas using ground water. Consequently, the safe yield under nonproject conditions is much less than present use or about 213,000 acre-feet per year.



SAN LUIS UNIT SERVICE AREA
GROUND-WATER PUMPING AND
WATER LEVELS IN DEEP WELLS

Water Supply

Under project conditions imported water will be available in greater quantity, with better quality, and at a cheaper price than will most well water. Consequently, ground-water withdrawals will decrease, recharge from irrigation losses will increase, and water levels will begin to recover. This recovery must be controlled at proper levels by pumps or by drains, if necessary, to avoid a serious drainage problem along the lower edge of the service area. Control by pumps will be aided by the fact that as the pump lifts decrease, wells will become relatively more economical and the better wells in the lower portions of the alluvial fans will probably provide water more cheaply than the works of the San Luis Unit. The result of this combination of physical and economic factors will be to stabilize pump lifts at some lesser figure than the more-than-400-foot average which prevailed in 1950-51. Probably the new level will be near 250 feet, although the unpredictable economic factor as well as new demands on the ground-water reservoir in adjacent areas influence this long-term average pump lift and cause a low accuracy in any such forecast.

With a level of 250 feet instead of the present average lift of over 400 feet, it has been assumed that the underflow from the east side of the San Joaquin Valley of about 181,000 acre-feet per year might be maintained. This appears likely because under project conditions, pumping on the west side will be concentrated near the eastern edge of the service area, which is expected to maintain largely the hydraulic gradient from east of the valley trough in its present state even though the piezometric surface will rise over most of the service area west of the pumping concentration. In addition, for the period 1938-39 through 1941-42, annual pumpage averaged about 270,000 acre-feet with an apparently stabilized average pumping level of about 250 feet. Water-level fluctuations on the east side of the San Joaquin Valley will influence the ground-water gradient and thus the underflow to the San Luis Unit; however, such conditions cannot be anticipated at present. In view of the above considerations, the underflow has been assumed to remain the same under project conditions as it was under 1950-51 conditions. In other words, the safe yield under project conditions has been estimated as 213,000 acre-feet plus that portion of the imported water which will reach ground-water pumping zones as an irrigation loss.

An estimated 25 percent of the irrigation water percolates past the root zone and reaches the ground-water reservoir. Under project conditions this irrigation return flow from imported surface-water plus the recoverable portions of the canal and distribution system losses will be about 454,000 acre-feet a year. Therefore, the total estimated ground-water recharge from all sources under project conditions will be about 667,000 acre-feet.

Discharge under project conditions.--In an integrated operation the discharge from the ground-water basin by wells and by drains will approximate recharge under project conditions. The estimated usable well discharge will amount to about 540,000 acre-feet annually. The remaining discharge of 127,000 acre-feet will be accomplished principally by drains along the eastern edge of the service area. This drainage will serve two purposes: (1) it will lower the water table which otherwise ultimately might stand in the root zone or on the surface near the lower end of the service area, and (2) it will remove water of poorer quality and thus maintain an overall acceptable quality of ground water and soils. Much of the ground water in use now is of poor quality because of high sodium or boron content. The drains will be used generally in the interfan areas of tight soils along the eastern side of the service area where the saline content of the drain water may be especially high. It is not expected that the drains will be needed for the first several years of project operation nor will there be a simultaneous need for the drains along all the service area, but rather the need will develop gradually according to the rate at which ground-water levels rise in the lower (eastern) part of the service area.

Water Requirements under Project Conditions

Water requirements for the San Luis Unit consist of agricultural water needed for full irrigation development of the project service area, including domestic water for both existing farmsteads and those which will be established, and municipal and industrial water for nearby municipalities and industrial development. Conveyance and distribution system losses are considered also as a part of the total water requirements.

Water Supply

The annual crop consumptive use requirement for water in the San Luis service area was estimated to be 1,214,000 acre-feet for 440,000 productive acres as shown in table 3. This value is based on the projected crop pattern under full development outlined in chapter VI. The crop irrigation requirement for the San Luis Unit area amounts to 1,126,000 acre-feet per year and is the amount of water which must be supplied to meet the consumptive use requirement mentioned above after allowance is made for the precipitation falling directly on the area. Studies by the Bureau of Reclamation based on Corps of Engineers isohyetal charts and Weather Bureau rainfall records indicate that under full development, an average annual quantity of 88,000 acre-feet of water from precipitation will be effectively used by crops in the San Luis Unit.

The amount of water applied to the land must be larger than the crop consumptive use requirement because of application losses. Bureau of Reclamation studies which considered such factors as soil texture, soil profile characteristics, irrigation frequency and duration, land slope, and irrigator's skill indicate that under conditions of full development, 417,000 acre-feet in excess of crop consumptive use would be applied during each irrigation season. Of this amount 31,000 acre-feet would be nonbeneficial consumptive use by weeds and other noncommercial plants growing along fence rows and in turn rows. The remainder percolates below the plant root zone and is subject to recovery by pumping from ground water.

Table 3.--Net consumptive use by crops under conditions of full development

San Luis Unit

Crop	Unit consumptive use (acre-feet/acre/year)	Area (acres)	Consumptive use (acre-feet)
Cotton	2.42	132,000	319,000
Alfalfa	3.47	88,000	305,000
Irrigated grain and hay	1.25	44,000	55,000
Irrigated pasture	3.87	44,000	170,000
Deciduous fruits and grapes	2.54	22,000	56,000
Field crops	1.76	66,000	116,000
Truck crops	2.20	88,000	193,000
Total		a/ 440,000	1,214,000
Average	2.76		

a/ Excludes double-cropped area of 44,000 acres.

Water Supply

Based on experience in the service area of the Friant-Kern Canal, the net delivery requirement for farmstead use in the San Luis Unit was estimated to be 17,400 acre-feet annually. Distribution system losses in the San Luis Unit service area was estimated at approximately five percent of the canalside supply. This value was based on a concrete pipe distribution system in which seepage and operational losses will be small.

The total annual water requirement of 1,666,000 acre-feet at canalside results from the addition of the crop irrigation requirement (1,126,000 acre-feet) the farm application losses (417,000 acre-feet) the farmstead use (17,400 acre-feet), the municipal and industrial requirement (22,600 acre-feet), and a distribution system loss allowance (83,000 acre-feet).

San Luis Canal will have an estimated conveyance loss equal to 10 percent of the water supplied at the canal headworks. This value consists of four percent seepage loss plus six percent wasteway and operational losses. Since 540,000 acre-feet will be pumped directly from ground water into the distribution system, only the 1,126,000 acre-feet canalside requirement will be delivered through the San Luis Canal each year at full development. A canal loss of 125,000 acre-feet added to 1,126,000 acre-feet results in an annual import water requirement of 1,251,000 acre-feet at the San Luis Canal headworks. The details of water flow in a typical year are illustrated on plate 5. Since the values given in plate 5 are for a typical year, they differ slightly from average values given later in this chapter.

As mentioned above, the total requirement for municipal and industrial water from project sources is estimated as 22,600 acre-feet annually. This projected water requirement comprises 18,600 acre-feet of municipal water and 4,000 acre-feet of industrial water. The municipal requirement under conditions of full development is based on an assumed per capita consumption of 275 gallons per day for estimated urban and rural nonfarm populations of 29,800 and 30,700 respectively. The basis for the population figures is explained in chapter VII. The industrial water requirement represents present consumption in the Avenal and Coalinga oil fields.

Project Water Supply

Central Valley Project.--The basic features of the Central Valley Project considered in San Luis water supply studies include those which are at present either existing, under construction, or are presently authorized for construction. The existing features included are: Shasta Dam and Powerplant, Keswick Dam and Powerplant, Tracy Pumping Plant, Delta-Mendota Canal, Contra Costa Canal, Delta-Cross Channel, Friant Dam, Madera Canal, Friant-Kern Canal, and other minor facilities. The features presently under construction are: Folsom Dam and Powerplant, Nimbus Dam and Powerplant, Sacramento Canals Unit, and the Sly Park Unit. All of the features listed as under construction, except the Sacramento Canals Unit, are nearing completion.

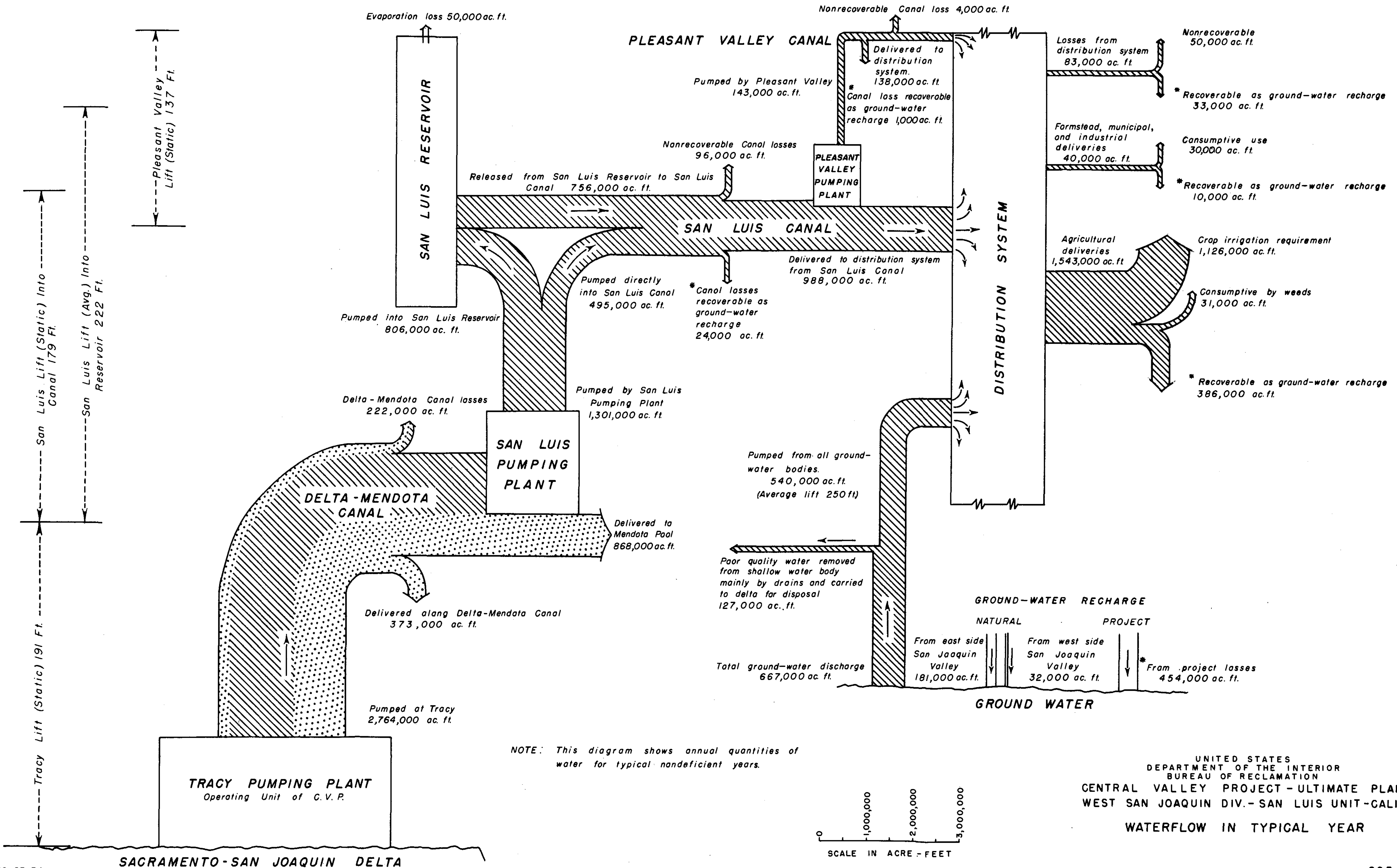
Water Supply

Authorized features included in the studies were the features of the Trinity River Division consisting of: Trinity Dam and Powerplant with an assumed reservoir capacity of 2,500,000 acre-feet, Lewiston Dam and Powerplant, Towerhouse Diversion Dam and Powerplant, Matheson Powerplant, and approximately 17 miles of transbasin tunnel.

In addition to the features of the San Luis Unit previously described in chapter II, allowances were made in the studies for the following possible future developments: Folsom North Canal, Folsom South Canal, and the Folsom Suburban Area Conduit. Also included in the studies was the effect on the Central Valley Project water supply of existing and potential future developments on the following streams: Stony and Putah Creek, Kings, American, Mokelumne, and Tuolomne Rivers.

Operational criteria.--The operation of the Central Valley Project including the Trinity River Division is based on the concept of basin-wide integration. This concept has been adopted so as to increase the irrigation yield by coordinating as far as possible the operations of the units of the project and thus providing the greatest possible utilization of water resources. With this concept the project will be operated to meet requirements for irrigation, municipal and industrial uses, flood control, navigation, salinity control, fish and waterfowl protection and power production.

Surplus Delta outflow to the ocean.--The coordinated reservoir operation studies of the Central Valley Project, including the Trinity River Division, show that even during the driest years considerable



NOTE: This diagram shows annual quantities of water for typical nondeficient years.

UNITED STATES
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CENTRAL VALLEY PROJECT - ULTIMATE PLAN
WEST SAN JOAQUIN DIV. - SAN LUIS UNIT - CALIF.
WATERFLOW IN TYPICAL YEAR

JUNE 1, 1954 REV. 10-23-54

805-208-13

GPO 968842

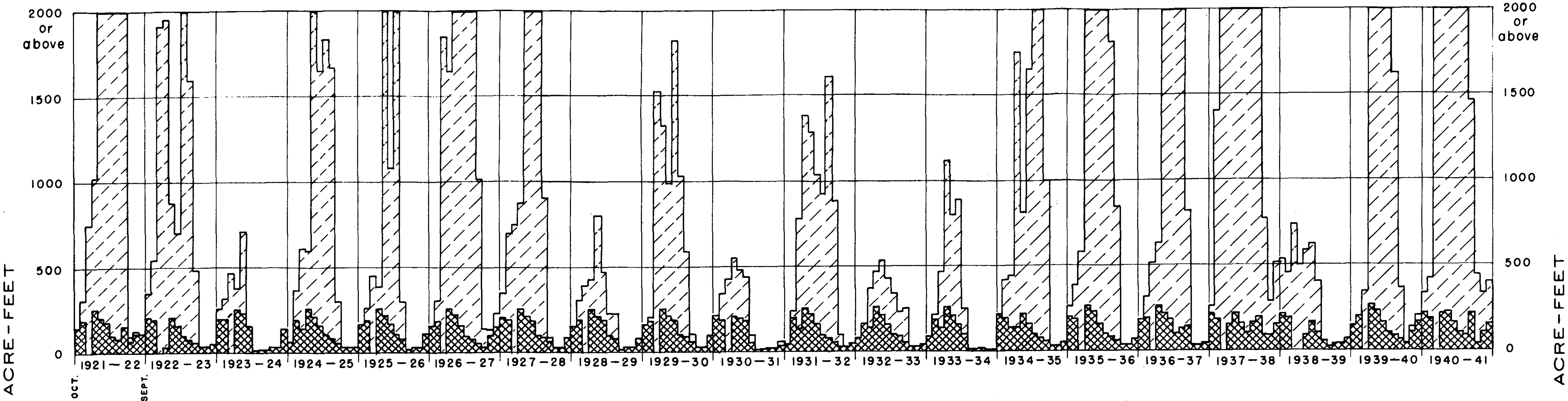
amounts of surplus water are wasted to the ocean. The magnitude of this wastage varies from about 2,000,000 acre-feet in 1924 to over 25,000,000 acre-feet in 1938.

The surpluses, which are derived principally from unregulated accretions below the various dams, cannot be utilized on a firm yield basis, as they occur, because they are ordinarily available only when irrigation demands are small. As was explained previously in chapter II, the water supply for the San Luis Unit is derived principally from these surpluses. Plate 6 shows the effect of the San Luis Unit on Delta surplus flows.

Utilization of Delta-Mendota Canal.--The Delta-Mendota Canal is an important feature in the operation of both the Central Valley Project and the San Luis Unit. Under the operation of the Central Valley Project, including the Trinity River Division, the canal will be required to deliver water in exchange for San Joaquin River flows and for the Delta-Mendota Canal service area, amounting to approximately 1,316,000 acre-feet per year. With the San Luis Unit included, the canal still is required to meet these commitments and in addition, deliver an average 1,257,000 acre-feet per year to the San Luis pumps for the San Luis Unit. This will be accomplished by using the conveyance capacity of the Delta-Mendota Canal to transport San Luis water during months when irrigation along the Delta-Mendota Canal and San Joaquin River does not demand the full capacity of the canal. Thus, the addition of the San Luis Unit increases the utilization of this existing project feature. Plate 6 shows the effect of the San Luis Unit on the Delta-Mendota Canal.

Operation of San Luis Reservoir.--The addition of the San Luis Unit to the Central Valley Project will furnish sufficient offstream regulation to Delta surpluses to permit utilization of a large amount of the surplus water of the Delta on a normal firm irrigation distribution. Regulation will be accomplished by pumping surplus flows into San Luis Unit via the existing Tracy Pumping Plant and Delta-Mendota Canal and the proposed San Luis Pumping Plant. Whenever the San Luis water delivered to the San Luis pumps coincides with the irrigation demand, the water will be pumped directly into the San Luis Canal rather than into the reservoir. The water applied directly will amount to an average of 471,000 acre-feet per year or approximately one-third of the average 1,297,000 acre-feet per year to be delivered to the San Luis pumps via the Delta-Mendota Canal. The remaining 826,000 acre-feet per year will be stored in the reservoir for later use. The values of 1,297,000 acre-feet and 826,000 acre-feet include 40,000 acre-feet to meet San Joaquin Valley demands as explained in the next paragraph. Plate 7 shows the amounts pumped directly into the San Luis Canal and the amounts pumped into the reservoir. The San Luis pumps also will serve to relift an average annual 77,000 acre-feet released from San Luis Reservoir when the water surface is below the gravity outlet to the San Luis Canal.

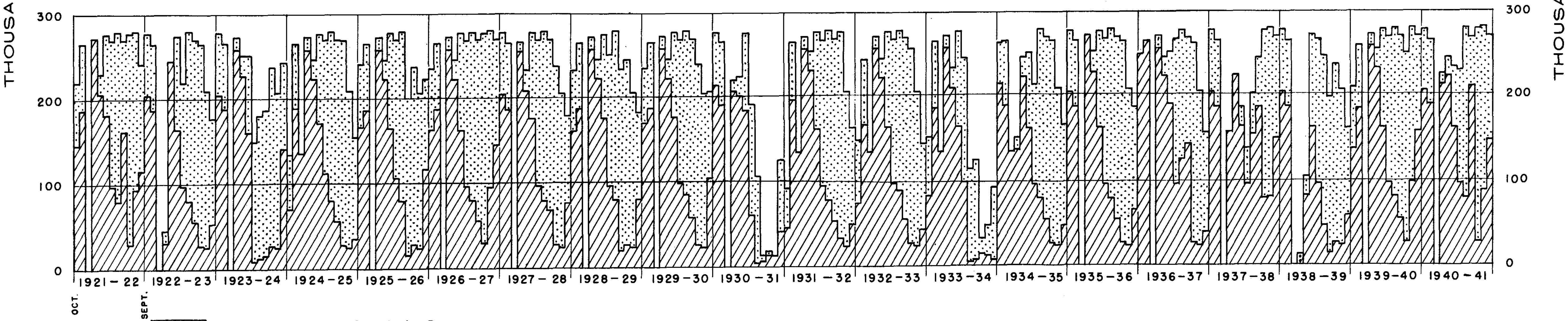
SURPLUS OUTFLOW TO OCEAN FROM SACRAMENTO – SAN JOAQUIN DELTA



Surplus outflow after San Luis Unit becomes operative (Monthly surplus above 2,000,000 acre-feet not shown)

Surplus outflow to be diverted to San Luis Unit (Includes a small transfer from project reservoirs)

WATER PUMPED INTO EXISTING DELTA-MENDOTA CANAL



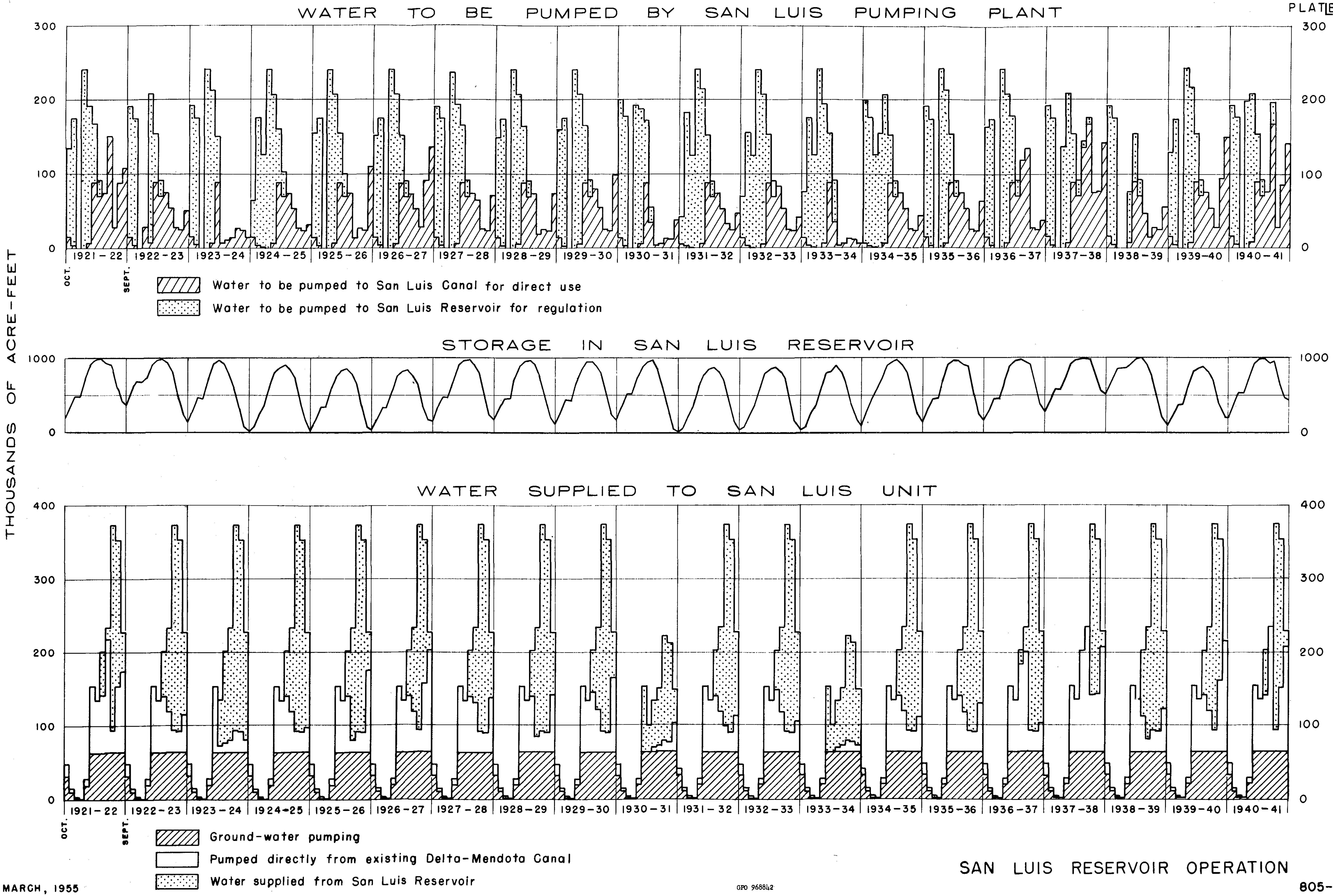
Water routed to San Luis Pumps

Water used along Delta-Mendota Canal

ROUTINGS FOR
SAN LUIS RESERVOIR OPERATION

805-208-35

MARCH, 1955 GPO 968842



SAN LUIS RESERVOIR OPERATION

MARCH, 1955

GPO 968842

805-208-36

Water Supply

In addition to regulating surplus flows, which are within the delivery capacity of the Delta-Mendota Canal, San Luis Reservoir provides added flexibility to the system. This is accomplished by transferring stored water from Shasta and Folsom Reservoirs to San Luis during periods when according to historical runoff characteristics, the water would likely be lost by spilling if retained in Shasta or Folsom. If necessary, the water thus transferred can be released from San Luis Reservoir to meet San Joaquin Valley demands normally met by Shasta and Folsom releases. Releases of this type appeared advantageous during two years of the twenty-year study, the average annual release being 40,000 acre-feet.

In terms of a firm water supply to the San Luis Unit service area, the import water supply will furnish 1,126,000 acre-feet from the San Luis Canal. This supply is in addition to 540,000 acre-feet per year furnished to the area at canalside from ground water. The total supply at canalside normally available each year to the San Luis Unit is then 1,666,000 acre-feet. The amounts of water from all sources for the San Luis Unit are shown on plate 7. It was necessary to take a 50 percent deficiency in the import water supply from April through October in 1931 and 1934 in the operation study. However, the period selected for streamflow analysis, 1921-41, contained an unusual 7-year dry period. Based upon precipitation records extending over 100 years, the probable long-term frequency of the 50 percent deficiencies will be about once in 30 years. Since the supply of ground water will be undiminished, the overall irrigation deficiency would be only about 33 percent in these years.

Water Supply

Pumping of an average 409,000 acre-feet per year from the San Luis Canal will be required to serve all irrigation demands in the San Luis Unit above the San Luis Canal except for a requirement of 143,000 acre-feet per year to be pumped to the Pleasant Valley Canal.

Power

Central Valley Project power consumption.--Operation of the San Luis Unit will require large amounts of electric power for pumping. This power will come from power facilities of the Central Valley Project. Project-use energy requirements of the Central Valley Project without the San Luis Unit total 381,000,000 kilowatt-hours for the following major uses: Tracy pumps, Contra Costa pumps, Shasta area, and Sacramento Canals Unit pumps. The San Luis Unit will add 756,000,000 kilowatt-hours to the pumping requirements for additional pumping at Tracy, San Luis pumping to San Luis Reservoir and to San Luis Canal, San Luis relift pumping and Pleasant Valley pumping.

Central Valley Project power supply.--Power generating facilities of the Central Valley Project including Trinity River Division are expected to have a maximum capability of 964,000 kilowatts reduced by losses to 888,000 kilowatts at major load centers. With firming support furnished by Pacific Gas and Electric Company under terms of existing contracts, the following firm peak loads could be met, measured at load center:

	Kilowatts	
	Without San Luis	With San Luis
Project use	113,000	233,000
Surplus dependable available for commercial sale	540,000	340,000
Total	653,000	573,000

The remaining nondependable peaking capacity would be usable for nonfirm generation when water is available and would provide additional revenues. Values for average energy utilization comparable to the above values for capacities are listed in table 4.

Water Rights

In the operation of the San Luis Unit, all existing water rights will be fully recognized and protected as required by Federal Reclamation laws. Rights to use of water for irrigation, domestic, and industrial purposes will be acquired in accordance with State laws governing the appropriation of unappropriated water for diversion and beneficial use.

Since the water supply for the San Luis Unit will be obtained from surplus flows from Central Valley streams available in the Delta, as well as from water stored in project reservoirs, the Bureau of Reclamation will, on behalf of the United States, and to the extent possible, modify existing applications on file with the State Engineer for Central Valley Project uses as may be required to include the San Luis Unit within the scope of the Project and/or file new applications with the State Engineer for the appropriation of water for use on the San Luis Unit or obtain

Table 4.--Central Valley Project energy utilization without and with San Luis Unit

	Kilowatt-hours per year	
	Without San Luis	With San Luis
Hydro generation	3,726,000,000	3,726,000,000
Support purchases	360,000,000	290,000,000
Subtotal	4,086,000,000	4,016,000,000
Transmission losses	291,000,000	293,000,000
Net for use	3,795,000,000	3,723,000,000
Use		
Project use	381,000,000	1,137,000,000
Sale of surplus:		
Firm	2,520,000,000	1,580,000,000
Nonfirm	894,000,000	1,006,000,000
Total use	3,795,000,000	3,723,000,000

assignments of applications filed by others for use of water on this area. In addition, an application for off-stream storage in San Luis Reservoir and diversion and use of surplus San Luis Creek flows will be filed by the Bureau of Reclamation immediately after Federal authorization of the San Luis Unit. These filings are necessary to conform with State requirements.

The State Department of Finance has filed four applications to appropriate unappropriated water with the State Division of Water Resources, two in 1927 and two in 1951, in connection with the State's Feather River Project. The service area of this Project includes the San Luis Unit area. Other applications also have been filed for the use of water on this area by the Kings River Water Conservation District and the Westlands Water District.

CHAPTER V

DESIGNS AND ESTIMATES

The estimated construction cost of the features required for the San Luis Unit were determined from detailed estimates based on preliminary designs. Factors relating to topography, geology, hydrology, special design and construction problems and operational requirements were considered during the preparation of these designs and cost estimates. The construction costs were based on prices prevailing in January 1954, which are about the same, or slightly lower than, present prices.

Maps and Surveys

Maps and survey information by the Geological Survey, Army Map Service, Coast and Geodetic Survey and photography available from the Department of Agriculture provided a valuable base for the conduct of the planning studies.

The area is covered by published topographic quadrangle maps of the Geological Survey at scales of 1:31,680 having a 5-foot contour interval. The field mapping was done between 1919 and 1933 with a remapping program of the area initiated by the Survey during the 1955-1956 period. The civilian edition of the Army Map Service (1:250,000 scale) shaded relief series maps, as published by the Geological Survey, provides an excellent general map of the project and related drainage area. The Coast and Geodetic Survey has conducted extensive vertical control surveys in the area, releveling most of the older lines in the last eight years.

Designs and Estimates

Horizontal and vertical control established by the Coast and Geodetic Survey has served as a base for additional surveys by the Bureau. San Luis dam site topography was taken by plane table methods in 1944 at a scale of one inch = 200 feet with 5 foot contours. The reservoir site was mapped in 1946 under contract by aerial photogrammetric methods, on a scale of one inch = 400 feet with a contour interval of 10 feet. Under the same contract the San Luis Pumping Plant intake area and the first 26 miles of the San Luis Canal were mapped at a scale of one inch = 200 feet and a contour interval of 5 feet.

Aerial photographs from the mapping contracts were available for the reservoir area, the pump intake, and the first reach of the canal to the Fresno-Merced County line. The scale of the photographs of the reservoir area was 1:12,000 and of the canal strip,1:24,000. Photographic coverage of the service area and adjacent lands, procured from the Department of Agriculture flights in 1950, provided the base for crop and land classification surveys and were valuable in our geology, ground water and drainage studies.

Geology of the San Luis Unit Features

Exploration.--The structures of this project will be located both on "bedrock" and valley alluvium. The geologic investigation included geologic mapping, drilling, and examining preliminary core holes at San Luis Dam site, drilling and studying exploratory holes at possible sites for the San Luis Pumping Plant and sampling and classification of construction materials in the proposed San Luis Reservoir. South of mile 18, San Luis

Canal and attendant structures will be located on valley alluvium for which soils surveys were made.

Although active faults are not known in the area the presently active San Andreas rift lies a few miles west, and the Ortigalita thrust, active in the recent past, is closer to the west. It is possible that severe earthquakes may be felt at any of the structure sites. In addition to seismic activity appreciable land subsidence has been noted over wide areas. This subsidence appears to be continuous in many areas. However, construction and operation of the proposed project is entirely practical with respect to the geologic factors.

San Luis Dam.--The foundation at the site is adequate for an earthfill dam. Bedrock is steeply tilted, competent sandstone, conglomerate and shale. Depth to bedrock in the stream section probably is 80 feet or more. Sandy or silty clays are prominent in the alluvial fill as shown by the construction materials investigation. Estimates of foundation conditions are substantiated by examination of cores from eleven test holes at the sites of the main and saddle dams.

All embankment materials for a zoned earth dam can be obtained within four miles of the dam site and mostly from within the reservoir site. Gravel suitable for the outer zone may be in short supply in the reservoir area but is abundant 10 miles south in the Los Banos Creek valley. Some of the Los Banos Creek gravels presently are being exploited as concrete aggregates.

San Luis Pumping Plant and Pump Canal.--The proposed pumping plant location is underlain by unconsolidated alluvium. Foundation testing will be required for specific site information.

Designs and Estimates

The pump canal probably can be located in an alluvial-filled channel where excavation would be common.

San Luis Canal and service area.--From the reservoir southward to mile 18, the San Luis Canal will traverse the lower slopes of foothills underlain by lenticular sandstone, siltstone, shale and conglomerate beds. These beds dip steeply eastward and are overlain by varying amounts of weathered bedrock, soil, and terrace alluvium. Rock excavation probably will be less than 50 percent.

The Los Banos and Ortigalita Creek siphons can be located on sandstone beds with good foundation properties.

Beyond mile 18, the canal will traverse unconsolidated sediments, where all excavation will be common. A few tests indicate that highly plastic expansive clays are not widespread along the canal line but some of the heavy textured materials, prominent in the interfan areas, may prove to be of these types.

Some sections of the canal will be in impervious soils and may require only compacted earth linings or perhaps will not require any lining. Bentonite for possible earth lining is available from local deposits. Proved sources of concrete aggregate are available near the San Luis Canal head and terminus. Unproved deposits between may shorten hauls considerably. Opaline diatomaceous shales are abundant in the nearby foothills and may be suitable for pozzolan if concrete additives are desired. Locally, water supply will be a problem.

Designs and Estimates

Pleasant Valley Pumping Plant and Canal.--The proposed Pleasant Valley Pumping Plant site is underlain by unconsolidated sediments whose specific foundation properties will have to be determined by testing.

The proposed canal traverses loose to friable sediments in which excavation is classified as common. Construction materials for Pleasant Valley Pumping Plant and Canal can be obtained from the sources cited above for other features.

Design and Construction Problems

Accessibility.--San Luis Dam and Pumping Plant are located approximately twelve miles west of Los Banos, and about eleven and one-half miles southwest of Volta. Access to railroad loading facilities in these two towns is by State Highway 152, an excellent, all weather, two lane, primary highway. The various reaches of the San Luis Canal, the Pleasant Valley Canal and the interceptor drain, though not paralleled by existing roads, are crossed by County and State highways which provide access to railroad facilities available in various communities in the area. Construction roads along the canal and drain berms, which would serve also as operating roads upon completion of the unit, would provide access and haul routes for all of the activities required for building these features. The Pleasant Valley Pumping Plant will be located adjacent to the Coalinga Road which intersects State Highway 33 approximately four and one-half miles from the plant site.

Designs and Estimates

Rights-of-way.--Virtually all of the lands that would be acquired for construction of the features of the San Luis Unit are presently developed. However, only about 40 percent of these lands are irrigated and very few farm buildings or improvements are located in the areas that will need to be acquired. Thus the purchase of the required rights-of-way should not present any special problems. The existing State Highway 152 traversing the San Luis Reservoir area will have to be relocated for approximately eight miles in order that the route can be carried along the reservoir rim above the maximum water line. A telephone line approximately paralleling this highway also will require relocation. It will be necessary to construct bridges to provide canal crossings for existing State and County highways and for existing and proposed farm roads.

Design floods.--The adopted spillway design flood for San Luis Creek at the San Luis Dam site has an estimated instantaneous peak of 20,000 cubic feet per second and a two and one-half day volume of 26,800 acre-feet.

Housing and community facilities.--There are several existing communities and towns in the area within reasonable commuting distance of the proposed project works. Housing facilities in these settlements, however, are generally very limited or else are nonexistent. The utilization of the housing facilities which are available in the larger centers of population in the vicinity would involve excessive travel distances. It will be necessary to provide a construction camp in the vicinity of San Luis Dam and possibly one or two smaller camps along the San Luis Canal. Permanent headquarters facilities at San Luis Dam, and subheadquarters facilities at the Pleasant Valley Pumping Plant will need to be provided for operation and maintenance of the San Luis Unit, with perhaps a few houses for ditchriders along the canal.

Special Problems

Subsidence.--Periodic releveling of the bench mark system in the vicinity of the proposed San Luis Unit indicates that the areas through which features would be constructed southerly from the Merced-Fresno County line have subsided. Eight feet of subsidence has been observed as a localized maximum about three miles east of the canal line near Panoche Creek and lesser amounts nearer the canal line. The eight-foot subsidence has occurred during a seven-year period. There are not sufficient data available to determine if this subsidence is due to consolidation of the surface soils from irrigation, to the withdrawal of underground water, or to a geological shift of the areas. In order to include a reasonable allowance for further subsidence which may occur after the San Luis Unit is in operation, a four-foot increase in canal bank height above that normally used was provided through subsidence areas. As an additional safety factor, the cost of preconstructing the foundations for the major canal structures and the cost to cover future modifications to meet future subsidence was included in the feasibility estimates. Further studies and investigations of possible continuing future land subsidence will be needed to provide information on methods of treatment to be adopted for construction designs.

Designs and Estimates

Drainage.--Soils of the area which will be served by the San Luis Unit contain salts which will be dissolved and carried by the percolating water into the soils in the lower parts of the service area. If left undrained evaporation and transpiration of the percolating waters would concentrate the salts and make these soils unsuitable for irrigation use. The construction of a drainage system will lower the ground-water table and prevent the concentration of salts. Since the normal summer flows in the natural drainage channels and rivers are insufficient to adequately dilute the saline waste waters which would be discharged by the drains, eventually it will be necessary to provide facilities for disposing of these waters. Carrying the flows to the Sacramento-San Joaquin Delta, as assumed in this design, is one method of effecting this disposal. Other methods involving concentration and deposition of salts may prove feasible. However, brief studies indicate the disposal of deposits would involve added operation and maintenance costs.

Floods.--Flood flows passing through the spillway of San Luis Reservoir would be discharged into San Luis Creek. The creek has sufficient capacity to handle the anticipated releases. Streams crossing the San Luis Canal in the upper reaches north of the Merced-Fresno County line also have adequate channel capacity to carry away flood flows. Streams south of the Merced-Fresno County line generally do not have adequate channel capacity. Land leveling operations and natural deposition of sediment have obliterated natural channels almost completely. Major flood flows from the drainageways would submerge lands in the proposed service areas under existing conditions. Since, under ultimate development of these service areas many farm homes and comparatively small farms are anticipated, floodways have been designed to insure protection against loss of lives and property.

Sedimentation.--An estimated 5,000 acre-feet of sediment would accumulate in San Luis Reservoir during the first 100 years of operation. Most of it would be deposited near the head of the reservoir, but some of it probably will be carried to the extreme bottom of the pool near the dam. Consequently, a dead storage space of 2,000 acre-feet has been provided. In the case of San Luis Canal it does not appear that sediment will present a serious problem. Water released from San Luis Reservoir should be practically sediment-free. Based on operating experience of the Delta-Mendota Canal, water pumped directly into San Luis Canal also will be free of sediment. Natural drainageways crossing the canal may carry some sediment, but since only the smallest of these will empty into San Luis Canal without ponding there should be very little sediment from this source. Consequently no special precautions have been taken in the canal design to care for sediment.

Mosquito control.--Unusual mosquito control problems are not expected to arise as a result of operation of the San Luis Unit. Some ponding of flood flows from natural drainages and waste releases from the canals will be required. It is likely, however, that since the fill slopes of the pond dikes will be relatively steep and the water surface will be drawn down fairly rapidly, conditions conducive to large mosquito production will not exist in these ponding areas. Some minor ponding of storm water along the outside base of the canal banks may occur in areas between canal inlet drains or culverts. It is anticipated that the control of these potential mosquito breeding areas can be carried on as a normal operational function. Since a closed tile drain system is proposed for drainage of the service area, there should be no need for carrying on mosquito abatement activities during operation of this feature. The open interceptor drain carrying the wastes from the closed drain system would provide for handling such flows at velocities sufficiently great to retard mosquito production.

Drawdown during the irrigation season should inhibit mosquito breeding within San Luis Reservoir. Measures recommended by the Public Health Service, United States Department of Health, Education and Welfare for prevention of mosquito breeding include: (1) clearing of the reservoir site; (2) making any residual ponding areas and marginal pools within the zone of reservoir fluctuations self-draining; (3) maintaining a vegetation-free shoreline; (4) eliminating vegetative growth in shallow water areas; and (5) constructing borrow pits to be self-draining, if they are not to be permanently inundated.

Main Storage and Conveyance Features

San Luis Dam and Reservoir.--A reservoir at the San Luis site having a capacity of 1,000,000 acre-feet will require the construction of a main dam across San Luis Creek and four saddle dams on the rim of the reservoir.

Designs and Estimates

All of the dams would have a crest elevation of 459 feet and would be earthfill. For the ultimate development of the San Joaquin Valley, additional west side storage capacity would be required. At that time, it would be possible to increase the storage in the San Luis Reservoir to 2,000,000 acre-feet. The embankment zones therefore would be arranged to facilitate the raising of the fill at some future date to provide a reservoir with the larger capacity. The main dam would have a height above the lowest point in the cut-off trench of 320 feet and a crest length of approximately 7,470 feet. The saddle dams would vary in height above natural ground from 48 feet to 125 feet and have crest lengths varying from 1,020 feet to 1,300 feet. At the normal water surface elevation of 450 feet the reservoir would have a capacity of 1,000,000 acre-feet. At the minimum water surface elevation of 280 feet the reservoir capacity would be 2,000 acre-feet.

The spillway would be located through a saddle on the left rim of the reservoir. It would be of the chute type with the ungated, emergency overflow crest set at elevation 452.2. This is the elevation to which the reservoir would rise if the entire spillway design flood were taken into storage at a time when the water surface was at elevation 450 feet at the beginning of the flood. The flood would be evacuated from the reservoir over a period of five days through an opening below the emergency crest. Flows through the opening would be controlled by a top seal radial gate and would discharge into the spillway chute. In the event of the occurrence of a second design storm before the first storm has been evacuated from the reservoir, excess flood flows would be discharged over the emergency crest of the spillway. Ultimately when the reservoir capacity is increased, it will be necessary to abandon the initial spillway and provide a suitable replacement structure at a higher elevation.

Water would be pumped into and released from San Luis Reservoir through the outlet works located under the right abutment of the dam. Initially, these outlet facilities would include a trashrack structure, a gate chamber, a valve house, four 15-foot inside diameter circular concrete conduits between the trashrack structure and the gate chamber, and four 20-foot inside diameter horseshoe concrete conduits between the gate chamber and the downstream toe of the dam. Three 15-foot inside diameter steel conduits would be housed in the 20-foot horseshoe conduits to carry the water from the gate chamber to the valve house. For the ultimate reservoir of 2,000,000 acre-feet, the capacity of the outlet facilities would be increased by the installation of a fourth 15-foot inside diameter steel conduit between the gate chamber and the valve house. The general details of San Luis Dam and appurtenant structures are shown on plate 8.

San Luis Pumping Plant and Intake Channel.--San Luis Pumping Plant would be a fully enclosed concrete structure 500 feet long, 63 feet wide and 80 feet high. It would house six pumping units each capable of delivering 810 cubic feet per second at 230 feet of head and two units each capable of delivering 750 cubic feet per second at 184 feet of head. Under rated conditions, maximum discharge from these pumps would be 4,860 cubic feet

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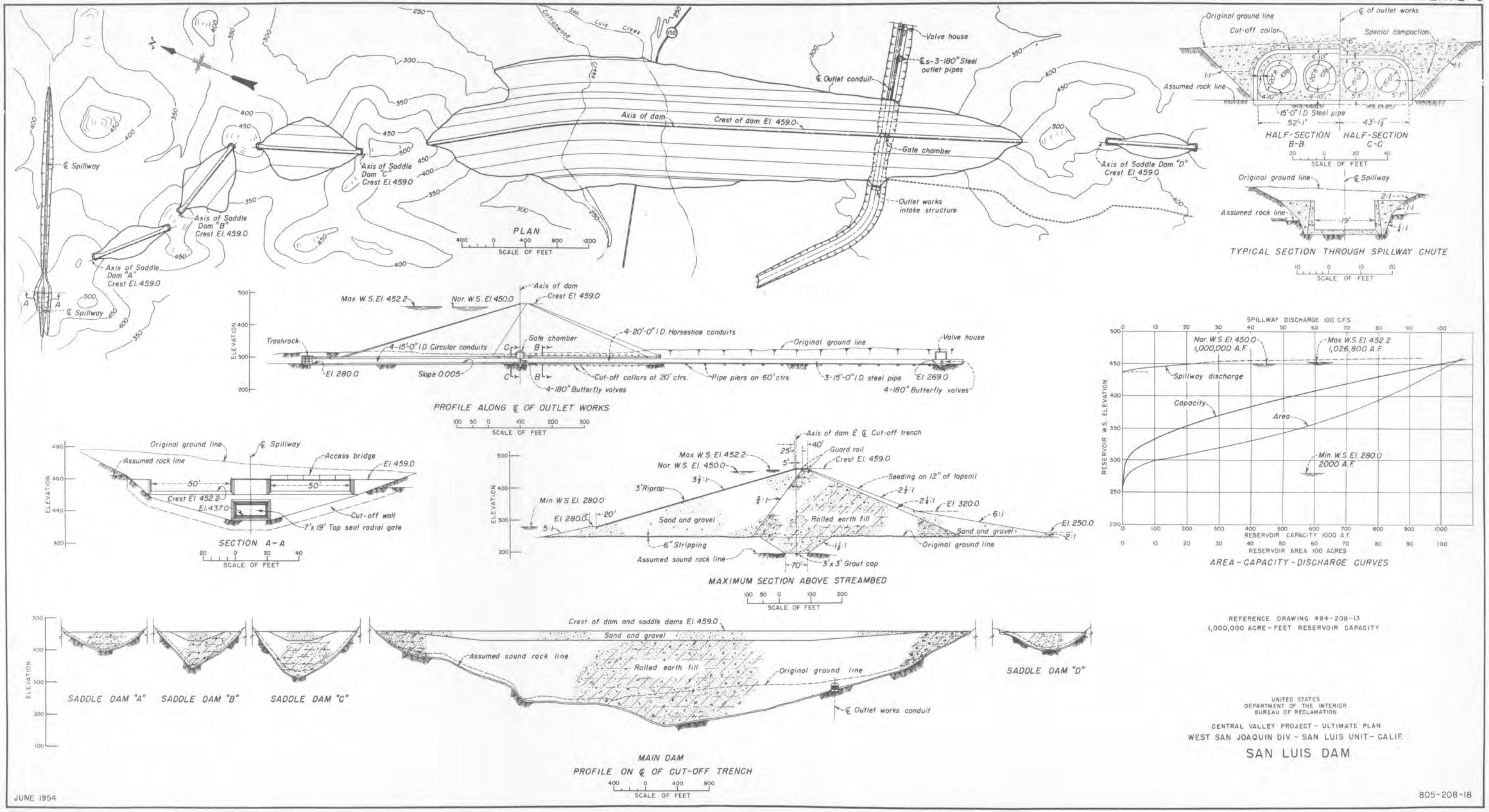

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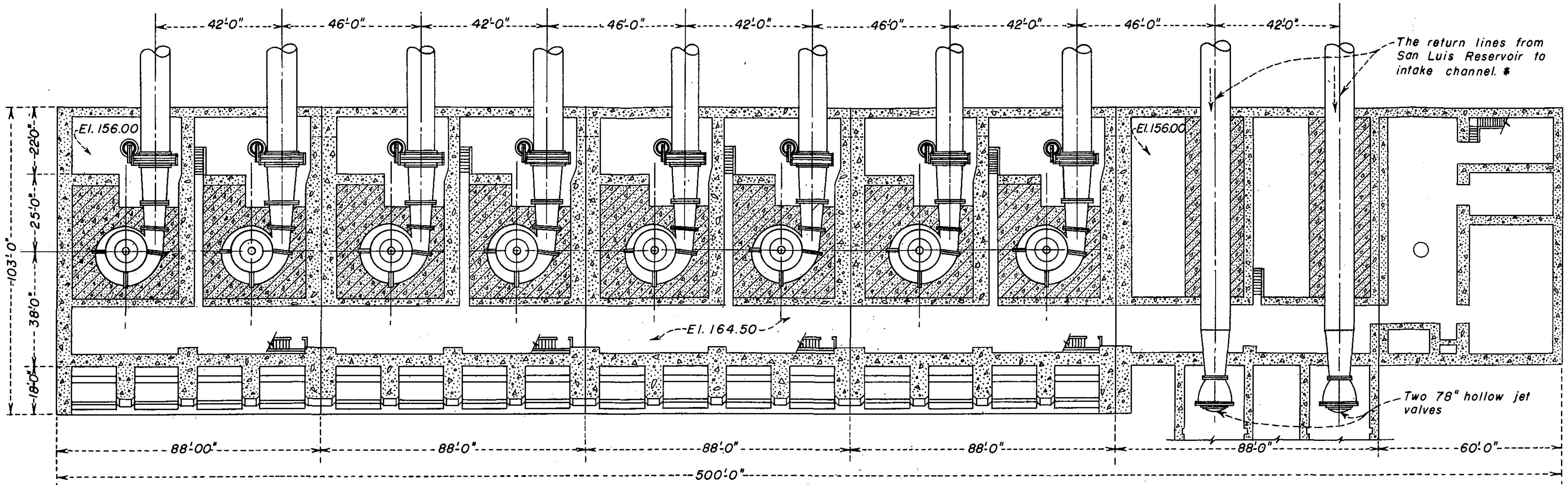
per second to San Luis Reservoir and 1,500 cubic feet per second to San Luis Canal or a total of 6,360 cubic feet per second. However, with San Luis Reservoir full the head on the larger units would be increased to 281 feet and the maximum discharge into the reservoir from the six larger pumps would be 2,460 cubic feet per second. Under this condition the maximum total discharge to San Luis Reservoir and Canal would be 3,960 cubic feet per second. The units would consist of vertical volute pumps driven by vertical synchronous electric motors. The six larger motors would be rated at 26,500 horsepower each, and the two smaller motors would be rated at 20,000 horsepower each.

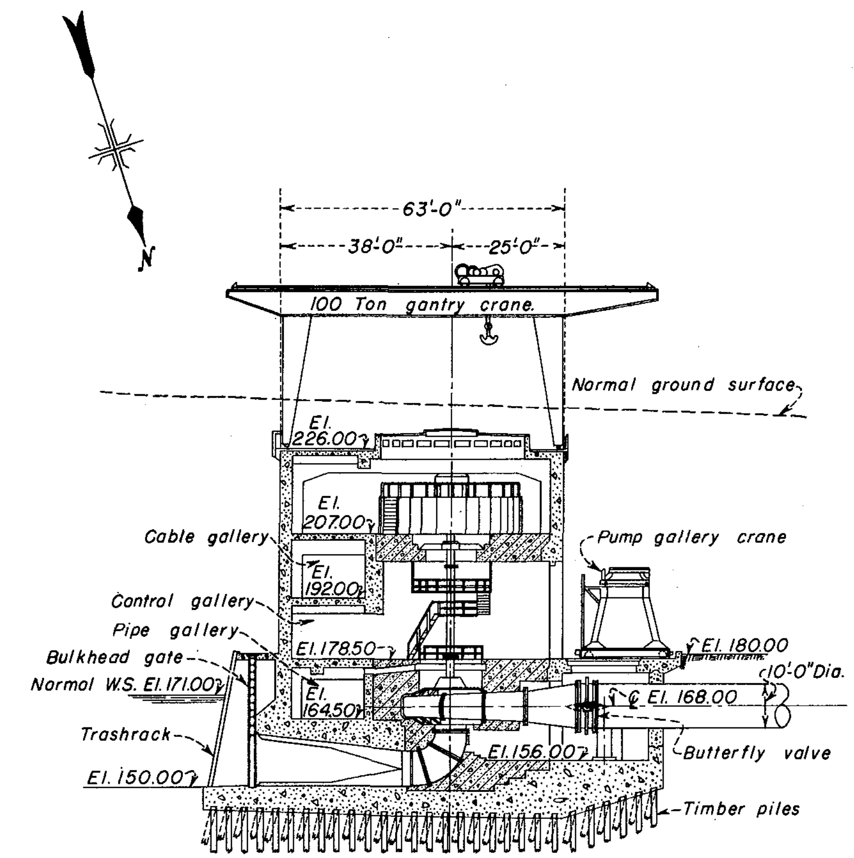
Water would be lifted from an intake channel, approximately 13,000 feet long, leading from the existing Delta Mendota Canal at Station 3014+20 and would be discharged through four 15-foot inside diameter steel discharge lines to San Luis Reservoir and San Luis Canal. The discharge lines would be so arranged that all pumps could discharge either to San Luis Reservoir or to San Luis Canal or to both at the same time. A return line would be provided for flow of water from San Luis Reservoir to the intake canal. This return line would be used for occasional return of water to Delta-Mendota Canal and for delivery of water to San Luis Canal from the reservoir when reservoir water surfaces would be below San Luis Canal water surface. For delivery to San Luis Canal from the low reservoir, water could thus be pumped in a normal manner from the intake canal. The electric energy required to drive the pumps would be obtained from the Central Valley Project at 230,000 volts. A switchyard at the pumping plant would reduce the voltage to that required to drive the pumps and for transmission to other pumping plants of the project. Plate 9 illustrates the type of pumping plant structure contemplated.

Pleasant Valley Pumping Plant and Intake Channel.--Pleasant Valley Pumping Plant would lift water from an inlet channel approximately 6,500 feet long leading from San Luis Canal at Station 4010+00 and discharge it through one 56-inch and two 84-inch steel discharge lines approximately 5,900 feet long to the Pleasant Valley Canal. The pumping plant structure, about 160-feet long, 32 feet wide, and 60 feet high, would consist of a reinforced concrete substructure and a structural steel and metal wall panel superstructure. The units would be vertical volute type pumps driven by vertical synchronous electric motors. There would be four units with 2,500 horsepower motors, each capable of discharging 125 cubic feet per second at a rated head of 150 feet. Two other units with 1,000 horsepower motors would discharge 50 cubic feet per second at a rated head of 150 feet. The electric energy required would be delivered at 115,000 volts. A switchyard would reduce the voltage to that required to drive the pumps. Plate 10 shows the general details of the proposed pumping plant structure.

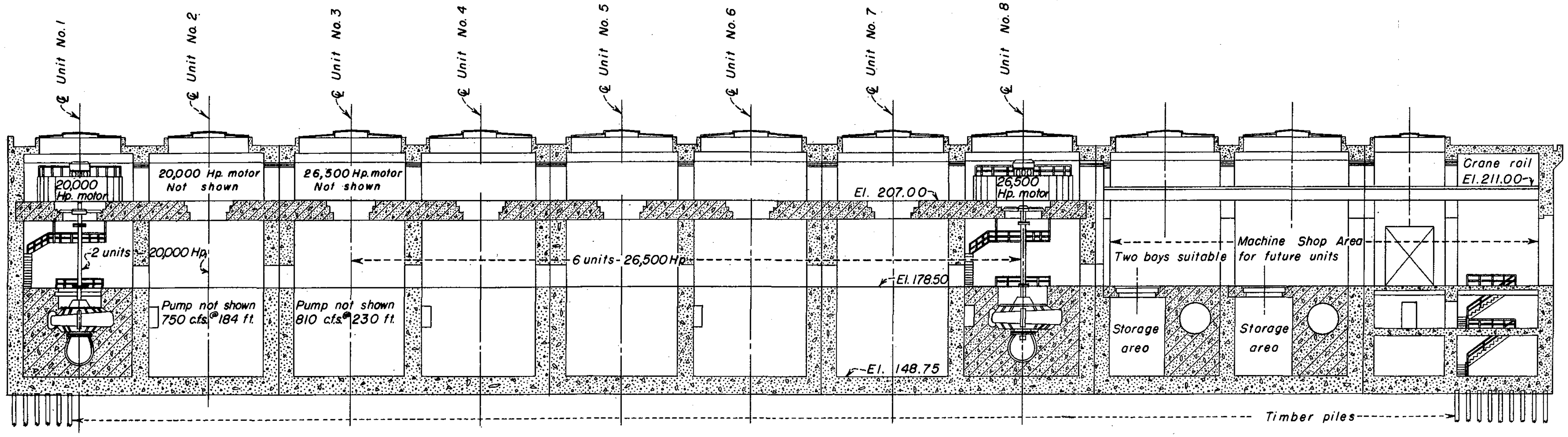
San Luis Canal and Wasteways.--The San Luis Canal, approximately 104.5 miles in length, would convey water from San Luis Reservoir to the Pleasant Valley pump lift at Canal Station 4010+00 and to the service area extending from approximately Canal Station 1100+00 (the Merced-Fresno County line) to Station 5510+00 near Kettleman City. As designed, the canal would be concrete lined for its entire length and would vary in capacity from 6,800



SECTIONAL PLAN THROUGH PUMPS



TRANSVERSE SECTION THROUGH UNITS



LONGITUDINAL SECTION THROUGH UNITS

REFERENCE DRAWING 484-208-46

10 0 10 20 30 40 50
SCALE OF FEET

* NOTE: The return lines to the intake channel would serve two purposes: First, for occasional return of water from San Luis Reservoir to Delta–Mendota Canal, and second, for delivery of water from San Luis Reservoir to San Luis Canal by pumping.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CENTRAL VALLEY PROJECT - ULTIMATE PLAN
WEST SAN JOAQUIN DIV. - SAN LUIS UNIT-CALIF.

SAN LUIS PUMPING PLANT

GENERAL ARRANGEMENT
PLAN AND SECTIONS

JUNE 21, 1954

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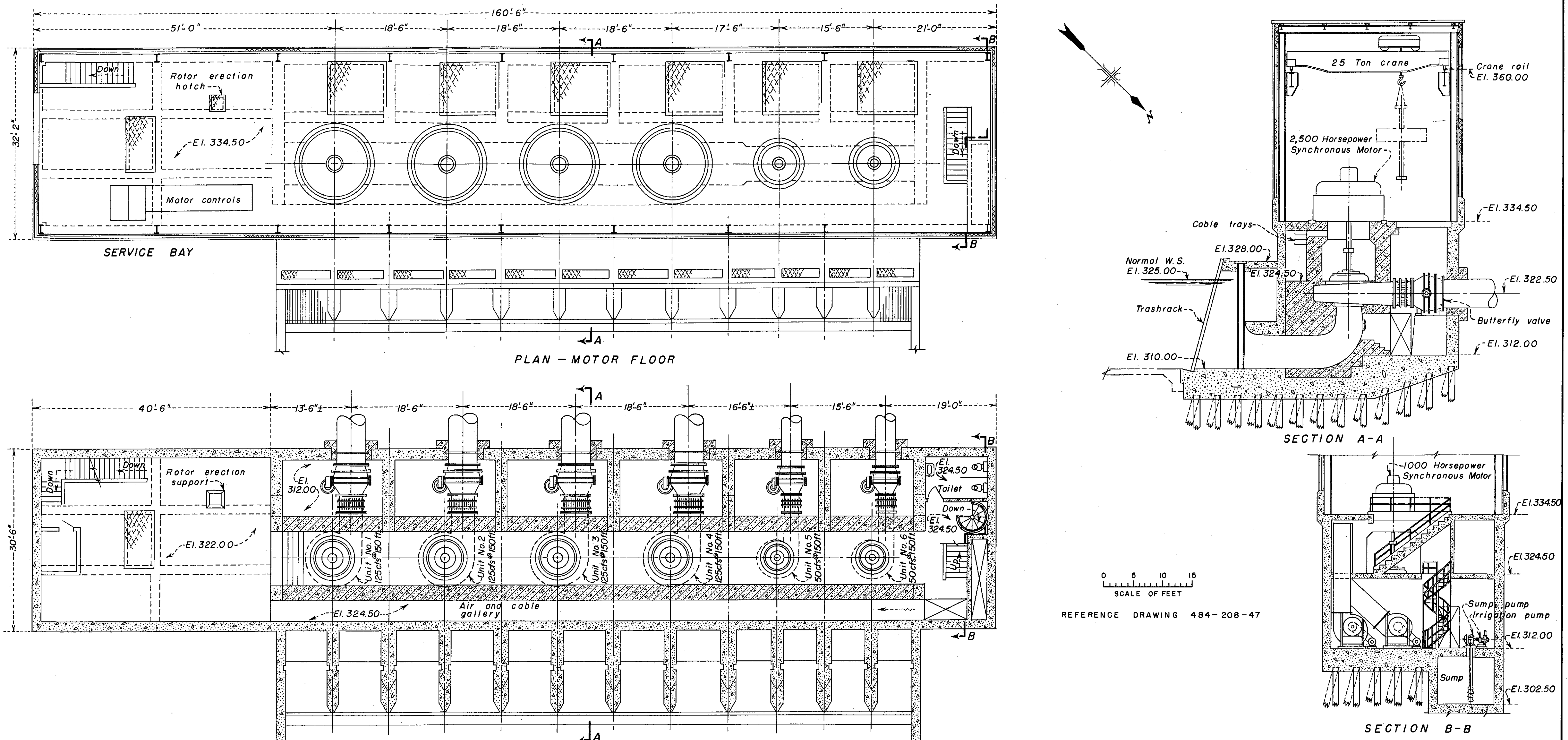

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CENTRAL VALLEY PROJECT – ULTIMATE PLAN
WEST SAN JOAQUIN DIV. – SAN LUIS UNIT – CALIF.

PLEASANT VALLEY PUMPING PLANT

GENERAL ARRANGEMENT
PLAN AND SECTIONS

JUNE 24, 1954

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cubic feet per second in the first reaches below San Luis Reservoir to 700 cubic feet per second in the terminal reach. The estimated water needs for the initial and ultimate service areas to be served from San Luis Canal would require canal capacities as listed below:

Canal reach Mile to Mile	Initial capacity cfs	Ultimate capacity cfs
0 to 45.4	6,000	6,800
45.4 to 75.9	4,600	5,300
75.9 to 89.15	1,700	-
89.15 to 104.5	700	-

Throughout the first 24.8 miles of San Luis Canal the cost of a canal section to accommodate the ultimate flows of 6,800 cubic feet per second would be only slightly greater than that for a section to handle flows of 6,000 cubic feet per second. Thus building the section and structures in this reach of canal to the ultimate capacity initially would be advantageous both from construction and economic standpoints. In the canal reach from mile 24.8 to mile 45.4, however, a section having concrete lining of sufficient height to accommodate only the initial capacity of 6,000 cubic feet per second would be provided. In addition bank heights 4 feet greater than required for the ultimate capacity would be provided. Such construction is considered advisable since subsidence, as mentioned previously, is expected to occur in this reach of the canal. Raising the concrete lining either to compensate for subsidence or to provide canal freeboard adequate for the ultimate capacity should be deferred until after land subsidence requirements are established, probably some years after canal operation begins. From mile 45.4 to mile 75.9 the canal section would provide concrete lining adequate for the initial capacity of 4,600 cubic feet per second and would have bank heights 4 feet greater than required for the ultimate flows. The concrete lining would be raised when ultimate capacity is needed. Structures in all of the above noted lengths of the canal would be constructed to the ultimate capacities, since the estimated savings in cost for construction to the initial capacities would not justify the deferred expenditures which would be required to replace or enlarge the structures at a later date. For the remaining reaches of the canal, structures and canal sections would be constructed which would accommodate the initial capacities.

Major structures along the canal include siphons under the main drainageways; regulating checks to maintain the proper water elevation in the canal; drop and side inlets to drain small drainageways into the canal; culverts to pass storm water under the canal; pump and gravity turnouts for delivery of water to the service areas; highway and farm bridges; wasteways to drain the canal; regulating and terminal reservoirs to provide greater flexibility of operation of the canal; fences and operating roads. It will be necessary to construct channels to carry off waste canal flows in some areas where natural drainage channels have been destroyed. Further, the central sloughs and rivers at the lower extremity of the service area do not have sufficient channel capacity to handle the entire wasteway discharges concurrently with high runoffs from Sierra snowmelts. Retention basins located adjacent to the sloughs would be provided for holding the wasteway releases until they could be safely released into these central drainageways. Wasteway channels leading from turnout points in the canal at Stations 2,400, 4,000 and 5,510 to retention basins would be provided. The first, Panoche Creek Wasteway, would have an earth section with concrete drop structures. It would be approximately 8.7 miles in length, with a capacity of 6,000 cubic feet per second. It would discharge into a retention basin constructed adjacent to Fresno Slough. The retention basin would provide 4,900 acre-feet of storage space for holding the wasteway releases. The second, Five Points Wasteway, of similar design would be approximately 16 miles long, with a capacity of 4,600 cubic feet per second. It would discharge into a retention basin constructed adjacent to Fresno Slough providing 5,990 acre-feet of storage space for holding the wasteway releases. The last, Kettleman City Wasteway, would have a concrete-lined channel approximately one and one-half miles long, a capacity of 700 cubic feet per second and would discharge into a retention basin constructed on lands outside the service area. The retention basin would provide a storage capacity of 590 acre-feet for holding the wasteway releases. Releases from the retention reservoir would be carried into the interceptor drain. The location of the canal and general details of the structures are shown on plates 11 and 12.

<u>Pleasant Valley Canal and Wasteway</u>.--The Pleasant Valley Canal, approximately 19.5 miles in length, would convey water from the Pleasant Valley pump lift to the service areas along the canal. Under ultimate development, municipal water for the city of Coalinga also would be supplied by the canal. The canal would be concrete-lined for its entire

length and would have a capacity of 600 cubic feet per second. The canal would terminate in a regulating reservoir having a storage capacity of 50 acre-feet. A 500 acre-foot retention basin would be constructed adjacent to this regulating reservoir for holding wasteway releases until they could be safely released into the San Luis Canal. Such flows would be carried in a concrete-lined channel having a capacity of 100 cubic feet per second which would lead from the retention basin to the San Luis Canal. Generally, major structures of the type listed for the San Luis Canal would be provided for the Pleasant Valley Canal. The location of the Canal and general details of the structures are shown on plates 11 and 12.

Floodways and retention basins.--As noted previously, protective works would be constructed to prevent the loss of lives and property that flood flows might otherwise inflict on the more densely populated areas expected under project conditions. For the major drainageways such facilities generally would consist of diked strips of land one-half mile in width through the service areas to confine the flood flows. The diked channels would carry flood flows to retention basins located adjacent to the central sloughs, rivers or existing canals for the purpose of holding the flood discharges until they could be safely released. Such facilities would be constructed for Little Panoche, Panoche, Cantua, Los Gatos, and Zapato Creeks. For the smaller drainageways, retention basins above the San Luis and Pleasant Valley Canals would be provided for holding flood flows until they could be safely discharged into the canals. The location of floodways, retention basins and general details of structures are shown on plates 11 and 12.

Electric system.--Power for operation of the project would be available at Tracy Switchyard from the Central Valley Project. The principal transmission lines needed to deliver this power to the project are described in the following paragraphs.

A single circuit steel-tower line would connect Tracy Switchyard with San Luis Switchyard. This line would be 60 miles long, operate at 230,000 volts, and use steel reinforced aluminum conductors with an area of 795,000 circular mills.

A single circuit wood-pole line of H-frame construction would extend from the San Luis Switchyard, to Pleasant Valley Pumping Plant Switchyard and to the various relift pumping plant voltage stepdown facilities. This line would be 88 miles long, operate at 115,000 volts, and use steel reinforced aluminum conductors with an area of 397,500 circular mills. In addition to the above, distribution lines would supply power to the canal relift pumps.

Relift pumps.--The canal relift pumps for supplying water to the concrete pipe distribution system serving 142,000 acres above the canal would be located at approximately two mile intervals along the San Luis Canal throughout the service area. The maximum static lift of about 160 feet would be made in two lifts by outdoor pumping plants. Water would be supplied to the pump intakes through pump turnout structures in the canal equipped with traveling moss screens. An electric distribution system would deliver energy at proper voltage to the relift pumps.

Designs and Estimates

Distribution System Features

This section describes features which would be primarily the responsibility of the water users. They could be constructed by the water users, or if they desire, by the Federal Government. The cost of these features are considered to be nonFederal expenditures in this study.

The type of works constructed, particularly the laterals, would be largely dependent on the water users' preferences. Concrete pipe laterals were chosen for use in this study because the topography is well suited to this construction, because the high value of the land and crops and the low maintenance favor the selection of pipe, and because the estimated cost would be high enough to construct any type of distribution that might be desired. The drainage system would not be constructed until required, and the transition from the present well pattern to the ultimate pattern would be gradual, depending on the length of life of existing wells.

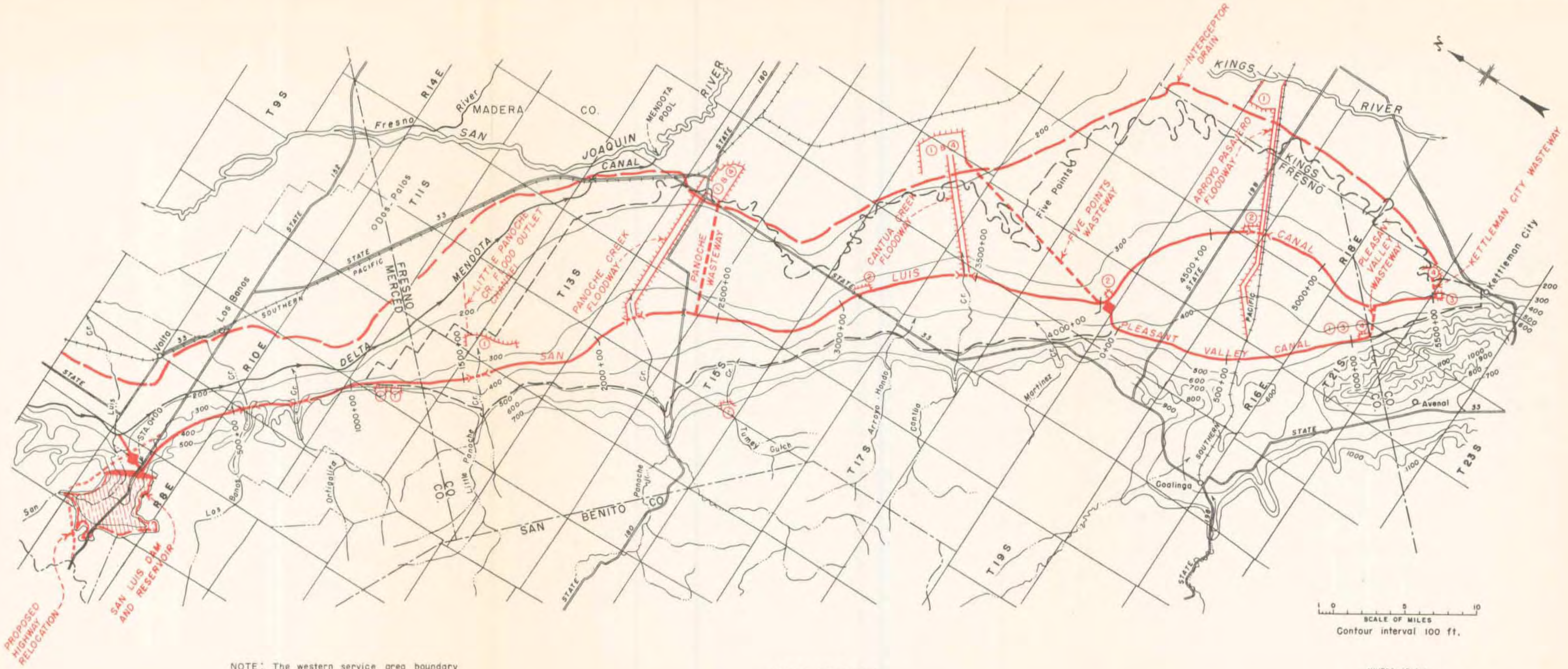
Concrete pipe laterals.--The concrete pipe lateral distribution systems used to supply water to the entire San Luis Unit service area would be of two general types: a full pressure gravity type for the areas below the San Luis and Pleasant Valley Canals; and a pump lift type for areas above the San Luis Canal. The total gross area served by the distribution system from the San Luis Canal is 457,000 acres. Of this total, 142,000 acres lying above the canal would be served by the pump lift type distribution systems. The maximum elevation of this land is about 485 feet between canal station 1100 and the Pleasant Valley Pumping Plant intake canal and about

375 feet from this point to the end of the service area. The remaining 315,000 acres lying below the canal would be served by gravity type distribution systems. The Pleasant Valley Canal would transport water to irrigate 39,000 gross acres lying below the canal which would be served by a full pressure gravity type distribution system. The total gross service area of the two canals would be 496,000 acres.

The full pressure gravity distribution systems would consist of precast concrete pipe laterals leading from the canal turnouts located at approximately two mile intervals along the canals, and branching sublaterals every one-half mile for serving farm delivery points. The pump type distribution systems would consist of discharge lines leading from the canal relift pumps along the San Luis Canal, the connecting precast concrete pipe laterals, discharge lines from the lateral relift pumps and branching sublaterals serving farm delivery points. The distribution systems would supply water requirements for a water-duty of one cubic foot per second for each 80 acres of gross irrigable area.

Drainage system.--Approximately 96,000 acres along the lower fringes of the service area will require a drainage system for the disposal of saline water unsuitable for reuse. The closed drain system for this area would consist of tile pipe drains, 10-inches to 24-inches in diameter, located at one-half mile intervals at approximate depths of 10 feet. The tile pipe would be connected to open drains carrying the waste flows to the interceptor drain. Trap boxes for deposit of silt would be provided in all closed drains at intervals of one-sixth mile. The San Luis interceptor drain, approximately 197 miles in length, would be an earth section channel extending from the vicinity of Kettleman City to Dutch Slough in the San Joaquin-Sacramento Delta. It would have a capacity of 300 cubic feet per second. Major structures along the interceptor drain include siphons under wasteways, floodways, existing canals, railroads, and highways; siphon spillways; reinforced concrete drops; State and County highway and farm road bridges; culverts; and irrigation ditch crossings. The closed pipe drain system would have a capacity sufficient to accommodate accumulated flows of one cubic foot per second for each mile of drain. The total volume of water to be wasted which would be handled by the drain system and interceptor drain would be approximately 127,000 acre-feet annually.

Wells.--It has been estimated that 540,000 acre-feet of ground water in the service area could be used for irrigation by pumping from wells. Wells varying in depth from 500 feet to 2,000 feet and having capacities ranging from 500 to 1,200 gallons per minute would be located throughout the service area for recovery of ground water. Existing wells in the area would be utilized for ground-water pumping initially. These wells would be replaced or supplemented by new wells as required. The new wells would be located adjacent to the distribution system laterals and pumped water would be discharged directly into these lines. To keep annual costs to a minimum, pumped ground water would be applied at the start of the irrigation season, import water from the canals would be gradually mixed in during the middle of the season, and ground water alone would be used again at the end of the season.



NOTE: The western service area boundary is fixed by available water supply. Present location is at about El. 485

EXPLANATION

Canal	Service area
Major pump lift	Wasteway
Siphon	Floodway
Interceptor drain	Reservoir

Reservoir: ① Flood retention ② Equalizing ③ Terminal ④ Wasteway

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CENTRAL VALLEY PROJECT - ULTIMATE PLAN
WEST SAN JOAQUIN DIV. - SAN LUIS UNIT - CALIF.

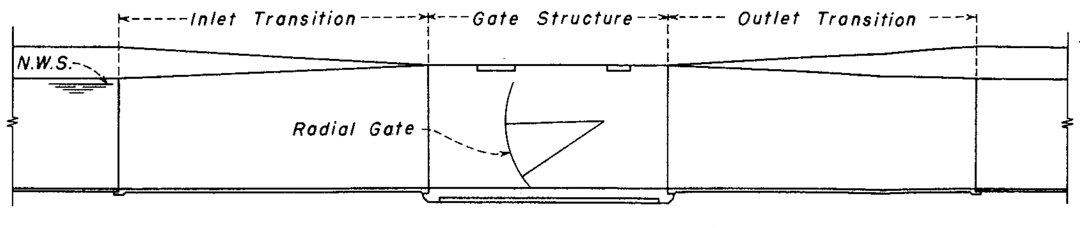
SAN LUIS AND PLEASANT VALLEY CANALS
LOCATION MAP

MARCH 25, 1955

REFERENCE DRAWING 484-208-48

805-208-37

GPO 968842



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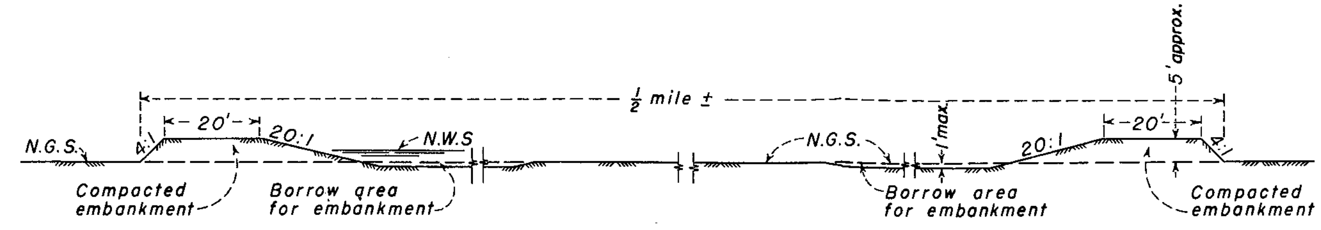
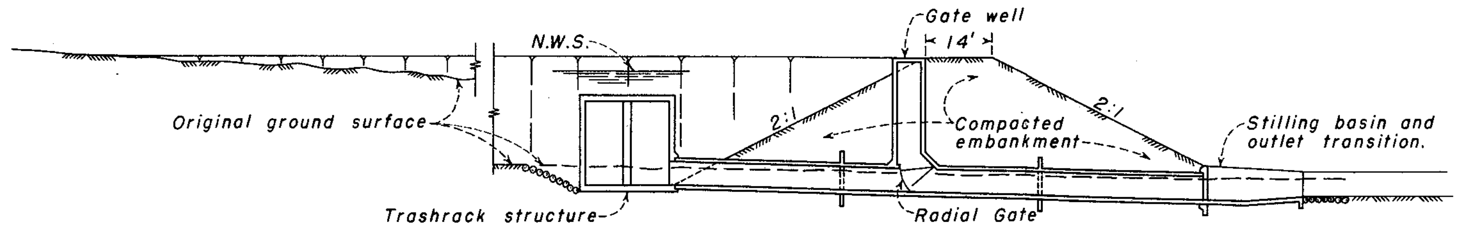
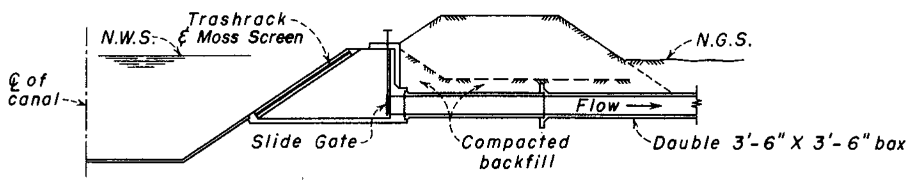


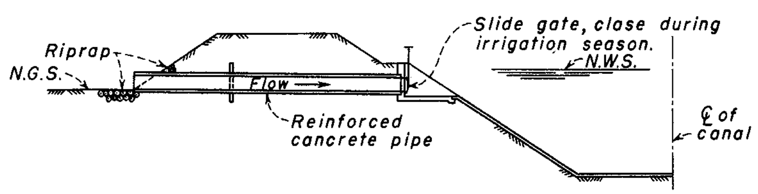
FLOODWAY



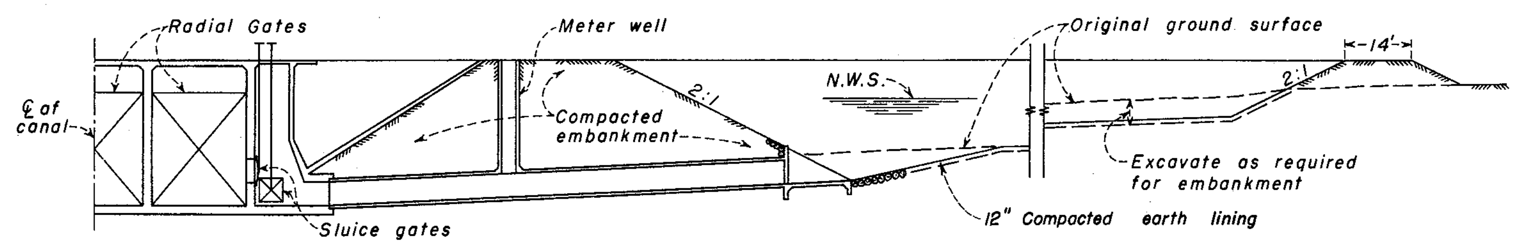
FLOOD RETENTION BASIN



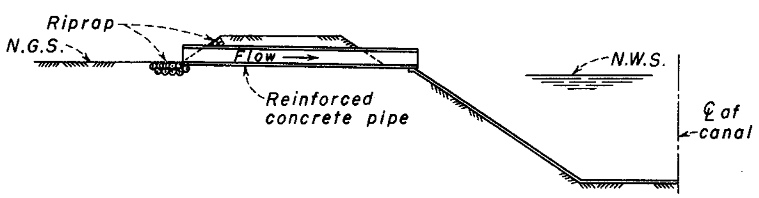
TURNOUT



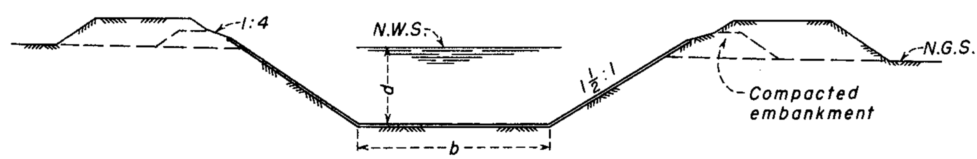
GATED DRAINAGE INLET ⚠1



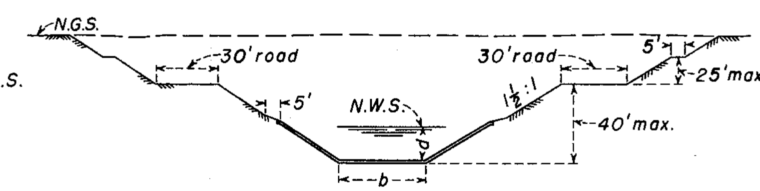
EQUALIZING AND TERMINAL RESERVOIR



UNGATED DRAINAGE INLET ⚠2



TYPICAL CANAL SECTION



TYPICAL PUMP INTAKE CANAL SECTION
(Road on one side only, for Pleasant Valley)

FLOODWAYS

Panoche Creek
Cantua Creek
Arroyo Pasajero

FLOOD RETENTION BASINS

	Capacity (Ac.Ft.)
Laguna Seco Creek	900
Sta. 1200	300
Little Panoche Creek	11,760
Panoche Creek *	35,000
Tumey Gulch	2,000
Cantua Creek *	12,590
Arroyo Pasajero	35,000
Arroyo Larga	270

NOTE:
* Flood Retention Basins utilized also for retention of canal waste and emergency releases.

EQUALIZING AND TERMINAL RESERVOIRS

	Capacity (Ac.Ft.)
Sta. 3060	100
Five Points	100
Sta. 4700	100
Kettleman City Terminal Res.	50
Pleasant Valley Terminal Res.	50

WASTEWAY RETENTION BASINS

	Capacity (Ac.Ft.)
Kettleman City Retention Basin	670
Pleasant Valley Retention Basin	500

HYDRAULIC PROPERTIES

		Q	b	d	s
San Luis Pump Intake Canal		4200	40'	15.7'	.00007
Lined Section No.1 Sta.0+00 to Sta.580+00	Ultimate	6800	40'	18.4'	.0001
Lined Section No.2 Sta.580+00 to Sta. 1310+00	Ultimate	6800	40'	22.0'	.00005
Lined Section No.3 Sta. 1310+00 to Sta. 2400+00	Initial	6000	40'	20.62'	.00005
	Ultimate	6800	40'	22.0'	.00005
Lined Section No.4 Sta. 2400+00 to Sta. 4010+00	Initial	4600	40'	17.96'	.00005
	Ultimate	5300	40'	19.3'	.00005
Lined Section No.5 Sta. 4010+00 to Sta. 4700+00		1700	20'	13.8'	.00005
Lined Section No.6 Sta. 4700+00 to Sta. 5510+00		700	12'	10.42'	.00005
Pleasant Valley Pump Intake Canal		600	10'	8.64'	.0001
Pleasant Valley Canal		600	10'	8.64'	.0001

NOTE:
⚠1 Required where normal ground surface is below normal water surface of canal.
⚠2 Required where normal ground surface is above normal water surface of canal.

REFERENCE DRAWING 484-208-49

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CENTRAL VALLEY PROJECT - ULTIMATE PLAN
WEST SAN JOAQUIN DIV. - SAN LUIS UNIT - CALIF.

SAN LUIS & PLEASANT VALLEY CANALS
TYPICAL STRUCTURES & SECTIONS

JUNE 24, 1954

805-208-19

GPO 968842

Designs and Estimates

Cost Estimate

Construction.--The estimated construction costs for all features of the San Luis Unit are summarized in table 5 and are shown in more detail in table 6. The cost estimates are based on unit prices prevailing in January 1954 and include an allowance for contingencies as well as costs for investigation, engineering, administration and supervision. Costs of the minimum basic recreational facilities discussed in Chapter VII and in the report of the National Park Service are included.

Construction Period

Preconstruction.--The preconstruction period varies from six months for the minor features to two years for the major features. During this time, additional data required for preparation of specification plans and estimates would be obtained, the plans and estimates prepared and contracts awarded. The project preconstruction activities would be scheduled so that the construction of San Luis Dam and Reservoir and San Luis Pumping Plant could be started eighteen months after the initiation of such activities. The preconstruction activities for other features of the project would be scheduled in a manner permitting the completion of construction of all major project features with the exception of the last 28.55 miles of the San Luis Canal at the time when the San Luis Dam and Reservoir and the San Luis Pumping Plant would be in operation.

Construction.--The construction period for completion of San Luis Dam and Reservoir and San Luis Pumping Plant is estimated to be five and one-half years. The time required for construction of the remaining project

Table 5.--Summary of capital costs

San Luis Unit

Feature	Capital Cost
Major storage and conveyance features	
San Luis Dam and Reservoir	$ 52,116,000[a]
San Luis Canal and Pump Intake Canal	78,487,000
San Luis Pumping Plant	37,333,000
Pleasant Valley Pumping Plant	4,579,000
Pleasant Valley Canal and Pump Intake Canal	4,629,000
Channels, levees, and floodworks	23,534,000
Relift distribution pumping plants	18,472,000
Electrical facilities	8,920,000
General property	1,073,000
Development of project plan	(500,000)[b]
Subtotal	$229,143,000
Distribution system features	
Concrete pipe distribution system	$129,748,000
Deep wells	19,681,000
Interceptor Drain	7,232,000
Closed Drains	13,406,000
Subtotal	$170,067,000
Total Capital Costs	$399,210,000

a/ Includes $90,000 for minimum basic recreational facilities
b/ Cost of project plan is distributed among project features

Note: January 1954 prices

features would be less than this period. In view of this, the initiation of construction for these latter features would not begin simultaneously with the start of construction of the dam and pumping plant. All of the major project features, except the last 28.55 miles of the San Luis Canal, would be completed at the end of a five and one-half year construction period. At the end of this period, water deliveries to the service areas along the San Luis Canal to Mile 75.95 and to the areas served by the Pleasant Valley Canal could be made. It is expected that construction of the nonproject irrigation distribution systems would be carried on during construction of the project features and portions of systems would be completed with the initial conveyance of water in the canals. The construction of the drain system and drilling of deep wells would not be carried on until after the project is in operation and definite requirements have been established. The estimated periods required for preconstruction and construction of both Federal and nonFederal features are shown on table 7.

Table 6

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FORM PF-1 (REV. SEPT. 1952)

OFFICIAL ESTIMATE

Rev. 1/20/55

Project: SAN LUIS UNIT--WEST SAN JOAQUIN DIVISION--CENTRAL VALLEY PROJECT--CALIF.

Prepared by: A.D. Fodier Jos. WJMC Approved by: PN Spencer

Date of Estimate: April 1954
Prices as of: January 1954 Sheet 1 of 5

Uniform Cost Classification (1)	DESCRIPTION (2)	Quantity (3)	Unit Cost (4)	Total Estimate (5)	Construction Contracts (6)	Materials and Supplies (7)	Labor (8)	Construction Facilities (9)	Other Costs (10)	Previous Official Estimate (11)
01.05	San Luis Dam and Reservoir and Recreational Facilities	1,000,000 AF		52,116,000	40,204,000	2,863,000		968,000	8,081,000	
.30	Land and Rights			1,371,000	1,132,000			26,000	213,000	
.31	Relocation of Existing Property			3,812,000	3,150,000			71,000	591,000	
.32	Clearing Lands			72,000	60,000			1,000	11,000	
.35	Dam			46,771,000	35,784,000	2,863,000		870,000	7,254,000	
.33	Recreational Facilities			90,000	78,000				12,000	
03.	Pumping Plants									
.06	San Luis	199,000 HP		37,333,000	20,641,000	9,142,000		700,000	6,850,000	
.30	Land and Rights			29,000	23,000			1,000	5,000	
.33	Structures and Improvements			9,787,000	7,726,000	82,000		183,000	1,796,000	
.36	Waterways			17,322,000	11,805,000	2,014,000		325,000	3,178,000	
.40	Pumps and Prime Movers			8,826,000	804,000	6,237,000		166,000	1,619,000	
.48	Accessory Electrical Equipment			761,000	153,000	454,000		14,000	140,000	
.49	Miscellaneous Equipment			608,000	130,000	355,000		11,000	112,000	
.07	Pleasant Valley	12,000 HP		4,579,000	2,897,000	745,000		100,000	837,000	
.30	Land and Rights			37,000	29,000			1,000	7,000	
.33	Structures and Improvements			1,066,000	848,000			23,000	195,000	
.36	Waterways			2,546,000	1,919,000	106,000		56,000	465,000	
.40	Pumps and Prime Movers			674,000	53,000	483,000		15,000	123,000	
.48	Accessory Electrical Equipment			184,000	27,000	119,000		4,000	34,000	
.49	Miscellaneous Equipment			72,000	21,000	37,000		1,000	13,000	
.08	Service Laterals above Canal	142,000 Ac		18,472,000	14,545,000			291,000	3,636,000	
.30	Land and Rights			10,200	8,000			200	2,000	
.33	Structures and Improvements			10,433,000	8,215,000			164,000	2,054,000	
.40	Pumps and Prime Movers			5,239,000	4,125,000			83,000	1,031,000	
.48	Accessory Electrical Equipment			1,975,000	1,555,000			31,000	389,000	
.49	Miscellaneous Equipment			814,800	642,000			12,800	160,000	
04.01.	Deep Wells a/	540,000 AF		19,681,000	15,497,000			310,000	3,874,000	
.33	Structures and Improvements			12,879,000	10,141,000			203,000	2,535,000	
.40	Pumps and Prime Movers			6,802,000	5,356,000			107,000	1,339,000	
05.	Canals and Conduits									
.76	San Luis Pump Intake Canal (Q = 4200 cfs)	2.5 miles		5,669,000	4,464,000			89,000	1,116,000	
.30	Land and Rights			34,000	27,000			500	6,500	
.33	Structures and Improvements			65,000	51,000			1,000	13,000	
.36	Waterways			5,103,000	4,018,000			80,500	1,004,500	
.37	Canal Structures			467,000	368,000			7,000	92,000	
.77	San Luis Canal - Reach No. 1 (Q = 6800 cfs)	11.0 miles		10,021,000	7,890,000			158,000	1,973,000	
.30	Land and Rights			64,000	50,000			1,000	13,000	
.31	Relocation of Existing Property			78,000	62,000			1,000	15,000	
.33	Structures and Improvements			238,000	187,000			4,000	47,000	
.36	Waterways			7,035,000	5,539,000			111,000	1,385,000	
.37	Canal Structures			2,227,000	1,754,000			35,000	438,000	
.38	Canal Protective Works			379,000	298,000			6,000	75,000	

a/ Distribution System Features

GPO 968887

Table 6

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FORM PF-1 (REV. SEPT. 1952)

OFFICIAL ESTIMATE

Rev. 1/20/55

Project: SAN LUIS UNIT--WEST SAN JOAQUIN DIVISION--CENTRAL VALLEY PROJECT--CALIF.

Date of Estimate: April 1954

Prices as of: January 1954

Sheet 2 of 6

Prepared by: Approved by:

Uniform Cost Classification (1)	DESCRIPTION (2)	Quantity (3)	Unit Cost (4)	Total Estimate (5)	Construction Contracts (6)	Materials and Supplies (7)	Labor (8)	Construction Facilities (9)	Other Costs (10)	Previous Official Estimate (11)
05.	Canals and Conduits Continued									
.78	San Luis Canal - Reach No. 2 (Q = 6800 cfs)	13.8 miles		9,273,000	7,302,000			146,000	1,825,000	
.30	Land and Rights			127,000	100,000			2,000	25,000	
.31	Relocation of Existing Property			147,000	116,000			2,000	29,000	
.33	Structures and Improvements			299,000	235,000			5,000	59,000	
.36	Waterways			6,972,000	5,490,000			110,000	1,372,000	
.37	Canal Structures			1,341,000	1,056,000			21,000	264,000	
.38	Canal Protective Works			387,000	305,000			6,000	76,000	
.79	San Luis Canal - Reach No. 3 (Q = 6000 cfs)	20.6 miles		18,848,000	14,777,000	63,000		297,000	3,711,000	
.30	Land and Rights			625,000	492,000			10,000	123,000	
.31	Relocation of Existing Property			951,000	749,000			15,000	187,000	
.33	Structures and Improvements			481,000	378,000			8,000	95,000	
.36	Waterways			10,456,000	8,233,000			165,000	2,058,000	
.37	Canal Structures			1,070,000	842,000			17,000	211,000	
.38	Canal Protective Works			5,265,000	4,083,000	63,000		82,000	1,037,000	
.80	San Luis Canal - Reach No. 4 (Q = 4600 cfs)	30.5 miles		24,437,000	19,059,000	182,000		385,000	4,811,000	
.30	Land and Rights			1,325,000	1,043,000			21,000	261,000	
.31	Relocation of Existing Property			1,767,000	1,391,000			28,000	348,000	
.33	Structures and Improvements			712,000	561,000			11,000	140,000	
.36	Waterways			14,333,000	11,285,000			226,000	2,822,000	
.37	Canal Structures			1,327,000	908,000	137,000		21,000	261,000	
.38	Canal Protective Works			4,973,000	3,871,000	45,000		78,000	979,000	
.81	San Luis Canal - Reach No. 5 (Q = 1700 cfs)	13.2 miles		5,245,000	4,115,000	15,000		83,000	1,032,000	
.30	Land and Rights			344,000	271,000			5,000	68,000	
.31	Relocation of Existing Property			250,000	197,000			4,000	49,000	
.33	Structures and Improvements			287,000	226,000			5,000	56,000	
.36	Waterways			4,090,000	3,221,000			64,000	805,000	
.37	Canal Structures			257,000	187,000	15,000		4,000	51,000	
.38	Canal Protective Works			17,000	13,000			1,000	3,000	
.82	San Luis Canal - Reach No. 6 (Q = 700 cfs)	15.3 miles		4,994,000	3,917,000	16,000		79,000	982,000	
.30	Land and Rights			335,000	264,000			5,000	66,000	
.31	Relocation of Existing Property			194,000	153,000			3,000	38,000	
.33	Structures and Improvements			203,000	160,000			3,000	40,000	
.36	Waterways			2,530,000	1,992,000			40,000	498,000	
.37	Canal Structures			828,000	640,000	12,000		13,000	163,000	
.38	Canal Protective Works			904,000	708,000	4,000		15,000	177,000	

Table 6

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FORM PF-1 (REV. SEPT. 1952)

OFFICIAL ESTIMATE

Rev. 1/20/55

Project: SAN LUIS UNIT--WEST SAN JOAQUIN DIVISION--CENTRAL VALLEY PROJECT--CALIF

Date of Estimate: April 1954

Prices as of: Jan. 1954

Sheet 3 of 6

Prepared by: ______ Approved by: ______

Uniform Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Construction Contracts	Materials and Supplies	Labor	Construction Facilities	Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
05.	Canals and Conduits Continued									
.86	Pleasant Valley Pump Intake Canal (Q = 600 cfs)	1.2 miles		576,000	454,000			9,000	113,000	
.30	Land and Rights			28,000	22,000			400	5,600	
.33	Structures and Improvements			23,000	18,000			400	4,600	
.36	Waterways			464,000	366,000			7,200	90,800	
.37	Canal Structures			61,000	48,000			1,000	12,000	
.87	Pleasant Valley Canal (Q = 600 cfs)	19.5 miles		4,053,000	3,175,000	16,000		64,000	798,000	
.30	Land and Rights			243,000	191,000			4,000	48,000	
.31	Relocation of Existing Property			237,000	186,000			4,000	47,000	
.33	Structures and Improvements			90,000	71,000			1,000	18,000	
.36	Waterways			2,804,000	2,207,000			45,000	552,000	
.37	Canal Structures			475,000	359,000	16,000		7,000	93,000	
.38	Canal Protective Works			204,000	161,000			3,000	40,000	
06.	Laterals a/									
.31	Concrete Pipe Distribution System below Canal	354,000 Ac		90,893,000	66,345,000			1,327,000	23,221,000	
.30	Land and Rights			4,584,000	3,346,000			67,000	1,171,000	
.36	Waterways			68,133,000	49,732,000			995,000	17,406,000	
.37	Lateral Structures			18,176,000	13,267,000			265,000	4,644,000	
.50	Concrete Pipe Distribution System above Canal	142,000 Ac		38,855,000	28,361,000			567,000	9,927,000	
.30	Land and Rights			1,217,000	888,000			18,000	311,000	
.36	Waterways			29,788,000	21,743,000			435,000	7,610,000	
.37	Lateral Structures			7,850,000	5,730,000			114,000	2,006,000	
07.	Drains a/									
.01	San Luis Interceptor Drain to Delta (Q = 300 cfs)	197 miles		7,232,000	5,693,000			114,000	1,425,000	
.30	Land and Rights			161,000	126,000			3,000	32,000	
.31	Relocation of Existing Property			1,716,000	1,351,000			27,000	338,000	
.36	Waterways			3,916,000	3,083,000			61,000	772,000	
.38	Drain Protective Works			489,000	385,000			8,000	96,000	
.39	Drain Structures			950,000	748,000			15,000	187,000	
.10	Closed Tile Drain System	96,000 Ac		13,406,000	10,556,000			211,000	2,639,000	
.30	Land and Rights			625,000	492,000			10,000	123,000	
.36	Waterways			11,492,000	9,049,000			181,000	2,262,000	
.39	Drain Structures			1,289,000	1,015,000			20,000	254,000	

a/ Distribution System Features

GPO 968887

Table 6

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FORM PF-1 (REV. SEPT. 1952)

OFFICIAL ESTIMATE

Rev. 1/20/55

Project: SAN LUIS UNIT--WEST SAN JOAQUIN DIVISION--CENTRAL VALLEY PROJECT--CALIF.

Date of Estimate: April 1954
Prices as of: Jan. 1954
Sheet 4 of 6

Prepared by: Approved by:

Uniform Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Construction Contracts	Materials and Supplies	Labor	Construction Facilities	Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
09.	Floodways and Flood Retention Basins									
.01	Laguna Seca Creek Retention Basin	900 AF		187,000	147,000			3,000	37,000	
.30	Land and Rights			64,000	50,000			1,000	13,000	
.36	Waterways			123,000	97,000			2,000	24,000	
.02	Station 1200 Creek Retention Basin	300 AF		97,000	76,000			2,000	19,000	
.30	Land and Rights			32,000	25,000			1,000	6,000	
.36	Waterways			65,000	51,000			1,000	13,000	
.03	Little Panoche Creek Retention Basin and Outlet Channel	11,760 AF		3,359,000	2,645,000			53,000	661,000	
.30	Land and Rights			1,318,000	1,038,000			20,000	260,000	
.31	Relocation of Existing Property			27,000	21,000			1,000	5,000	
.33	Structures and Improvements			31,000	24,000			1,000	6,000	
.36	Waterways			1,983,000	1,562,000			31,000	390,000	
.04	Panoche Creek Floodway, Flood Retention Basin, and Outlet Works	33,000 AF		5,402,000	4,254,000			85,000	1,063,000	
.30	Land and Rights			2,830,000	2,229,000			44,000	557,000	
.31	Relocation of Existing Property			151,000	119,000			2,000	30,000	
.33	Structures and Improvements			15,000	11,000			1,000	3,000	
.36	Waterways			2,406,000	1,895,000			38,000	473,000	
.05	Tumey Gulch Retention Basin	2,000 AF		635,000	500,000			10,000	125,000	
.30	Land and Rights			81,000	63,000			2,000	16,000	
.36	Waterways			554,000	437,000			8,000	109,000	
.06	Cantua Creek Floodway and Flood Retention Basin	6,180 AF		2,820,000	2,222,000			44,000	554,000	
.30	Land and Rights			1,944,000	1,531,000			31,000	382,000	
.36	Waterways			876,000	691,000			13,000	172,000	
.07	Arroyo Pasajero Floodway, Flood Retention Basin, and Zapota Creek Training Dike	35,000 AF		11,034,000	8,687,000			174,000	2,173,000	
.30	Land and Rights			7,004,000	5,515,000			110,000	1,379,000	
.31	Relocation of Existing Property			107,000	84,000			2,000	21,000	
.33	Structures and Improvements			13,000	10,000			200	2,800	
.36	Waterways			3,910,000	3,078,000			61,800	770,200	

Table 6

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FORM PF-1 (REV. SEPT. 1952)

Prepared by:______________________ Approved by:______________________

OFFICIAL ESTIMATE

Rev. 1/20/55

Project: SAN LUIS UNIT--WEST SAN JOAQUIN DIVISION--CENTRAL VALLEY PROJECT--CALIF.
Date of Estimate: April 1954
Prices as of: January 1954 Sheet 5 of 6

Uniform Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Construction Contracts	Materials and Supplies	Labor	Construction Facilities	Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
13	Transmission Lines, Switchyards and Substations									
.40	Tracy - San Luis 230 KV Transmission Line	60 mi.		2,650,000	907,000	1,249,000		43,000	451,000	
.30	Land and Rights			76,000	62,000			1,000	13,000	
.31	Relocation of Existing Property			28,000	23,000			1,000	4,000	
.32	Clearing Lands			141,000	115,000			2,000	24,000	
.53	Towers and Fixtures			1,477,000	497,000	704,000		24,000	252,000	
.54	Overhead Conductors and Devices			928,000	210,000	545,000		15,000	158,000	
.41	San Luis Canal 115 KV Transmission Line	88 mi.		1,776,000	1,444,000			29,000	303,000	
.30	Land and Rights			251,000	204,000			4,000	43,000	
.31	Relocation of Existing Property			8,000	6,000			1,000	1,000	
.32	Clearing Lands			86,000	70,000			1,000	15,000	
.53	Poles and Fixtures			622,000	506,000			10,000	106,000	
.54	Overhead Conductors and Devices			809,000	658,000			13,000	138,000	
.74-5	Tracy Switchyard Additions - 230 KV			262,000	60,000	172,000		5,000	25,000	
.51	Station Equipment, Electric			262,000	60,000	172,000		5,000	25,000	
.42	San Luis Switchyard 230/115/13.8 KV	150,000 KVA		1,986,000	220,600	1,355,400		31,500	378,500	
.30	Land and Rights			3,000	2,300			100	600	
.32	Clearing Lands			3,000	2,300			100	600	
.33	Structures and Improvements			50,000	40,000			800	9,200	
.51	Station Equipment, Electric			1,930,000	176,000	1,355,400		30,500	368,100	
.43	Pleasant Valley Switchyard 115/13.8/4.16 KV	15,000 KVA		261,000	32,300	175,700		4,000	49,000	
.30	Land and Rights			300	250				50	
.32	Clearing Lands			300	250				50	
.33	Structures and Improvements			3,000	2,300			200	500	
.51	Station Equipment, Electric			257,400	29,500	175,700		3,800	48,400	
.44	Relift No. 1 Substation 115/13.8 KV	3,000 KVA		118,000	11,400	86,600		2,000	18,000	
.30	Land and Rights			300	250				50	
.32	Clearing Lands			300	250				50	
.33	Structures and Improvements			3,000	2,300			200	500	
.51	Station Equipment, Electric			114,400	8,600	86,600		1,800	17,400	
.45	Relift No. 2 Substation 115/13.8 KV	7,500 KVA		140,000	13,100	102,900		2,300	21,700	
.30	Land and Rights			300	250				50	
.32	Clearing Lands			300	250				50	
.33	Structures and Improvements			3,000	2,300			200	500	
.51	Station Equipment, Electric			136,400	10,300	102,900		2,100	21,100	
.46	Relift No. 3 Substation 115/13.8 KV	7,500 KVA		140,000	13,100	102,900		2,300	21,700	
.30	Land and Rights			300	250				50	
.32	Clearing Lands			300	250				50	
.33	Structures and Improvements			3,000	2,300			200	500	
.51	Station Equipment, Electric			136,400	10,300	102,900		2,100	21,100	

GPO 968887

Table 6

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FORM PF-1 (REV. SEPT. 1952)

Prepared by: Approved by:

OFFICIAL ESTIMATE

Rev. 1/20/55

Project: SAN LUIS UNIT--WEST SAN JOAQUIN DIVISION--CENTRAL VALLEY PROJECT--CALIF.
Date of Estimate: April, 1954
Prices as of: Jan. 1954 Sheet 6 of 6

Uniform Cost Classification	DESCRIPTION	Quantity	Unit Cost	Total Estimate	Construction Contracts	Materials and Supplies	Labor	Construction Facilities	Other Costs	Previous Official Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
13.	Transmission Lines, Switchyards and Substations Continued									
.47	Relift No. 4 Substation 115/13.8 KV	3,000 KVA		118,000	11,400	86,600		2,000	18,000	
.30	Land and Rights			300	250				50	
.32	Clearing Lands			300	250				50	
.33	Structures and Improvements			3,000	2,300			200	500	
.51	Station Equipment, Electric			114,400	8,600	86,600		1,800	17,400	
.48	Distribution System 13.8 KV			1,450,000	1,150,000			23,000	277,000	
.49	Service to Dam 480 V	300 KVA		19,000	3,810	11,490		300	3,400	
.33	Structures and Improvements			1,500	1,150			50	300	
.51	Station Equipment, Electrical			14,400	1,200	10,400		200	2,600	
.52	Poles and Fixtures			1,980	940	690		50	300	
.53	Overhead Conductors and Devices			1,120	520	400			200	
15.70	General Property (Permanent Operation Facilities)			1,073,000	878,000			18,000	177,000	
.30	Land and Rights			10,200	8,000			200	2,000	
.33	Structures and Improvements			1,062,800	870,000			17,800	175,000	
GL 142.										
.1	Development of Project Plan			(500,000)					(500,000)	
	Main Storage and Conveyance Features Cost			229,143,000						
	Distribution System Features Cost			170,067,000						
	TOTAL PROJECT COST			399,210,000						

LEGEND: Types of Activity

Preconstruction   Construction

Table 7

LINE NO.	CLASS AND ACCOUNT	PROGRAM ITEM	QUANTITY	UNIT	ESTIMATED TOTAL	TOTAL TO JUNE 30, 1954	FISCAL YEARS 1955	1956	1957	1958	1959	1960	1961	BALANCE TO COMPLETE	ESTIMATED COMPLETION DATE	LINE NO.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1		Irrigation Service - Supplemental	440,000	Ac.										440,000	Ac.	1
2																2
3	108	CONSTRUCTION PROGRAM														3
4		Main Storage and Conveyance Features														4
5	01.05	San Luis Dam and Reservoir	1,000,000	A.F.	52,116,000	114,000	1,185,000	6,177,000	15,660,000	7,447,000	8,579,000	7,965,000	4,991,000			5
6	05.06	San Luis Pumping Plant	199,000	H.P.	37,333,000	82,000	918,000	2,000,000	4,500,000	8,400,000	9,700,000	6,500,000	5,233,000			6
7	.07	Pleasant Valley Pumping Plant	12,000	H.P.	4,579,000	10,000				119,000	850,000	2,200,000	1,400,000			7
8	.08	Relift Pumps on Distribution System	142,000	Ac.	18,472,000	40,000		30,000	30,000	500,000	1,000,000	2,000,000	4,000,000	10,872,000		8
9	05.	San Luis Canal and Pump Intake Canal	6,800	cfs	78,487,000	171,000	548,000	1,528,000	4,986,000	13,214,000	13,389,000	22,141,000	16,055,000	6,455,000		9
10	05.	Pleasant Valley Canal and Pump Intake Canal	600	cfs	4,629,000	10,100				48,900	647,000	810,000	3,113,000			10
11	09	Channels, Levees and Floodworks	89,140	A.F.	23,534,000	50,800				98,000	374,000	5,387,000	8,530,200	9,094,000		11
12	13.74-4	Tracy Switchyard Additions			262,000	700						14,300	247,000			12
13	13.4	Electrical Transmission Lines and Switchyard	148 186,300	Mi. KVA	8,658,000	19,400					173,000	2,240,700	6,224,900			13
14	15.70	General Property			1,073,000	2,000							48,000	1,023,000		14
15																15
16		Totals for Main Storage and Conveyance Features			229,143,800	500,000	2,649,000	9,735,000	25,178,000	29,826,900	34,712,000	49,258,000	49,542,100	27,442,000		16
17																17
18																18
19																19
20		Distribution System Features														20
21	04.01	Deep Wells	540,000	A.F.	19,681,000									19,681,000		21
22	07.	Drains			20,638,000									20,638,000		22
23	06.	Distribution System Laterals			129,748,000			150,000	150,000	3,000,000	6,000,000	10,000,000	16,000,000	94,448,000		23
24																24
25		Totals for Distribution System Features			170,067,000			150,000	150,000	3,000,000	6,000,000	10,000,000	16,000,000	134,767,000		25
26																26
27																27
28		Total for the Construction Program			399,210,000	500,000	2,649,000	9,885,000	25,328,000	32,826,900	40,712,000	59,258,000	65,542,100	162,209,000		28
29																29
30																30
31																31
32																32
33																33

Notes:

Recommended: W. J. McCaskill (Regional Engineer) 7/8/54 (Date)

Recommended: [signature] (Regional Director) 7-8-54 (Date)

Recommended: (Director of Programs & Finance) (Date)

Approved: (Commissioner) (Date)

Revised: 1/20/55 (Date)   SHEET ... OF ... SHEETS

Form PF 2   April 1951

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

CONTROL SCHEDULE
FOR THE
SAN LUIS UNIT - WEST SAN JOAQUIN DIVISION
CENTRAL VALLEY PROJECT, CALIFORNIA
PROJECT OR UNIT

Sacramento (OFFICE)   June 29, 1954 (DATE)   2 (REGION)

☐ GENERAL INVESTIGATIONS ☐ OPERATION & MAINTENANCE
■ CONSTRUCTION ☐ OTHER

Designs and Estimates

GPO 968887

CHAPTER VI

AGRICULTURAL PROJECT EFFECTS

This chapter discusses the expected agricultural economy of the San Luis Unit service area without project development and the agricultural economy as it is expected it would be with San Luis Unit development. By comparing these conditions, the agricultural benefits accruing from construction of the Unit are derived for use in the economic analysis which follows in a later chapter. Included also is an analysis of the portion of the net farm income available to meet irrigation costs.

Present Agricultural Economy

Gross crop income.--The 1950 crop survey of the San Luis Unit service area made by the Bureau of Reclamation showed almost 401,000 acres developed for irrigation; of this total about 273,000 acres were irrigated and the remainder was fallowed. The irrigated land was devoted principally to the following crops: grain, 162,400 acres; cotton, 73,300 acres; miscellaneous field crops, 18,100 acres; truck crops, 16,400 acres; forage crops, 2,700 acres. Livestock production in recent years has not comprised a significant element in the area's economy. The estimated gross crop income for 1950 averaged slightly more than $120 per acre for the acreage developed for irrigation and over $175 an acre for the acreage actually irrigated in that year.

Land ownership.--The San Luis Unit service area is characterized by large-scale land holdings and farm operations. The following tabulation summarizes the land ownership pattern for the proposed initial service area in 1949 as obtained from records of the County Recorders' offices:

Agricultural Project Effects

Size group	Owners No.	Owners Percent	Acreage No.	Acreage Percent
5-40 acres	248	23.6	7,200	1.5
41-80 acres	194	18.5	13,300	2.8
81-160 acres	336	32.0	51,100	10.7
161-320 acres	142	13.5	42,500	8.9
Over 320 acres	130	12.4	363,100 a/	76.1 a/
Total	1,050	100.0	477,200 b/	100.0

a/ Equals 73 percent of the 496,000 acres in the proposed service area.
b/ Difference in total area due primarily to the exclusion of ownerships of less than 5 acres and slight variation in area boundary used in the ownership survey.

It will be noted from the above tabulation that 74 percent of the ownerships comprise units of 160 acres or less and comprise only 15 percent of the gross acreage. About 85 percent of the land area is controlled by 26 percent of the ownerships in land holdings in excess of 160-acre units.

Excess land holdings.--According to official county records there were 86 individual land holdings in excess of 320 acres in 1949. These ownerships totaled 114,000 acres, or 23 percent of the proposed service area. In addition, 44 corporations held 249,000 acres, about 50 percent of the proposed service area, in ownerships in excess of 320 acres. When allowance is made for the amount of irrigable land presently entitled to receive project water under existing Reclamation Law, there would still remain about 325,000 acres, or approximately 65 percent of the proposed initial project service area, which would be entitled to receive project water only under appropriate contract provisions.

Agricultural Project Effects

The following tabulation summarizes the land ownerships involving excess lands for the San Luis service area:

Number	Size range acres	Gross acreage	Nonexcess acreage	Excess acreage
64	321 - 1,000	39,700	18,700	21,000
52	1,001 - 5,000	111,200	17,300	93,900
10	5,001 - 10,000	68,500	1,900	66,600
4	Over 10,000	143,700	640	143,060
130		363,100	38,540	324,560

Agricultural Economy Without Project Development

Under long-term conditions without project development the estimated safe annual yield of ground water would be limited to about 213,000 acre-feet. It is anticipated that irrigation farming in the proposed service area, with no other source of water available to it, would revert to a cropping pattern adapted to the use of this limited ground-water supply.

The most likely crop combination under such conditions is assumed as one-third cotton and two-thirds grain. The above estimated firm water supply would be adequate for 148,000 irrigated acres composed of 98,700 acres of barley and 49,300 acres of cotton. These crops complement each other in a rotational plan and are well suited to the area and the type of water supply available. This is evidenced by present cropping practices in the service area. This crop pattern has resulted in a high load factor and therefore more economical pumping energy costs to the farmer since pumps are used more continuously all year.

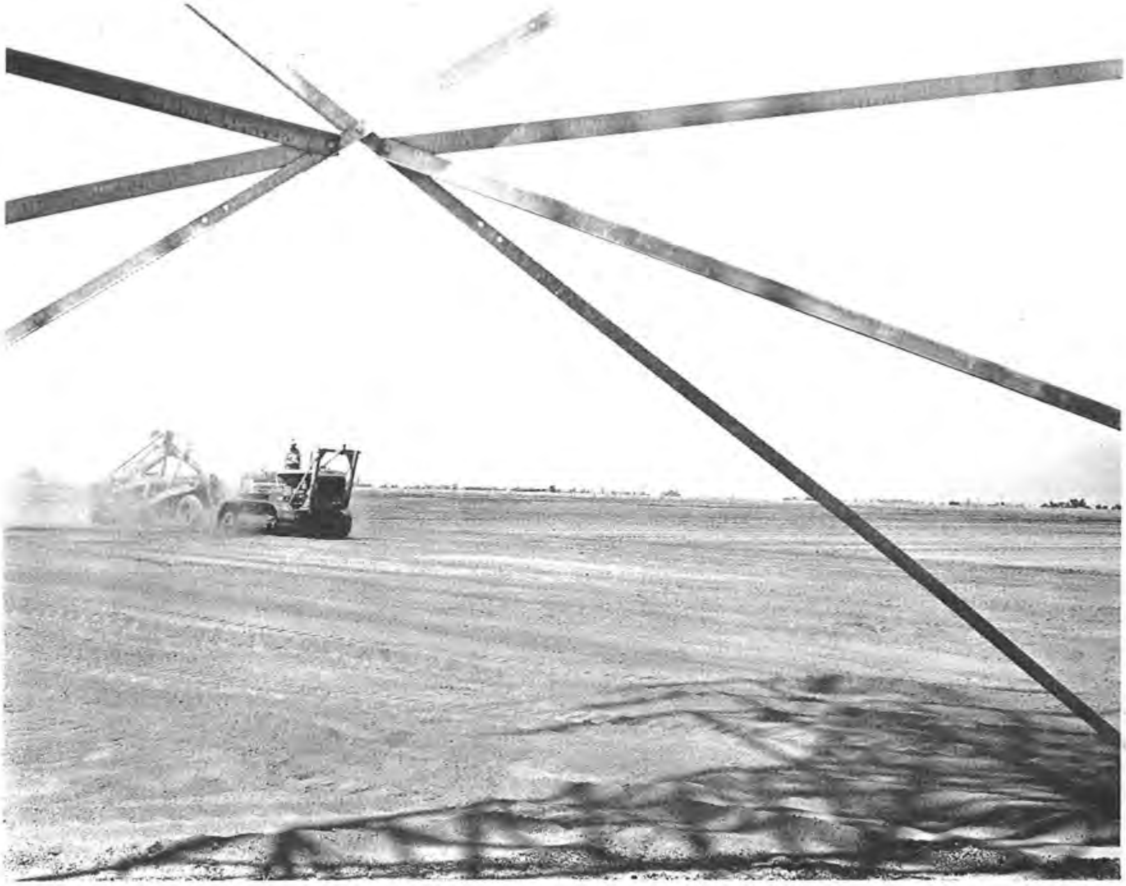
Agricultural Project Effects

Since present pumping installations are located throughout the entire service area, this analysis considered that the irrigated crops would be grown on all land classes in proportion to the amount of land of each irrigable land class for the service area. The remainder of the area probably would revert to limited dry farming or more probably dry pasture, from which only a small income would be realized. Farming operations would most likely reflect continued emphasis on large-scale units as at present. On this basis, long-term net farm income under "without" project conditions has been estimated at $8,173,000 annually as indicated on table 9.

Agricultural Economy With Project Development

Provision of an adequate and dependable water supply is expected to bring considerable changes in the agricultural economy of the service area. The increased farm water supply would permit more intensive or diversified land use within individual ownerships. It also would facilitate the transition from present large-scale operation to a type of agricultural settlement more nearly characteristic of irrigated areas on the east side of the San Joaquin Valley. This shift from large-scale farming would not involve any great change in the type of crops produced; however, there would be a shift in proportionate relationships among the crops now grown.

Projected crop pattern.--Projection of a long-term crop pattern for an area of 440,000 productive acres which are suited to a large number



HEAVY EQUIPMENT FOR LAND LEVELING AND MECHANICAL COTTON PICKERS FACILITATE FARMING IN THE AREA.

of climatically-adapted crops is necessarily conjectural. While the prevailing crop pattern furnishes indications as to the profitableness of certain crops, it cannot be considered indicative of stable long-range conditions because it is predicated to a large extent on the most profitable use of an inadequate and increasingly costly water supply. In the final analysis, the crops which will be grown at any one time under project conditions will largely reflect experience, preference, and prognosis on the part of the individual farmers concerned.

Some of the items considered during the selection of the projected crop pattern were: crop suitability; present crop pattern; considered opinions of local farmers and various agricultural technicians; competitive outlook among crops and producing areas; and estimates of long-range future requirements for food and fiber. The projected crop pattern which resulted from a considered judgment of the foregoing factors is shown in the following tabulation:

Crop	Area in acres
Cotton	132,000
Alfalfa	88,000
Irrigated grain and grain hay	44,000
Irrigated pasture	44,000
Deciduous fruits and grapes	22,000
Miscellaneous field crops	66,000
Truck crops	88,000
Subtotal	484,000
Less double cropped area under grain and grain hay	44,000
Total	440,000

Agricultural Project Effects

Land management problems.--The soils in the San Luis Unit are generally of excellent quality, and the area has few serious land management problems. However, even the better quality soils have some inherent minor problems of management, most of which relate to irrigation water control and frequency of application. Maintenance of soil fertility and organic matter content is also a problem on the loamy class 1 and 2 lands.

Certain of the class 2 and 3 lands have compacted soil profiles; others have saline soils. The former require careful, limited water application; the latter require irrigation water in quantities adequate to hold the salt below the principal root zone or, if possible, remove it completely from the root zone. In both cases limitations regarding soil suitability for certain crops must be recognized.

Some of the fine-textured class 2 soils have a tendency to develop a surface crust after a rain. These soils must be worked within a narrow range of moisture content to avoid caking or puddling.

The coarse-textured class 2 and 3 soils require frequent water application to insure maintenance of proper moisture relationship between the soil and plants. Maintenance of the fertility level of these lands is a problem also.

Agricultural lands in the service area are relatively free of noxious weeds with the exception of an area estimated at about 15,000 acres immediately west and south of Mendota, and a few isolated infestations in the Five Points area. Cultural, crop rotational, and chemical weed control methods now are in effect in the area. Many of the operators own spray rigs and aggressive efforts are being made to control certain of the noxious weeds. The advent of project water service imported over considerable distances will intensify the weed problem, and effective control will require coordinated action by appropriate Federal, State, and local agencies.

Size and number of farms.--The crop pattern projected for the service area is typified by farm units ranging from 40 to 160 acres in older irrigated portions of the San Joaquin Valley. As presented in the following tabulation, there are three major categories of farm enterprises occurring within this range in size which are representative of stabilized agricultural areas:

Crop, crop combination, or enterprise	Size
Deciduous fruits and nuts	40 gross acres
Truck crops, tomato or field crops other than irrigated pasture	80 gross acres
Meat production	160 gross acres

These sizes are assumed to be representative of typical irrigated farms on the San Luis Unit under project conditions. Applying the above indicated unit sizes to the projected crop pattern results in a total of 6,100 farms. This number of farms will support a total estimated rural population of about 31,000.

Agricultural Project Effects

Farm development.--Approximately 90 percent of the productive acreage of the proposed initial service area already has been developed for irrigation. Most of the presently undeveloped land can be levelled with relatively little effort and at low cost. The only major item of cost involved in preparing the land for project water service results from the requirement for farm distribution systems. The present systems which serve the existing large ownerships are not adaptable to smaller sized farm units.

The prevalence of large units and existing leasehold operations has tended to concentrate agricultural, administrative, and residential facilities in a relatively few localities. Therefore, construction of residences, out-buildings, and other facilities appurtenant to farmstead layouts will be a major part of the farm development program visualized for the project service area.

Agricultural labor requirements.--At present, farm labor requirements in the area have considerable seasonal variation with heavy dependence on migratory labor in the fall. Increasing emphasis on mechanical cotton harvesters will act to bring future cotton harvest labor requirements into line with the availability of the local labor force. This factor, together with smaller farm unit development under project conditions and the resulting diversification of crops, will tend to stabilize the local labor supply and increase the availability of adequate farm labor to meet future requirements.

Agricultural Project Effects

Transportation, marketing, and credit facilities.--The agricultural commodities presently produced in the service area are shipped to numerous markets throughout the State and nation. The Southern Pacific Railroad and State highways now provide a fairly adequate transportation system. Other interconnecting farm-to-market roads and branch rail lines would be needed to serve the area under conditions of more intensive agricultural development.

Principal marketing or processing facilities presently available to the area consist of the following: Cotton and cotton seed processors, fruit and vegetable packers and shippers, dehydrators, grain dealers, wineries, livestock dealers and packers. These facilities are adequate to meet present needs and could be expanded to meet increasing demands of the area.

Credit facilities are available either in or adjacent to the service area. These facilities include commercial banks, production credit associations, processing establishments, cooperative organizations, and individual brokers, agents, and dealers. Short-term or production loans are readily available from the sources indicated above. Long-term loans, however, are virtually unobtainable for the proposed service area at the present time due to the uncertainty of ground-water supply conditions. Because of the inherently high productivity of the area of provision of a firm water supply should attract long-term credit to the area. While subdivision and settlement of the project area may seriously tax existing sources of credit it is anticipated that adequate credit resources to facilitate such development will be attracted to the area.

Crop yields.--The generally excellent soils and favorable climate of the area are conducive to relatively high productivity. Average crop yields used in the evaluation of the proposed development represent conservative estimates based upon historical records and the collective judgment of local farmers, processors, and agricultural technicians. Table 8 presents a summary of crop yields by land class used in this analysis.

Farm income.--Farm price and cost items considered in the economic evaluation of the proposed project development are essentially representative of an agricultural price index level of 215 (1910-14 = 100). The one exception to use of the 215 level for production costs applies to tax rates. Based on the premise that future property tax rates are more likely to remain in line with recent levels than to revert to the somewhat lower 215 index level, tax rates as used in this analysis reflect the period 1949-50.

By applying the price-cost data discussed above to the projected crop pattern, through the medium of budget analysis, annual net crop income under project development is computed to be about $35,216,000 or about $80 per productive acre for a total area of 440,000 acres.1/

Irrigation benefits.--Monetarily measurable benefits arising from project irrigation water service are of two types--primary and secondary.

1/ For the irrigable acreage which includes 18,460 acres of noncropped land in addition to the productive acreage (cf. table 2) this value reduces to $76.80.

Table 8.--Estimated crop yields per acre by land class

San Luis Unit

Crop	Unit	Class 1	Class 2	Class 3
Cotton	bale	1.8	1.6	1
Alfalfa	ton	8	6.5	-
Irrigated pasture	aum[a/]	17.5	15	12.5
Barley	cwt	35	30	25
Milo maize	cwt	33	30	26
Blackeye beans	cwt	-	15	-
Sugar beets	ton	20	18	15
Cantaloupe	crate	150	120	110
Tomatoes - canning	ton	14	12	-
Potatoes	cwt	240	-	-
Peaches - freestone	ton	9	-	-
Olives	ton	2.5	-	-
Grapes - raisin	ton (fresh)	8	7	-

a/ Animal unit months.

Agricultural Project Effects

Primary irrigation benefits represent an increase in long-term net farm income resulting from project water service. The firm annual nonproject water supply available to the service area is estimated as adequate for full irrigation of only about 148,000 acres. It is estimated that, under project conditions, adequate water will be available for the entire productive area of 440,000 acres. As shown by table 9, the differential net farm income for these two conditions is about $27,043,000. This value is considered to represent annual primary irrigation benefits attributable to project under conditions of full development.

Secondary irrigation benefits are national in scope and produce increased net income from processing, transporting, and merchandising farm products of the area. Also included in this benefit category is the increase in the sale of consumers' goods and services to project farmers. As shown by table 10, this increased net income, or secondary irrigation benefit, is computed to be about $27,632,000 annually for San Luis Unit under conditions of full development.

In addition to the deduction of nonproject net farm income, several other adjustments must be made. These adjustments include: (1) the adjustment of net benefits for 98,700 acre-feet of water developed mutually by Trinity Division and San Luis Unit and for which benefits previously were assigned to the Trinity River Division; and (2) adjustment for farmstead demand. These adjustments result in an agricultural

Table 9.--Primary irrigation benefits

San Luis Unit

Crop or crop group	Net area Acres	Net crop income per acre[a]	Total net crop income
Without project development			
Cotton	132,000	$119.83	$15,818,000
Truck crops	88,000	55.45	4,880,000
Alfalfa	88,000	60.02	5,282,000
Irrigated pasture	44,000	67.58[b]	2,973,000
Tree and vine crops	22,000	103.60	2,279,000
Other field crops	66,000	33.41	2,205,000
Hay and grain (double crop)	44,000	40.44	1,779,000
Total or average	484,000		
(area without double crop)	440,000	$ 80.04	$35,216,000
Without project development			
Cotton	49,300	$116.26[c]	$ 5,731,000
Barley	98,700	24.74[c]	2,441,000
Dry farm	292,000	-[d]	-
Total or average	440,000	$ 18.58	$ 8,173,000
Total primary irrigation benefits			$27,043,000

a/ Weighted average, all land classes
b/ Calculated in terms of livestock products
c/ Weighted on the basis of land class
d/ Negligible income

Table 10.--Secondary irrigation benefits

San Luis Unit

Crop or crop group	Net area: Without project	Net area: With project	Gross returns per acre[a]: Without project	Gross returns per acre[a]: With project	Total gross returns: Without project	Total gross returns: With project	Increase due to project	Indirect benefit factor	Gross indirect benefit
	Acres	Acres	$	$	$	$	$	%	$
Cotton	49,300	132,000	236.66	241.46	11,667,000	31,873,000	20,206,000	124	25,055,000
Truck crops		88,000		334.99		29,479,000	29,479,000	74	21,814,000
Alfalfa		88,000		141.64		12,464,000	12,464,000	71	8,850,000
Irrigated pasture		44,000		350.66		15,429,000	15,429,000	63	9,720,000
Tree and vine crops		22,000		405.91		8,930,000	8,930,000	74	6,608,000
Other field crops		66,000		96.75		6,385,000	6,385,000	75	4,789,000
Hay and grain	98,700	44,000[b]	68.75	65.70	6,786,000	2,891,000	-3,895,000	73	-2,843,000
Total or average	148,000[c]	440,000[d]	124.68	244.21	18,453,000	107,451,000	88,998,000		73,993,000
Federal cost adjustment factor									30.4[e]
Net secondary benefit of project commodities									22,494,000
Goods and services benefit to project area									5,138,000[f]
Total annual net secondary benefit under full development									27,632,000

a/ Weighted average, all land classes

b/ Double crop

c/ Exclusive of 292,000 acres of dry land assumed to yield negligible income

d/ Total acreage does not include 44,000 acres of double cropping

e/ Federal cost adjustment factor

$$\frac{\text{increase in gross farm income} - \text{increase in farm costs}}{\text{increase in gross farm income}} = \frac{\$88,998,000 - \$61,956,000}{\$88,998,000} = 30.4\%$$

f/ Goods and services benefit equals 19 percent of primary irrigation benefit (see table 9) benefit under conditions of full development of $51,756,000 annually or $40.94 per acre-foot at the farm headgate.[2/] The following tabulation summarizes these adjustments:

Primary irrigation benefit	$27,043,000
Secondary irrigation benefit	27,632,000
Less:	
Benefits from mutually-developed water	3,631,800
Subtotal	$51,043,200
Plus:	
Benefits from farmstead use[a/]	$ 712,400
Total	$51,755,600
say	$51,756,000

a/ Per acre-foot benefits accruing from the farmstead water use (17,400 acre-feet x $40.94) are considered equal to the irrigation water benefit per acre-foot.

Payment Capacity

Payment capacity is measured in terms of farm income which is available annually to the water user for payment of all irrigation costs after making deductions for recognized prior claims on farm income. Included as one of these prior claims on income, in addition to allowance for all operating and overhead costs, is a sum representing

2/ This is equivalent to a canalside benefit of $33.81 per acre-foot when the costs of the distribution system and water losses in the distribution system are taken into account.

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an allowance toward family living expenses. The payment capacity was computed on the basis of farm price index level of 215 (1910-14 = 100) which was used in evaluation of benefits. The projected crop pattern for the San Luis Unit under full development shows a total payment capacity of $33,994,000.

Payment capacity attributable to project development.--The portion of net farm income available to meet project irrigation costs, both Federal and nonFederal was determined by identifying the increment in payment capacity attributable to project development. This determination is accomplished by deducting the average annual payment capacity under long-term, future conditions without the project, ($8,174,000), from annual payment capacity under anticipated project conditions. This process results in an incremental payment capacity of $25,820,000. The following tabulation summarizes incremental payment capacities per acre both on the basis of productive and of irrigable acreage.

Acreage basis	Acres	Total incremental payment capacity	Payment capacity: Per acre by land class, Class 1	Class 2	Class 3	Weighted average all classes
Productive	440,000	$25,820,000	$72.58	$50.72	$43.22	$58.68
Irrigable	458,460	$25,820,000	$69.66	$48.65	$41.56	$56.40

CHAPTER VII

NONAGRICULTURAL EFFECTS

Although the main purpose of the San Luis Unit is irrigation development, it would also provide a source from which municipal and industrial water supplies could be obtained, increase recreational opportunities, and affect fish and wildlife values. In this chapter, these expected effects are discussed, and evaluated in monetary terms for later use in the economic analysis.

Municipal and Industrial Economy

Nonproject conditions.--Large commercialized farm operations and the production of oil form the basis of the present economy in the San Luis Unit service area. The oil fields are relatively mature with almost no new drilling or development under way at this time. Most of the people associated with the oil industry are engaged in operation and maintenance of existing wells, pipelines, and pumping and absorption plants making their homes in and around Avenal and Coalinga.

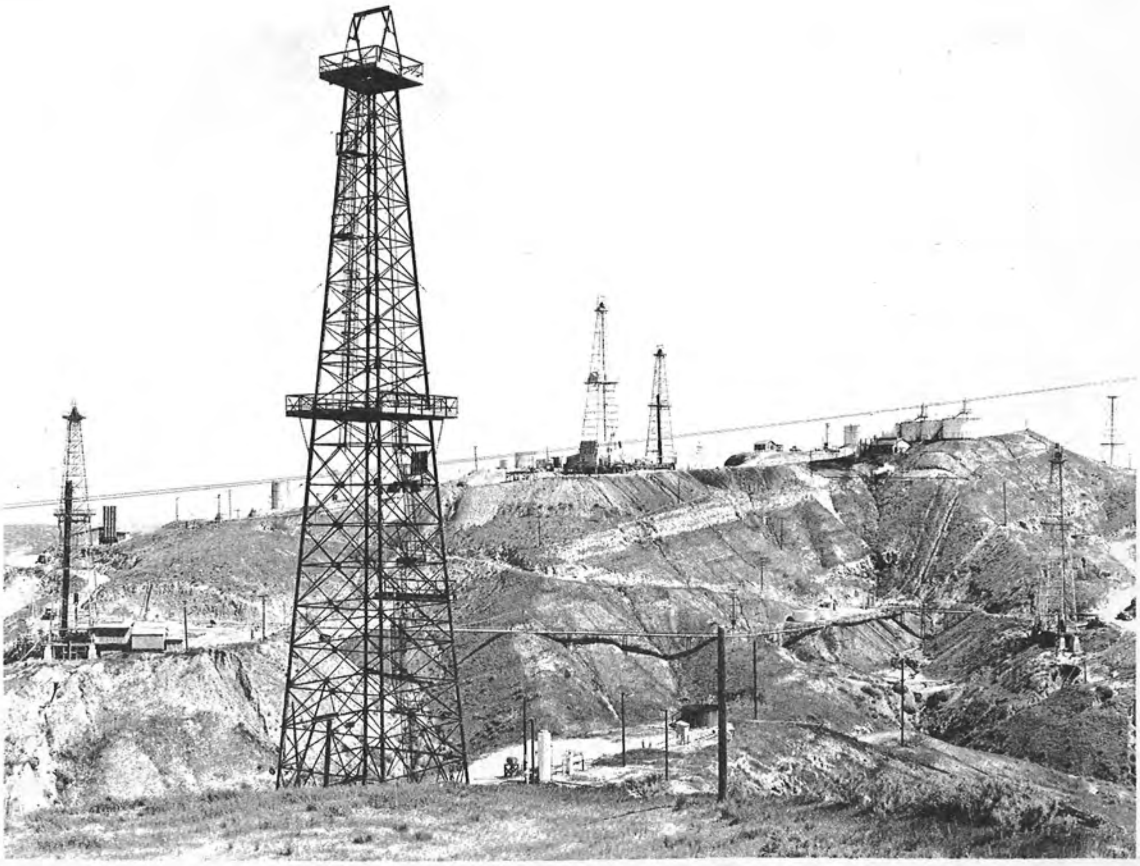
As the large-scale irrigated farming has expanded in recent years it has brought in a large number of migratory agricultural workers. They reside in the service area only during planting or harvesting seasons. At other times a few skilled machine operators and irrigators do the work on the highly mechanized farms which are devoted largely to grain and cotton. As a result, the number of farm residents is small compared to the size of the service area, and the rural nonfarm and urban population is exceedingly low in proportion to the farm population. The 1950 census reported 10,515 rural residents in the service area and an additional 12,037 residents in the cities and towns. Of the latter, all but about 2,500 live in the oil-based communities of Avenal and Coalinga.

Project conditions.--As shown in chapter VI, it is expected that, with a firm supply of water available for all land in the proposed service area, a substantial subdivision of the existing large farms will occur. More intensive farming of cotton, field crops, truck, fruit and other crops will be possible with an assured supply of irrigation water at reasonable cost. This should lead to a substantial increase in the resident farm population. This anticipated increase in farm population will require many new services including various retail stores, farm supply establishments, transportation facilities, schools, medical, legal and other professional services, and public utilities.

Thus, under project conditions, there probably will be a general increase in population and the percentage of rural nonfarm and urban residents will increase. Comparison with similar fully developed agricultural areas elsewhere in California indicates that by the year 2000 the San Luis Unit service area might support a total of about 27,000 farm residents, 30,700 rural nonfarm residents, and 29,800 urban residents.

Benefits.--The measure of benefit of municipal and industrial water is normally considered equivalent to the cost of the least-cost alternative supply. This assumes that the water would be of similar quality and potability. In the San Luis Unit service area ground water is of marginal potability except at Coalinga where it is unsatisfactory for culinary and drinking purposes and the supply for these needs must be imported by rail and distributed through a separate system.

THE TOWN OF COALINGA, WHOSE BUSINESS DISTRICT IS SHOWN ABOVE, HAS DEVELOPED TO SERVE THE NEARBY OIL FIELDS.



Nonagricultural Effects

The cost of supplying ground water varies but an average cost for the area is about $25 per acre-foot measured at a point equivalent to canalside for project water. Quality and potability aside, this is less for municipal and industrial water than the benefit derived in chapter VI for irrigation water furnished at canalside, $33.81 per acre-foot. With ordinary treatment project water will be potable and of better quality for all municipal and industrial purposes than the present ground-water supply. On the basis of its superior quality, municipal and industrial water obtained from the project is assumed to have value at least equal to the unit irrigation benefit. Therefore the per-acre-foot benefit from municipal and industrial water is considered as $33.81, the same as for irrigation water. At this value the total annual benefit from the 22,600 acre-feet of municipal and industrial water, which would be furnished at canalside with full development, would be $764,100.

Fish and Wildlife[1/]

Present conditions.--The hot, dry climate of the westside lands severly limits the growth of vegetation which serves as food and cover for wildlife. Since the antelope became extinct there are no large game species left on the valley floor and even small game is scarce. A few doves and quail are present where they can reach water, and flocks of geese sometimes visit grain fields during the winter to glean the stubble or to feed on newly

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1/ Fish and wildlife aspects of the San Luis Unit are discussed in more detail in a report by the United States Department of the Interior, Fish and Wildlife Service, Fish and Wildlife Resources in Relation to the Water Development Plan for the San Luis Unit, December 1954; bound at the back of this volume.

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sprouting grain. Mountain plovers spend the winter in the short grass range. A few badgers, skunks and kit foxes prey on rodents and insects, while an occasional coyote that has escaped the predator control program waylays an unwary jack rabbit or ground squirrel.

The San Luis Reservoir site, being in the foothills and having water in some springs and intermittently in Cottonwood and San Luis Creeks during the winter and spring, is not quite as barren of either flora or fauna as are the unirrigated parts of the valley floor. Oaks occur at a few places along the margin of the proposed maximum reservoir water level (elevation 450 feet) and also some cottonwoods and willows occur in the draws. In the winter and spring a few deer come down from the higher elevations to feed, and smaller game species are perhaps more numerous because there is water and more adequate cover.

Anticipated post-project conditions.--With irrigation, the crop pattern will change with grain acreage decreasing, and alfalfa, pasture and row crops increasing. As habitat, this would not be a great improvement over the present, especially if it is accompanied by increased density of settlement. Doves and quail might increase in numbers but the movement of the large wintering flocks of geese would be restricted even though the area might provide their dietary requirements. Also, irrigating new land would further decrease the already limited habitat of the mountain plover which winters in this area.

Clearing and filling San Luis Reservoir will destroy some small animal habitat forcing these creatures up the draws and creek channels.

The few deer which now come down from the higher elevations will have to skirt the reservoir over new routes. In one important respect the reservoir will be beneficial--it will provide a large expanse of resting area from which waterfowl, particularly geese, may make forays into the valley to feed. Since there presently are no large reservoirs on the west side of the valley, San Luis would add significantly to the overall habitat picture in this respect. As large expanses of the reservoir floor are exposed with the advance of the irrigation season it may be that crops such as sorghum and other dry land crops can be grown thereby providing feeding area also. If such cropping proves possible the reservoir area can contribute significantly to crop depradation control in the valley rice lands.

Flood channels, drains and particularly the Panoche and Five Points Wasteway areas could add significantly to waterfowl habitat and management opportunity just as the San Luis Wasteway on the Delta-Mendota Canal does now. The Panoche Wasteway could be located adjacent to a State waterfowl management area now being acquired to the west of Mendota Pool thereby increasing the value of both areas for waterfowl management. The Fish and Wildlife Service estimates that with suitable management practices wildlife benefits would amount to $37,000 annually.

Fisheries

Since water will be pumped from the Delta for delivery to San Luis Reservoir and to the San Luis Canal service area during the winter months as well as during the irrigation season the diversion of water at Tracy will be prolonged into a year-round hazard to the fishery; one particularly dangerous to young salmon which pass through the Delta on their migration to the ocean in the early spring. Under current operation the pump draft is low at the time of the salmon migration while the streams generally are at their maximum thus moving the fish toward the ocean.

Although the young striped bass and shad now occupy the Delta at the height of the pumping season and already are subject to major pumping influence, the effect upon these fish will be increased by the larger pumping period. Black bass, crappie, blue gills and catfish should not be affected to any great extent since they do not have the migratory instinct and do not move downstream as a part of their life cycle.

While careful study has been given to screening the fish at the Tracy fish screen some will inevitably pass through any screens that may be constructed. Experience has shown that many of these survive passage through the Tracy pumps and it is reasonable to expect that they also will survive lifting into San Luis Reservoir. The reservoir thus will be stocked with fish from the Delta. The warm water fishes, black bass, blue gills, crappie, carp, and catfish should thrive there as well as they do in other reservoirs. Striped bass also may survive to catchable size if a food supply develops but salmon are not likely to endure the summer water temperatures even if other conditions prove favorable.

With the reservoir offering an escape from the canal and an environment in which fresh water fish can thrive, it will, in a sense, salvage fish that otherwise would be lost. Thus no screens are needed at the lift into San Luis Reservoir. The escape of fish from the reservoir with releases into San Luis Canal should present no greater threat than do releases from Millerton Lake into the Madera and Friant-Kern Canals neither of which is screened. Thus no fishery maintenance costs are foreseen.

Angling in the canals is advocated by the Fish and Wildlife Service and the California Department of Fish and Game. However, public traffic on canal roads would interfere with canal maintenance, while steep canal sides would create a hazard to public safety. Fish are likely to be lost by diversion into fields and killed by toxic weed and algae control agents. This combination of factors makes it impracticable to attempt to maintain angling as a sport in the canals.

Benefits.--No significant wildlife habitat would be adversely affected by the project while important benefits should accrue to waterfowl. The Fish and Wildlife Service in its report, which is attached hereto as an appendix, estimates the net annual habitat value of the San Luis Reservoir and the Panoche and Five Points Wasteways at $30,000, if these areas are not developed and $37,000 if developed. It is believed that these may be viewed as minimum values. Existing habitat will diminish progressively as lands are more intensively developed and settled thereby increasing the value of those areas dedicated to waterfowl management even though such management may be only a corollary function as it would be in the case of project features.

Winter pumping from the Delta will increase the threat to the Delta fishery and result in a fishery loss. That loss will be minimized by the Tracy fish screen and offset to some extent by the fishery created in San

Luis Reservoir. The Fish and Wildlife Service estimates the present value of the Delta fishery at $29,917,000, and the value with the project (including a San Luis Reservoir fishery) at $29,617,000. The difference of $300,000, being only 1 percent of the present value, is comparatively small and should probably be viewed as indicative of the degree of loss rather than as a monetary measure of its extent since the value of the resource is not susceptible of such precise measurement.

Recreation[2]

Existing opportunities and facilities.--Other than small city parks and the small George J. Hatfield and Fremont Ford State Parks on the San Joaquin River the people on the west side of the San Joaquin Valley have no public outdoor recreational areas they may enjoy. These existing parks are principally picnic grounds and playgrounds. Mendota Pool, an irrigation diversion, offers some boating and angling and some people swim in the irrigation canals. Some also angle for warm water fishes in the canals and in drainage ditches although the agencies which operate these facilities generally discourage such activities. During the open season on waterfowl many people turn nimrod, hunting ducks and geese which migrate through and winter in the valley.

Recreational needs.--An opportunity for outdoor activity and escape from the summer heat are the primary recreational needs on the west side

2/ Details on the recreational aspects of San Luis Unit are contained in a report of the United States Department of the Interior, National Park Service, Recreational Potentialities, Proposed San Luis Unit, Central Valley Project, California, February 1955; bound at the back of this volume.

of the San Joaquin Valley. Mostly this means trees for shade and water for such sports as swimming, bathing, and boating. Nature provides little of either. People who can do so go to the sea coast or the mountains. Others use the meager facilities of the local parks, utilize irrigation canals or simply enjoy home facilities if they have them. Many who desire more activity and who feel the need of getting away from the home scene, without having to go as far as the mountains or the ocean, will no doubt seek the waters of San Luis Reservoir.

Potential recreational development.--Besides developments for the aquatic sports, bathing, angling, and boating, and the usual camp and picnic grounds, the historic importance of the San Luis Reservoir area could well be recognized. The Pacheco Pass Road (State Highway 152) has been the historic route from the valley across the Coast Range to the sea and Rancho San Luis Ganzaga, or San Luis Station, has been a stopping place for travelers from the days of Mexican settlement to the present. The relocation of State Highway 152 will provide opportunities for historical markers, and new vistas of the reservoir and the valley.

As the discussion of a potential fishery in San Luis Reservoir indicates, the continuing introduction of fish, particularly striped bass, from the Sacramento-San Joaquin Delta may provide unique inland angling. In any case a warm water fishery similar to that in other reservoirs will be available.

Besides valley residents San Luis Reservoir may attract people from the coast. Recreational traffic over Pacheco Pass moves both ways. Valley residents seek the coast for relief from the heat while coastal residents go inland to escape the ocean fog and chill. For the latter, San Luis Reservoir could provide a significant recreational objective (which they do not have now) where they could enjoy such activities as motor boating, sailing and angling more safely than they can at most places along the coast.

The Merced County Planning Commission and the County Recreation Commission have indicated that there is a definite need on the west side of the county for a recreation area such as San Luis Reservoir could provide. If the reservoir area should become an important unit in the State waterfowl conservation program as anticipated, an administrative arrangement between the California Department of Fish and Game and Merced County to accommodate both the recreation and wildlife conservation functions might be advantageous to all interests.

The National Park Service estimates that minimum basic recreational facilities for the San Luis Reservoir area would cost $90,000 and that sum has been included in the cost estimates for San Luis Dam and Reservoir. In accordance with Departmental policy this sum would be a nonreimbursable project cost but subject to expenditure only if a local or State agency assumes responsibility for the area and for the operation and maintenance of the facilities provided.

Recreational benefits.--The National Park Service in its report estimates a potential recreational use of 126,000 visitor-days at San Luis

Reservoir on the basis of the population projected for 1960. The capitalized value of the benefits which may be assigned to the project by reason of this use is estimated by the Service to be slightly over $55,000 annually.

CHAPTER VIII

ECONOMIC ANALYSIS

Economic justification for adding San Luis Unit to the Central Valley Project was determined by an analysis of the incremental benefits and costs on an annual equivalent basis. This analysis compares annual equivalent benefits attributable to the San Luis Unit with annual equivalent costs necessary to achieve these benefits. The comparison provides a measure of the dollars in benefits attributed to each dollar of expenditure.

Expenditures include capital investment in facilities for water storage, conveyance, and distribution, power generation and transmission, and annual operation, maintenance, and replacement expenses associated with these features. The analysis was based on a 100-year period and an interest rate of 2.5 percent for funds expended and benefits obtained. Benefits and costs were converted to annual equivalent values beginning at the date of initial operation of the Unit.

Measurable benefits accruing as a result of construction of the San Luis Unit include those attributable to irrigation, municipal and industrial water supply, recreation, and wildlife. In computing benefits, a reduction in fishery values, and power benefits foregone are also recognized. Irrigation benefits were calculated at farm headgate. All the costs necessary to convey water to the farm headgate are included in this analysis.

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Economic Analysis

Benefits

Irrigation benefits.--Total primary and secondary irrigation benefits for the San Luis Unit under conditions of full development based on a price level of 215 (1910-14 equals 100) are estimated at $51,756,000 annually. Primary benefits comprise 49.5 percent of the total benefits, and secondary benefits make up the balance. A detailed discussion of the derivation of irrigation benefits is presented in chapter VI, "Agricultural Project Effects."

Annual equivalent irrigation benefits.--In the San Luis Unit a development period of less than full production must be considered. Since most of the productive acres in the area already are developed to irrigaton farming and since it is contemplated that parallel construction will take place between storage, conveyance, and distribution facilities, a development period of 10 years with 25 percent of the project water supply delivered the initial year (1965) was contemplated. It was estimated that the increase in the use of project water supplies will continue so that by 1974 full irrigation development will be achieved. On the basis of this development period, a 100-year period of analysis with 2.5 percent interest, and initial water deliveries occurring in 1965, the annual equivalent irrigation benefits were determined to be $46,907,000. Primary benefits comprise 49.5 percent of the total, or $23,219,000.

Municipal and industrial water supply benefits.--Municipal and industrial water supply benefits have been assumed as $33.81 per acre-foot, the same as the benefits for irrigation water. This was done because, as noted in chapter VII, "Nonagricultural Effects", there is no adequate alternative source for the municipal and industrial water of satisfactory quality which the San Luis Unit would furnish. Also, since municipal use is recognized as a higher priority use than irrigation, it is considered unrealistic to assume lesser benefits. Under this assumption the municipal and industrial water benefit at full development would be $764,100 annually.

Annual equivalent municipal and industrial water benefits.--On the basis of population forecasts it has been estimated that the use of municipal and industrial water will increase from 11,800 acre-feet per year in 1965 to 22,600 acre-feet per year by the year 2000 and remain constant thereafter. With a benefit per acre-foot of $33.81 and an interest rate of 2.5 percent the annual equivalent benefit over a 100-year period beginning in 1965 is estimated at $636,000.

Recreational benefits.--The National Park Service in its report on the recreational potentials of the San Luis Reservoir, has estimated the annual recreation benefit to be about $55,000.

Fish and wildlife effects.--The Fish and Wildlife Service has evaluated the gains and losses expected to result from the San Luis development. From this analysis, fishery values would be reduced $300,000 annually. Wildlife benefits would amount to $37,000 annually. A discussion of the reasons for these effects is given in chapter VII, "Nonagricultural Effects".

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Power benefits foregone.--As discussed in chapter IV, "Water Supply", the addition of the San Luis Unit to the Central Valley Project requires the use of a large amount of electric energy for pumping during the winter months. In evaluating the Central Valley Project without the San Luis Unit, this energy is assumed to be sold commercially with most of it usable under dependable capacity requirements. Using the energy for pumping for the San Luis Unit during a few months of the year decreases the dependable capacity of the project with a consequent decrease in revenues and benefits. The annual equivalent value of this power, measured in terms of the cost of the most likely alternative development, amounts to $5,942,000. Inasmuch as the alternative is assumed to be a privately financed steam plant, the value associated with this effect includes a tax component in the amount of $1,241,000. The decrease in benefits ($5,942,000) has been accounted for as an adjustment of benefits creditable to the San Luis Unit.

Summary of measurable annual equivalent benefits.--Annual equivalent benefits attributable to the construction and operation of the San Luis Unit amount to $41,393,000 in total. Annual equivalent primary benefits resulting from project development amount to $17,705,000. These benefits are summarized by function in the following tabulation:

Economic Analysis

Function	Primary annual equivalent benefit	Total annual equivalent benefit
Irrigation	$23,219,000	$46,907,000
Municipal and industrial water service	636,000	636,000
Recreation	55,000	55,000
Fish	-300,000	-300,000
Wildlife	37,000	37,000
Power benefits foregone	-5,942,000	-5,942,000
Total	$17,705,000	$41,393,000

Intangible benefits.--In addition to the measurable benefits identified above, there are other more indirect and less tangible benefits resulting from project development. These benefits are not readily susceptible of evaluation in monetary terms although they are real and in some instances of considerable importance. The provision of a water supply and the creation of new farm opportunities contribute to the strengthening of the economic and social structure of the area immediately involved as well as the nation as a whole. Furthermore, the advent of project water service will serve to preserve and protect existing capital investment amounting to many millions of dollars which is threatened by a rapidly diminishing ground-water supply. The production of necessary food and fibre for an expanding regional and national economy, contributions toward national security, and enlargement of the tax base are some of the intangible types of project benefits. Although these benefits are difficult to measure, they are nonetheless real and important and must be considered in the evaluation of the economic soundness of this proposed development.

*

Economic Analysis

Annual Equivalent Cost

The annual equivalent cost of the development is the annual sum required to amortize the capital investment and pay required operation, maintenance, and replacement expenses. As previously mentioned, the 2.5 percent interest factor and the 100-year period of analysis were used in these computations as in the annual equivalent benefit determination.

The total estimated capital cost of the San Luis Unit including the distribution system is $399,210,000. In benefit-cost evaluation to determine the economic justification for incurring further costs, the estimated $500,000 spent in development of the project plan is subtracted, leaving a capital cost of $398,710,000. It was estimated that features would be constructed and placed in service beginning in 1965 and concluding in 1974. To determine the present worth of these costs, interest during construction, and salvage value were taken into account.

Capital costs of the various features were discounted to present worth at the beginning of 1965 and amortized in equal annual payments over the subsequent 100-year period at 2.5 percent interest. On this basis, the annual equivalent cost of capital amortization would be $11,450,000. Annual operation, maintenance, and replacement costs shown in table 11 likewise were converted to annual equivalents for the purpose of benefit-cost comparison. The annual equivalent operation, maintenance, and replacement expense for the San Luis Unit amounts to $6,728,000. To determine total annual equivalent costs an adjustment of $373,000 was made to account for the decreased power costs associated with wheeling and purchased energy which would result from the reduction in dependable capacity mentioned previously in the discussion of power benefits foregone. In addition, since power benefits foregone, measured in terms of a privately financed steam plant, include a tax component it is necessary to make a negative cost adjustment of $1,241,000 thus maintaining comparability in power benefit and cost values. Applying these aforementioned adjustments results in total annual equivalent costs of $16,564,000 as shown in table 12.

Benefit-Cost Ratio

Annual equivalent benefits creditable to the San Luis Unit have been computed, as indicated above, at $41,393,000. As contrasted with these benefits, annual equivalent economic costs of $16,564,000 have been estimated. A comparison of these values indicates a ratio of benefits to costs of 2.50 to 1.00. If only the primary benefits of $17,705,000 are considered, the ratio of benefits to costs is 1.07 to 1.00. Inasmuch as the primary function of this development is water service and since municipal and industrial water benefits, on a per-acre-foot basis, are considered equal to those for irrigation benefits no functional benefit-cost ratios are presented herein.

The favorable benefit-cost relationship reveals that for every dollar spent in developing the proposed plan, two and one-half dollars in benefits will accrue to the nation. This favorable benefit-cost ratio effectively demonstrates the justification of the proposed plan to the benefit of the area involved, the State, and the nation. Intangible benefits, not accounted for in the benefit-cost ratio, further emphasize the economic merits of the proposed plan of development.

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Table 11.--Summary of annual operation, maintenance and replacement costs

San Luis Unit

Features	Operation and maintenance	Replacement a/	Replacement b/
Main storage and conveyance features			
San Luis Dam	$ 47,500	$ 42,500	$ 37,000
San Luis Pumping Plant	270,400	286,000	237,400
San Luis Canal	458,300	90,900	201,800
Pleasant Valley Pumping Plant	49,500	22,000	26,700
Pleasant Valley Canal	49,000	7,800	14,300
Transmission lines	118,600	69,000	124,400
Floodworks	23,600	3,300	4,800
Service lateral pumping plants	323,400	212,100	128,800
Distribution system features			
Distribution system	2,168,300	424,000	608,900
Deep wells	246,400	864,200	664,400
Drains	93,500	28,800	62,400
Tracy Pumping Plant	--	83,300	80,900
Total	$3,848,500	$2,133,900	$2,191,800

a/ Interest-free, 50 years - used in repayment analysis.
b/ Interest-bearing, 100 years - 2.5 percent. When adjusted to annual equivalents, these are used in benefit-cost analysis. Annual equivalent operation, maintenance, and replacement costs are shown in table 12.

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Table 12.--Annual equivalent costs

San Luis Unit

(Sheet 1 of 2)

Feature	Capital cost[a]	Initial year of operation	Net project investment[b]	Annual capital amortization[c]	OM&R[d]	Annual equivalent
San Luis Unit						
Main storage and conveyance features						
San Luis Dam and Reservoir	$ 52,116,000	1965	$ 55,207,000	$1,508,000	$ 85,000	$1,593,000
San Luis Pumping Plant	37,333,000	1965	40,600,000	1,109,000	508,000	1,617,000
San Luis Canal and Pump Intake Canal	78,487,000	1965	85,355,000	2,331,000	660,000	2,991,000
Pleasant Valley Pumping Plant	4,579,000	1965	4,808,000	131,000	76,000	207,000
Pleasant Valley Canal and Pump Intake Canal	4,629,000	1965	4,803,000	131,000	63,000	194,000
Transmission Lines	8,920,000	1965	9,143,000	250,000	243,000	493,000
Channels, levees, and floodworks	23,534,000	1965	24,417,000	667,000	28,000	695,000
Relift distribution pumping plants	18,472,000	1965	19,857,000	542,000	452,000	994,000
General property	1,073,000	1965	1,073,000	29,000	-	29,000
Subtotal	229,143,000		245,263,000	6,698,000	2,115,000	8,813,000

Table 12.--Annual equivalent costs

San Luis Unit

(Sheet 2 of 2)

Feature	Capital cost[a]	Initial year of operation	Net project investment[b]	Annual capital amortization[c]	OM&R[d]	Annual equivalent
Distribution system features						
Distribution systems	$129,748,000	1965	$145,967,000	$3,986,000	$2,777,000	$ 6,763,000
Deep wells	19,681,000	1966	17,437,000	288,000	1,636,000	1,924,000
Interceptor and tile drains	20,638,000	1975	18,138,000	495,000	119,000	614,000
Subtotal	399,210,000		426,805,000	11,467,000	6,647,000	18,114,000
Less: Development of plan (in above costs)	-500,000	1954	-640,000	-17,000	-	-17,000
Replacement cost increase - Tracy Pumping Plant					81,000	81,000
Subtotal	$398,710,000		$426,165,000	$11,450,000	$6,728,000	18,178,000
Decreased power costs[e]						-1,614,000
Total						$16,564,000

a/ Cost estimates for the San Luis Unit are from PF-1 estimate dated April 1954; revised January 20, 1955, with prices as of January 1954.

b/ Capital cost, plus interest at 2.5 percent for half the construction period adjusted to present worth in 1965.

c/ Capital is amortized in equal annual payments over 100-year period (1965-2064) at 2.5 percent interest.

d/ Operation, maintenance and replacement expenses are based on 1954 price levels.

e/ Represents decrease in purchased power and wheeling costs and tax adjustment.

CHAPTER IX

ALLOCATION AND REPAYMENT ANALYSIS

As proposed in this report, the San Luis Unit would be integrated operationally and financially with the Central Valley Project. Feasibility, or probable repayment, has been tested by a cost allocation and repayment analysis of the enlarged Central Valley Project including the San Luis Unit. Repayment analyses are presented in this chapter for the Central Valley Project both with and without the San Luis Unit additions. From these two sets of repayment schedules the estimated financial result of adding the San Luis Unit to the Central Valley Project is indicated.

Allocation of Capital Cost of the Central Valley Project Before and After the addition of the San Luis Unit

The total construction cost of the enlarged project, exclusive of distribution and drainage systems, is estimated at $988,308,000 and is comprised of $229,143,000 in incremental costs for the San Luis Unit and $759,165,000 for the base Central Valley Project without San Luis additions. The latter amount was allocated by the separable cost-remaining benefit method--the method recently adopted for use by the Federal Power Commission, Army Corps of Engineers and the Department of the Interior.

Essentially, the separable cost-remaining benefit method of allocation provides a "ceiling" allocation be determined for each function as the lesser of (1) equivalent annual benefits, or (2) the

*

annual equivalent cost of providing those benefits from the most likely alternative. In this way, no function is assigned costs in excess of the benefits which accrue or the cost of obtaining those benefits from a single-purpose alternative. This maximum is the justifiable expenditure. Next, the "floor" or minimum allocation is determined for each function. This is the separable cost assigned to each function, and is defined as the cost of the multiple-purpose project less the cost of the project with that function being omitted. The difference between the separable cost (floor) and the justifiable expenditure (ceiling) provides the basis for the percentage needed to distribute project joint costs among project functions. The allocation to each function is the sum of the allocated joint and separable costs.

In the financial study of the "base" Central Valley Project the initial allocations were made to water service, power, fish and wildlife, flood control, recreation and navigation. Thereafter, the cost assigned to water service was suballocated between irrigation and municipal and industrial water use; and the power costs suballocated among irrigation, municipal and industrial water service and commercial power. This new approved cost allocation method also provides for the simultaneous allocation of total project costs, including both construction and operation, maintenance and replacement. Thereafter, annual operation, maintenance and replacement costs are deducted to determine the construction cost allocation.

Allocation and Repayment Analysis

The incremental cost of the San Luis addition, except for $90,000 single-purpose recreational cost and $8,920,000 in single-purpose power items, is all assigned to water service. To financially integrate the San Luis Unit these costs were added to the similar "base" Central Valley Project cost distribution before suballocation. Thereafter the joint water service cost was distributed, as in the "base" allocation by the separable cost-remaining benefit method, by suballocation on the basis of "firm" water deliveries. Similarly, power was suballocated as before. Suballocation of the power cost of the enlarged project is proportionate to the cost of an alternative power supply required for irrigation, municipal, and industrial water pumping and commercial power generation respectively. The allocation of the Central Valley Project both before and after the inclusion of the San Luis Unit is presented in the following tabulation:

*

Allocation and Repayment Analysis

Item	Construction Cost Allocation: Central Valley Project without San Luis Unit	Central Valley Project with San Luis Unit
Nonreimbursable		
Navigation	$18,472,000	$18,472,000
Flood Control	52,749,000	52,749,000
Fish and wildlife	6,065,000	6,065,000
Recreation	215,000	305,000
Total nonreimbursable	$77,501,000	$77,591,000
Reimbursable		
Irrigation	$405,832,000	$696,149,000
Commercial power	263,260,000	195,956,000
Municipal and industrial water service	12,572,000	18,612,000
Total reimbursable	$681,664,000	$910,717,000
Total without distribution systems	$759,165,000	$988,308,000

The only differences in the nonreimbursable allocations pertain to the recreational function. The allocation for the Central Valley Project without the San Luis Unit assigns $215,000 to the recreation purpose. With the San Luis Unit added, an additional recreation allocation of $90,000 is included. These recreation costs, estimated by the National Park Service, are for minimum single-purpose recreational facilities.

Annual Costs of Operation, Maintenance, and Replacement of the Central Valley Project Before and After Addition of the San Luis Unit

Annual costs assigned to reimbursable functions under conditions of full development, for operation and maintenance, replacement, purchased energy, wheeling, and intraproject energy charges associated with the Federal facilities of the Central Valley Project, without the San Luis

Unit are estimated at $8,800,000. With the San Luis Unit added, these charges are estimated at $12,053,000. In general, annual costs for operation, maintenance and replacement of individual features are distributed proportionate to physical accomplishments.

Repayment Analyses

The reimbursable capital cost of the Central Valley Project, including the San Luis Unit, but exclusive of San Luis or other distribution systems, is estimated at $910,717,000. Distribution system repayment is contemplated under terms of separate 40-year contracts between the United States and the districts for whom the distribution facilities are constructed. The repayment demonstration summarized below relates to the amount of $910,717,000 to be paid from revenues derived from contemplated water and power service contracts.

The estimated repayment of the reimbursable allocations of the authorized Central Valley Project is summarized in table 13, with additional details in the functional repayment tables 14, 15, and 16. The financial feasibility of the enlarged Central Valley Project including San Luis Unit is summarized in table 17, and supported by functional repayment tables 18, 19, and 20.

The principal criteria used in the repayment analysis are:

(a) The investment allocated to each reimbursable function is to be repaid within 50 years after the last major feature comes into service;

*

(b) Commercial power and municipal and industrial water service investments must be paid in full, with interest, from the net revenues earned by those functions;

(c) Interest is charged annually on the unamortized commercial power and municipal and industrial water plant-in-service investments at 3 percent and 2-1/2 percent respectively;

(d) Additional financial aid necessary to complete amortization of the irrigation investment is drawn: (1) from the municipal and industrial net revenues after repayment of the municipal and industrial investment; (2) from commercial power net revenues after repayment of the commercial power investment; and

(e) Interest components are not credited towards investment amortization.

The repayment potential of the enlarged project, by functions, is further discussed in the following paragraphs.

Irrigation repayment of the Central Valley Project including the San Luis Unit.--Total reimbursable capital costs allocated to irrigation (exclusive of distribution systems) amount to $696,149,000. The irrigation repayment analysis is based on an assumed water rate structure of $1.50 an acre-foot for interim irrigation service and class 2 water supply; $3.50 an acre-foot for a class 1 water supply as presently

Table 13
REPAYMENT ANALYSIS
CENTRAL VALLEY PROJECT - CALIFORNIA

Thousands of Dollars

Year of study (fiscal)	Power: Net operating revenue	Power: Components of net power revenues: Interest on investment	Power: Components of net power revenues: Excess over interest	Power: Investment repayment from power revenues: Interest Bearing: Electric plant in service	Power: Interest Bearing: Balance to be repaid	Power: Interest free: Revenues credited to irrigation repayment	Power: Earned surplus (cumulative)	Municipal Water Service: Net operating revenue	Municipal: Components of net municipal revenues: Interest on investment	Municipal: Excess over interest	Municipal: Investment repayment from Municipal revenues: Interest bearing: Municipal plant in service	Municipal: Interest bearing: Balance to be repaid	Municipal: Interest free: Revenues credited to irrigation repayment	Irrigation Water Service: Net operating revenue	Irrigation: Total(a) revenues credited to irrigation repayment	Irrigation: Investment repayment: Irrigation plant in service	Irrigation: Investment repayment: Balance to be repaid	Recapitulation: Net operating revenue	Recapitulation: Components of net revenues: Interest on investment	Recapitulation: Net revenue	Recapitulation: Investment repayment: Plant in service	Recapitulation: Investment repayment: Balance to be repaid	Recapitulation: Earned surplus (cumulative)	Year of study (fiscal)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1941																								1941
42																								42
43				2,215.8	2,215.8																2,215.8	2,215.8		43
44				13,713.5	13,713.5																13,713.5	13,713.5		44
45	1,560.4	411.4	1,149.0	15,668.3	14,519.3													1,560.4	411.4	1,149.0	15,668.3	14,519.3		45
1946	3,304.4	435.6	2,868.8	15,984.8	11,966.9													3,304.4	435.6	2,868.8	15,984.8	11,966.9		1946
47	2,989.7	359.0	2,630.7	16,058.2	9,409.7													2,989.7	359.0	2,630.7	16,058.2	9,409.7		47
48	2,603.1	282.3	2,320.8	24,580.7	15,611.4						5,569.5	5,569.5				22,662.2	22,662.2	2,603.1	282.3	2,320.8	52,812.2	43,842.9		48
49	6,447.2	534.8	5,912.4	34,650.8	19,769.0			36.5	139.2	-100.7	6,292.7	6,395.4		-45.5	-45.5	24,245.4	24,290.9	6,440.2	674.0	5,766.2	65,188.9	50,455.3		49
50	8,588.4	595.1	7,995.3	52,749.3	29,872.3			29.5	158.8	-130.3	6,734.7	6,965.7		-21.9	-21.9	125,017.5	125,064.9	8,596.0	752.9	7,843.1	184,501.5	161,922.9		50
1951	9,164.1	896.2	8,267.9	61,687.0	30,552.1			36.0	174.1	-138.0	7,178.2	7,567.2		-618.3	-618.3	151,672.6	152,258.5	8,571.8	1,070.3	7,501.6	220,537.8	190,457.6		1951
52	8,232.7	916.5	7,316.2	78,491.5	40,040.4			26.5	188.7	-162.2	7,579.1	8,110.3		-608.0	-608.0	189,320.1	190,613.8	7,651.2	1,105.2	6,546.0	275,390.7	238,764.5		52
53	6,999.1	1,201.2	5,797.9	80,812.7	36,563.7			80.3	202.8	-122.5	6,356.8	7,010.5		908.1	908.1	194,395.7	194,781.3	7,987.5	1,404.0	6,583.5	281,565.2	238,355.5		53
54	7,775.1	1,096.9	6,678.2	85,068.7	34,141.5			304.5	175.3	129.1	9,527.0	10,051.6		567.1	567.1	217,155.2	216,953.7	8,646.7	1,272.2	7,374.4	311,750.9	261,146.8		54
Total through 1954	37,654.2	6,727.0	30,927.2	85,068.7	34,141.5			515.3	1,039.9	-524.6	9,527.0	10,051.6		181.5	181.5	217,155.2	216,953.7	38,351.0	7,766.9	30,584.1	311,750.9	261,146.8		Total through 1954
1955	6,439.4	1,024.2	5,415.2	147,046.0	90,705.6			124.9	251.3	-126.4	8,392.0	9,063.0		952.1	952.1	266,600.0	265,466.4	7,516.4	1,275.5	6,240.9	422,038.0	365,235.0		1955
56	6,888.3	2,721.1	4,167.2	148,724.0	88,214.4			172.9	226.1	- 53.2	8,464.0	9,168.2		1,383.1	1,383.1	268,751.0	266,214.3	8,444.3	2,947.2	5,497.1	425,939.0	363,596.9		56
57	7,938.4	2,646.5	5,291.9	149,901.0	84,099.5			213.4	229.2	- 15.8	8,771.0	9,491.0		2,812.8	2,812.8	276,325.0	270,995.5	10,964.6	2,875.7	8,088.9	434,997.0	364,586.0		57
58	7,427.7	2,523.0	4,904.7	149,901.0	79,194.8			255.4	237.3	18.1	8,787.0	9,488.9		3,098.3	3,098.3	276,740.0	268,312.2	10,781.4	2,760.3	8,021.1	435,428.0	356,995.9		58
59	7,173.5	2,375.8	4,797.7	150,290.0	74,786.1			291.9	237.2	54.7	9,958.0	10,605.2		3,262.2	3,262.2	304,909.0	293,219.0	10,727.6	2,613.0	8,114.6	465,157.0	378,610.3		59
60	6,902.1	2,243.6	4,658.5	151,505.0	71,342.6			350.8	265.1	85.7	10,397.0	10,958.5		3,129.8	3,129.8	315,496.0	300,676.2	10,382.7	2,508.7	7,874.0	477,398.0	382,977.3		60
1961	7,474.7	2,140.3	5,334.4	224,037.0	138,540.2			406.9	274.0	132.9	11,281.0	11,709.6		3,506.5	3,506.5	349,908.0	331,581.7	11,388.1	2,414.3	8,973.8	585,226.0	481,831.5		1961
62	7,945.0	4,156.2	3,788.8	224,037.0	134,751.4			454.3	292.7	161.6	11,300.0	11,567.0		3,777.3	3,777.3	350,363.0	328,259.4	12,176.6	4,448.9	7,727.7	585,700.0	474,577.8		62
63	8,063.0	4,042.5	4,020.5	263,260.0	169,953.9			498.5	289.2	209.3	12,308.0	12,365.7		4,033.1	4,033.1	399,474.0	373,337.3	12,594.6	4,331.7	8,262.9	675,042.0	555,656.9		63
64	8,369.0	5,098.6	3,270.4		166,683.5			527.9	309.1	218.8	12,308.0	12,146.9		4,187.1	4,187.1	399,474.0	369,150.2	13,084.0	5,407.7	7,676.3	675,042.0	547,980.6		64
65	9,741.0	5,000.5	4,740.5		161,945.0			547.2	303.7	243.5	12,308.0	11,903.4		4,344.7	4,344.7	399,474.0	364,505.5	14,632.9	5,304.2	9,328.7	675,042.0	538,353.9		65
1966	9,669.0	4,858.3	4,810.7		157,132.3			567.5	297.6	269.9	12,308.0	11,633.5		4,480.3	4,480.3	399,474.0	360,325.2	14,716.8	5,155.9	9,560.9	675,042.0	529,091.0		1966
67	9,597.0	4,714.0	4,883.0		152,249.3			594.3	290.8	303.5	12,308.0	11,330.0		4,595.4	4,595.4	399,474.0	355,729.8	14,786.7	5,004.8	9,781.9	675,042.0	519,309.1		67
68	9,482.0	4,567.5	4,914.5		147,334.8			612.9	283.3	329.6	12,308.0	11,000.4		4,694.0	4,694.0	399,474.0	351,035.8	14,788.9	4,850.8	9,938.1	675,042.0	509,371.0		68
69	9,482.0	4,420.0	5,062.0		142,272.8			641.1	275.0	366.1	12,572.0	10,898.3		4,781.4	4,781.4	405,832.0	352,612.4	14,904.5	4,695.0	10,209.5	681,664.0	505,783.5		69
70	9,492.0	4,268.2	5,223.8		137,049.0			666.3	272.5	393.8		10,504.5		4,836.9	4,836.9		347,775.5	14,995.2	4,540.7	10,454.5		495,329.0		70
1971	9,368.0	4,111.5	5,256.5		131,792.5			679.1	262.6	416.5		10,088.0		4,952.2	4,952.2		342,823.3	14,999.3	4,374.1	10,625.2		484,703.8		1971
72	9,369.0	3,953.8	5,415.2		126,377.3			701.9	252.2	449.7		9,638.3		5,046.5	5,046.5		337,776.8	15,117.4	4,206.0	10,911.4		473,792.4		72
73	9,372.0	3,791.3	5,580.7		120,796.6			714.1	241.0	473.1		9,165.2		5,123.9	5,123.9		332,652.9	15,210.0	4,032.3	11,177.7		462,614.7		73
74	9,203.0	3,623.9	5,579.1		115,217.5			735.3	229.1	506.2		8,659.0		5,180.7	5,180.7		327,472.2	15,119.0	3,853.0	11,266.0		451,348.7		74
75	9,205.0	3,456.5	5,748.5		109,469.0			745.7	216.5	529.2		8,129.8		5,230.0	5,230.0		322,242.2	15,180.7	3,673.0	11,507.7		439,841.0		75
1976	9,202.0	3,284.1	5,917.9		103,551.1			755.3	203.2	552.1		7,577.7		5,276.2	5,276.2		316,966.0	15,233.5	3,487.3	11,746.2		428,094.8		1976
77	9,068.0	3,106.5	5,961.5		97,589.6			773.1	189.4	583.7		6,994.0		5,311.6	5,311.6		311,654.4	15,152.7	3,295.9	11,856.8		416,238.0		77
78	9,064.0	2,927.7	6,136.3		91,453.3			781.1	174.8	606.3		6,387.7		5,344.0	5,344.0		306,310.4	15,189.1	3,102.5	12,086.6		404,151.4		78
79	8,974.0	2,743.6	6,230.4		85,222.9			797.3	159.7	637.6		5,750.1		5,364.0	5,364.0		300,946.4	15,135.3	2,903.3	12,232.0		391,919.4		79
80		2,556.7	6,417.3		78,805.6			806.5	143.7	662.8		5,067.3		5,386.5	5,386.5		295,589.9	15,167.0	2,700.4	12,466.6		379,462.8		80
1981		2,364.2	6,609.8		72,195.8			822.9	127.2	695.7		4,391.6		5,402.5	5,402.5		290,157.4	15,199.4	2,491.4	12,708.0		366,744.8		1981
82		2,165.9	6,808.1		65,387.7			827.7	109.8	717.9		3,673.7		5,420.5	5,420.5		284,736.9	15,222.2	2,275.7	12,946.5		353,798.3		82
83		1,961.6	7,012.4		58,375.3			842.5	91.8	750.7		2,923.0		5,430.5	5,430.5		279,306.4	15,247.0	2,053.4	13,193.6		340,604.7		83
84		1,751.3	7,222.7		51,152.6			846.5	73.1	773.4		2,149.6		5,441.0	5,441.0		273,865.4	15,261.5	1,824.4	13,437.1		327,167.6		84
85		1,534.6	7,439.4		43,713.2			849.7	53.7	796.0		1,353.6		5,447.0	5,447.0		268,418.4	15,270.7	1,588.3	13,682.4		313,485.2		85
1986		1,311.4	7,662.6		36,050.6			862.1	33.8	828.3		325.3		5,450.0	5,450.0		262,968.4	15,286.1	1,345.2	13,940.9		299,344.3		1986
87		1,081.5	7,892.5		28,158.1			863.7	13.1	850.6		0.0	325.3	5,453.0	5,778.3		257,190.1	15,290.7	1,094.6	14,196.1		285,348.2		87
88		844.7	8,129.3		20,028.8			864.5	0.0	864.5			864.5	5,454.5	6,319.0		250,871.1	15,293.0	844.7	14,448.3		270,899.9		88
89		600.9	8,373.1		11,655.7			875.3		875.3			875.3	5,452.5	6,327.8		244,543.3	15,301.8	600.9	14,700.9		256,199.0		89
90		349.7	8,624.3		3,051.4										6,327.8		238,215.5		349.7	14,952.1		241,266.9		90
1991		90.9	8,883.1		0.0	5,851.7									12,179.5		226,036.0		90.9	15,210.9		226,036.0		1991
92		0.0	8,974.0			8,974.0									15,301.8		210,734.2		0.0	15,301.8		210,734.2		92
93						8,974.0									15,301.8		195,432.4					195,432.4		93
94						8,974.0									15,301.8		180,130.6					180,130.6		94
95						8,974.0									15,301.8		164,828.8					164,828.8		95
1996						8,974.0									15,301.8		149,527.0					149,527.0		1996
97						8,974.0									15,301.8		134,225.2					134,225.2		97
98						8,974.0									15,301.8		118,923.4					118,923.4		98
99						8,974.0									15,301.8		103,621.6					103,621.6		99
2000						8,974.0									15,301.8		88,319.8					88,319.8		2000
2001						6,058.4	2,915.6								12,386.2		75,933.6					75,933.6	2,915.6	2001
02						0.0	11,889.6								6,327.8		69,605.8					69,605.8	11,889.6	02
03							20,863.6										63,278.0					63,278.0	20,863.6	03
04							29,837.6										56,950.2					56,950.2	29,837.6	04
05							38,811.6										50,622.4					50,622.4	38,811.6	05
2006							47,785.6										44,294.6					44,294.6	47,785.6	2006
07							56,759.6										37,966.8					37,966.8	56,759.6	07
08							65,733.6										31,639.0					31,639.0	65,733.6	08
09							74,707.6										25,311.2					25,311.2	74,707.6	09
10							83,681.6										18,983.4					18,983.4	83,681.6	10
2011							92,655.6										12,655.6					12,655.6	92,655.6	2011
12							101,629.6										6,327.8					6,327.8	101,629.6	12
2013	8,974.0	0.0	8,974.0	263,260.0	0.0	0.0	110,603.6	875.3	0.0	875.3	12,572.0	0.0	875.3	5,452.5	6,327.8	405,832.0	0.0	15,301.8	0.0	15,301.8	681,664.0	0.0	110,603.6	2013
Totals	577,679.5	111,139.6	466,539.7	263,260.0	0.0	92,676.1	110,603.6	43,593.0	7,948.7	35,644.3	12,572.0	0.0	23,072.3	290,083.6	405,832.0	405,832.0	0.0	911,355.9	119,088.3	792,267.6	681,664.0	0.0	110,603.6	Totals

(a) Includes aid from power and municipal water service as well as irrigation net operating revenues.

SUMMARY

	Cost Allocation	Probable Repayment (a) (through F.Y. 2013)	Probable Repayment (a) (through F.Y. 2014)
Storage, Conveyance, and Power Facilities			
Reimbursable			
Irrigation	$ 405,832,000	$290,083,600	$295,536,100
M & I Water Service	12,572,000	35,644,300 (b)	36,519,600 (c)
Power	263,260,000	355,936,100 (d)	349,608,300 (e)
Subtotal	$ 681,664,000	$681,664,000	$681,664,000
Non-reimbursable			
Flood Control, Navigation, Fish & Wildlife, and Recreation	$ 77,501,000	--	--
Total	$ 759,165,000	$681,664,000	$681,664,000
Interest on Investment		$119,088,300 (f)	$119,088,300 (f)
Earned Surplus		$110,603,600	$125,905,400

(a) The affect of probable repayment through F.Y. 2014 is also shown to provide comparability with the repayment of the Central Valley Project including San Luis Unit. See Table 17.

(b) Includes $23,072,300 aid toward irrigation repayment.

(c) Includes $23,947,600 aid toward irrigation repayment.

(d) Includes $92,676,100 aid toward irrigation repayment.

(e) Includes $86,348,300 aid toward irrigation repayment.

(f) Includes $111,139,600 on power investment and $7,948,700 on M & I investment.

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Checked by: L.J. Bishop
April 29, 1965

Table 14

IRRIGATION WATER SERVICE REPAYMENT ANALYSIS

CENTRAL VALLEY PROJECT-CALIFORNIA

Water Deliveries (Acre Feet)

Year of study (a)	Fiscal year	San Joaquin River (b)	Sacramento Canals Unit	Contra Costa Canals	Delta-Mendota Canal	Friant-Kern Canal Class 1	Friant-Kern Canal Class 2	Madera Canal Class 1	Madera Canal Class 2	Sly Park	Folsom Service Area	Total
1	2	3	4	5	6	7	8	9	10	11	12	13
	1941			20								20
	42	380(i)		95								475
	43	750(i)		222								972
	44	120,570(i)		560					46,525			167,655
	45	126,700(i)		757					133,121			260,578
	1946	177,232(i)		687					106,860			284,779
	47	133,916(i)		613					74,781			209,310
	48	38,571(j)		2,423					20,082			61,076
1	49	211,068		3,470					92,803			307,341
2	50	163,593		4,957			138,047		140,898			447,495
3	1951	97,742		4,604	1,632		207,533		121,765			433,276
4	52	43,514		5,087	31,813	66,811	259,292	13,678	129,899			549,094
5	53	23,300		3,906	109,673	188,533	459,719	49,025	145,149			979,307
6	54	23,500		6,106	196,303	300,464	442,436	53,850	160,881			1,183,540
Total[m] through	1954	1,160,836		33,489	339,421	554,808	1,507,027	116,553	1,172,784			4,884,918
7	1955	31,500		12,000	245,000	325,000	470,000	60,000	210,000			1,353,500
8	1956	35,000		15,000	270,000	340,000	510,000	85,000	310,000	3,700		1,568,700
9	57			18,000	290,000	400,000	570,000	110,000	300,000	5,400		1,728,400
10	58		20,500	21,000	310,000	476,000	540,000	140,000	263,000	6,400		1,810,900
11	59		38,900	24,000	330,000	516,000	515,000	140,000	248,000	7,300		1,853,200
12	60		111,200	27,000	350,000	550,000	490,000	140,000	238,000	8,200	43,000	1,992,400
13	1961		177,500	30,000	375,000	575,000	475,000	140,000	228,000	9,100	85,000	2,129,600
14	62		237,800	32,000	395,000	597,000	467,000	139,000	215,000	10,100	121,000	2,248,900
15	63		292,000	34,000	415,000	599,000		137,000		11,000	154,000	2,359,000
16	64		340,300	35,000	437,000					12,000	187,000	2,464,300
17	65		382,500	35,000						13,000	217,000	2,537,500
18	1966		413,800	36,000						13,900	241,000	2,598,500
19	67		448,700	34,000						14,900	264,000	2,651,600
20	68		478,900	34,000						15,800	284,000	2,697,700
21	69		495,200	33,000						16,700	304,000	2,738,900
22	70		525,600	32,000						17,500	339,000	2,804,000
23	1971		550,700	32,000							371,000	2,861,200
24	72		570,600	31,000							401,000	2,910,100
25	73		585,300	31,000							427,000	2,950,800
26	74		594,700	30,000							452,000	2,984,200
27	75		600,800	30,000							475,000	3,013,300
28	1976		605,600	30,000							497,000	3,040,100
29	77		609,000	29,000							516,000	3,061,500
30	78		611,000	29,000							534,000	3,081,500
31	79		611,700	28,000							549,000	3,096,200
32	80			28,000							564,000	3,111,200
33	1981			27,000							577,000	3,123,200
34	82			27,000							589,000	3,135,200
35	83			26,000							598,000	3,143,200
36	84			26,000							605,000	3,150,200
37	85			26,000							609,000	3,154,200
38	1986			25,000							612,000	3,156,200
39	87			25,000							614,000	3,158,200
40	88			25,000							615,000	3,159,200
41	89			24,000							616,000	3,159,200
42	90											
43	1991											
44	92											
45	93											
46	94											
47	95											
48	1996											
49	97											
50	98											
51	99											
52	2000											
53	2001											
54	02											
55	03											
56	04											
57	05											
58	2006											
59	07											
60	08											
61	09											
62	10											
63	2011											
64	12											
65	2013	35,000	611,700	24,000	437,000	599,000	467,000	137,000	215,000	17,500	616,000	3,159,200
Totals		3,222,336	30,099,800	1,589,489	25,169,421	34,889,808	29,361,027	6,057,553	14,149,784	917,500	27,244,000	174,891,718

Operating Revenues (Thousand Dollars)

Year of study (a)	Fiscal year	San Joaquin River ($1.50 a.f. after 1948) (b)	Sacramento River (c)	Sacramento Canals Unit ($2.75 a.f.)	Contra Costa Canal ($3.50 a.f. after 1948)	Delta-Mendota Canal ($3.50 a.f.)	Friant-Kern Canal Class 1 ($3.50 a.f.)	Friant-Kern Canal Class 2 ($1.50 a.f.)	Madera Canal Class 1 ($3.50 a.f.)	Madera Canal Class 2 ($1.50 a.f.)	Sly Park ($2.50 a.f.) (d)	Folsom Service Area (e) ($1.50 a.f.)	Misc.	Total
1	2	14	15	16	17	18	19	20	21	22	23	24	25	26
	1941				.144									.144
	42	.570			.249									.819
	43	.600			.608								2.100	3.308
	44	69.443			1.189					12.800			2.425	85.857
	45	79.480			1.622					45.000			1.369	127.471
	1946	106.385			2.045					55.459			4.343	168.232
	47	114.420			2.300					49.457			5.176	171.353
	48	57.772			8.480					30.123			6.327	102.702
1	49	318.309			12.143					139.242			4.524	474.218
2	50	245.391			17.350			207.558		211.347			16.480	698.126
3	1951	123.623			16.116	5.712		311.972		182.647			17.936	657.906
4	52	65.271			17.804	111.345	230.339	389.366	47.873	194.848			27.260	1,084.106
5	53	35.550			13.679	383.857	659.866	689.578	171.588	217.723			37.746	2,209.567
6	54	35.250			21.371	687.061	1,051.824	663.654	188.475	241.322			27.635	2,916.392
Total[m] through	1954	1,251.964			116.100	1,187.975	1,941.829	2,262.128	407.936	1,379.968			153.321	6,700.221
7	1955	47.200			42.000	857.500	1,137.500	705.000	210.000	315.000			10.000	3,324.200
8	1956	52.500			52.500	946.000	1,190.000	765.000	297.500	465.000	3.700			3,781.200
9	57		1,000.000		63.000	1,015.000	1,400.000	855.000	385.000	450.000	5.400			5,235.900
10	58			56.400	73.500	1,085.000	1,662.500	810.000	490.000	394.500	12.800			5,647.200
11	59			107.000	84.000	1,155.000	1,802.500	772.500	490.000	372.000	14.600			5,860.100
12	60			305.800	94.500	1,225.000	1,925.000	735.000	490.000	357.000	16.400	64.500		6,276.700
13	1961			488.100	105.000	1,312.500	2,012.500	712.500	490.000	342.000	22.800	127.500		6,675.400
14	62			654.000	112.000	1,382.500	2,089.500	700.500	488.500	322.500	25.200	181.500		7,016.700
15	63			803.000	119.000	1,452.500	2,096.500		479.500		27.500	231.000		7,294.500
16	64			936.800	122.500	1,529.500					30.000	280.500		7,559.800
17	65			1,051.900	122.500						32.500	325.500		7,723.400
18	1966			1,151.200	122.500						34.800	361.500		7,861.000
19	67			1,253.900	119.000						37.200	396.000		7,977.100
20	68			1,303.200	119.000						39.500	425.000		8,078.700
21	69			1,361.800	115.500						41.800	456.000		8,166.100
22	70			1,446.100	112.000						43.800	506.500		8,300.400
23	1971			1,514.400	112.000							555.500		8,417.700
24	72			1,569.200	108.500							601.500		8,514.000
25	73			1,609.600	106.500							640.500		8,593.400
26	74			1,635.400	105.000							678.000		8,653.200
27	75			1,652.200	105.000							712.500		8,704.500
28	1976			1,665.400	105.000							745.500		8,750.700
29	77			1,674.800	101.500							774.000		8,795.100
30	78			1,680.200	101.500							801.000		8,817.500
31	79			1,682.200	98.000							823.500		8,838.500
32	80				98.000							846.000		8,861.000
33	1981				94.500							865.500		8,877.000
34	82				94.500							883.500		8,895.000
35	83				91.000							897.000		8,905.000
36	84				91.000							907.500		8,915.500
37	85				91.000							913.500		8,921.500
38	1986				87.500							918.000		8,922.500
39	87				87.500							921.000		8,925.500
40	88				87.500							922.500		8,927.000
41	89				84.000							924.000		8,925.000
42–64	90–2012													
65	2013	52.500	1,000.000	1,682.200	84.000	1,529.500	2,096.500	700.500	479.500	322.500	43.800	924.000	10.000	8,925.000
Totals		4,344.164	57,000.000	82,775.400	5,561.100	88,092.975	122,082.829	44,043.128	28,201.436	20,845.466	2,271.400	40,866.000	743.321	496,827.221

Operating Revenue Deductions (Thousand Dollars), **Net Operating Revenues, Other Revenues Credited to Irrigation Repayment, Irrigation Plant** (Thousand Dollars)

Operation and maintenance expenses	Replacement reserve	Pumping energy (2.5 mills per kwhr.)	Total	Net Operating Revenues	Other Revenues Credited to Irrigation Repayment: Power (f)	Other Revenues Credited to Irrigation Repayment: M&I (g)	Irrigation Plant: Cumulative investment (h)	Irrigation Plant: Balance to be repaid	Fiscal year	Year of study (a)
27	28	29	30	31	32	33	34	35	36	37
									1941	
									42	
									43	
									44	
									45	
									1946	
									47	
							22,662.2	22,662.2	48	
1,176.974(k)		2.631(k)	1,179.605(k)	- 45.601(l)			24,245.4	24,290.9	49	1
663.638	52.000	4.376	720.014	- 21.888			125,017.5	125,064.9	50	2
1,060.200	213.300	2.713	1,276.213	-618.307			151,672.5	152,358.3	1951	3
1,335.669	253.000	103.436	1,692.105	-607.999			189,320.1	190,613.6	52	4
734.889	253.000	313.615	1,301.504	908.063			194,395.7	194,781.3	53	5
1,676.935	172.900	499.458	2,349.293	567.099			217,135.2	216,958.7	54	6
6,648.305	944.200	926.229	8,518.734	181.487			217,136.2	216,953.7	1954	Total through[m]
1,537.400	173.700	561.0	2,372.100	952.100			266,600.0	265,466.4	1955	7
1,537.400	173.700	687.0	2,398.100	1,383.100			268,731.0	266,214.3	1956	8
1,537.400	173.700	712.0	2,423.100	2,812.800			276,325.0	270,995.5	57	9
1,611.600	200.300	737.0	2,548.900	3,098.300			276,740.0	268,312.2	58	10
1,611.600	200.300	786.0	2,597.900	3,262.200			304,909.0	293,219.0	59	11
2,041.400	297.500	807.0	3,145.900	3,129.800			315,496.0	300,676.2	60	12
2,041.400	297.500	830.0	3,168.900	3,506.500			349,906.0	331,581.7	1961	13
2,067.800	320.800	851.0	3,239.400	3,777.300			350,363.0	328,259.4	62	14
2,067.800	320.800	873.0	3,261.400	4,033.100			399,474.0	373,357.3	63	15
2,142.800	340.900	889.0	3,372.700	4,187.100			399,474.0	369,150.2	64	16
2,142.800	340.900	895.0	3,378.700	4,344.700			399,474.0	364,805.5	65	17
2,142.800	340.900	897.0	3,380.700	4,480.300			399,474.0	360,325.2	1966	18
2,142.800	340.900	898.0	3,381.700	4,595.400			399,474.0	355,729.8	67	19
2,142.800	340.900	901.0	3,384.700	4,694.000			399,474.0	351,035.8	68	20
2,142.800	340.900	901.0	3,384.700	4,781.400			405,832.0	352,612.4	69	21
2,194.300	366.200	903.0	3,463.500	4,836.900				347,775.5	70	22
		905.0	3,465.500	4,952.200				342,823.5	1971	23
		907.0	3,467.500	5,046.500				337,776.8	72	24
		909.0	3,469.500	5,123.900				332,652.9	73	25
		912.0	3,472.500	5,180.700				327,472.2	74	26
		914.0	3,474.500	5,230.000				322,242.2	75	27
		914.0	3,474.500	5,276.200				316,966.0	1976	28
		913.0	3,473.500	5,311.600				311,654.4	77	29
		913.0	3,473.500	5,344.000				306,310.4	78	30
		914.0	3,474.500	5,364.000				300,946.4	79	31
		914.0	3,474.500	5,386.500				295,559.9	80	32
		914.0	3,474.500	5,402.500				290,157.4	1981	33
		914.0	3,474.500	5,420.500				284,736.9	82	34
		914.0	3,474.500	5,430.500				279,306.4	83	35
		914.0	3,474.500	5,441.000				273,865.4	84	36
		914.0	3,474.500	5,447.000				268,418.4	85	37
		912.0	3,472.500	5,450.000				262,968.4	1986	38
		912.0	3,472.500	5,453.000		325.3		257,190.1	87	39
		912.0	3,472.500	5,454.500		864.5		250,871.1	88	40
		912.0	3,472.500	5,452.500		875.3		244,543.3	89	41
								238,215.5	90	42
					5,851.7			226,056.0	1991	43
					8,974.0			210,734.2	92	44
					8,974.0			195,432.4	93	45
					8,974.0			180,150.6	94	46
					8,974.0			164,828.8	95	47
					8,974.0			149,527.0	1996	48
					8,974.0			134,225.2	97	49
					8,974.0			118,923.4	98	50
					8,974.0			103,621.6	99	51
					8,974.0			88,319.8	2000	52
					6,058.4			75,933.6	2001	53
					0.0			69,605.8	02	54
								63,278.0	03	55
								56,950.2	04	56
								50,622.4	05	57
								44,294.6	2006	58
								37,966.8	07	59
								31,639.0	08	60
								25,311.2	09	61
								18,983.4	10	62
								12,655.6	2011	63
								6,327.8	12	64
2,194.300	366.200	912.000	3,472.500	5,452.500	0.0	875.3	405,832.0	0.0	2013	65
132,108.105	21,260.300	53,375.229	206,743.634	290,083.587	92,676.1	23,072.3	405,832.0	0.0		Totals

(a) The initial year of study is the first year in which an operation and maintenance appropriation is received.

(b) Deliveries in future years are estimated requirements of Grasslands Water District assumed to come through Delta-Mendota Canal or from Friant.

(c) Figures used as representing probable average revenues.

(d) One dollar per acre-foot for F.Y. 1956 and 1957; $2.00 per acre-foot for F.Y. 1958, 1959, and 1960; and $2.50 per acre-foot after F.Y. 1960. These rates are established on the assumption that the El Dorado Irrigation District will operate and maintain works.

(e) The $1.50 an acre-foot figure reflects the nominal value to Folsom irrigation water storage and diversion facilities.

(f) The financial assistance required from power is paid from net power revenues that become available after retirement of the power investment.

(g) The amount of financial assistance from municipal and industrial water revenues is the net available after the retirement of the M&I investment. This amount is applied toward repayment of the irrigation plant investment annually as it becomes available.

(h) Cumulated estimated investment in irrigation plant in service at end of fiscal year.

(i) For calendar year.

(j) For six months, January through June 1948, in order to report on fiscal year basis.

(k) Operating revenue deductions through 1949 are cumulated and shown in totals as the expenditure during fiscal year 1949.

(l) Represents the difference between cumulated total operating revenues and operating revenue deductions through fiscal year 1949.

(m) Water deliveries, operating revenues, and operating revenue deductions are from O&M or Control and Finance records.

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Checked by: L. J. Bishop
April 29, 1955

214-208-2238

GPO 969085

TABLE 15

CENTRAL VALLEY PROJECT-CALIFORNIA

POWER SYSTEM AVERAGE RATE AND REPAYMENT STUDY

AVERAGE POWER RATE USED TO COVER REVENUE DEDUCTIONS AND THE RETURN OF COSTS TO BE BORNE BY POWER

PRELIMINARY

1	2	3	4	5	6	7	8	9	10	11
		Sale of Electric Energy - Kilowatt-hours				Operating Revenues				
			Sale of Project Surplus Energy				Surplus			
Year of Study	Fiscal Year	Project Use	Firm	Non-firm	Total Cols. 3, 4, & 5	Project Use $	Firm 4.3 Mills After 1978 $	Non-firm 2.4 Mills After 1963 $	Other Electric Revenue $	Total Cols. 7, 8, 9, & 10 $
	1943									
	1944									
1	1945		215,130,507	513,374,934	728,505,441		1,079,574	770,062	68,750	1,918,386
2	1946	2,792,000	800,110,000	647,746,234	1,450,648,234	6,980	2,699,625	971,619	75,000	3,753,224
3	1947	3,672,000	800,722,966	494,009,873	1,298,404,839	9,180	2,704,580	741,015	76,122	3,530,897
4	1948	4,792,000	800,358,993	539,492,257	1,344,643,250	11,980	2,801,732	969,781	75,000	3,858,493
5	1949	9,158,058	1,615,315,483	0	1,624,473,541	27,950	6,492,953	0	791,671	7,312,574
6	1950	9,725,325	1,721,241,245	0	1,730,966,570	26,456	9,314,271	0	(9,574)	9,331,153
7	1951	12,105,066	2,195,025,115	0	2,207,130,181	30,263	10,480,630	0	19,568	10,530,461
8	1952	59,906,166	1,937,419,813	513,803,597	2,511,129,576	149,834	8,283,251	1,461,221	87,986	9,982,292
9	1953	136,461,092	1,407,034,280	655,532,532	2,199,027,904	341,429	6,372,284	2,014,224	97,233	8,825,170
10	1954	212,700,110	1,150,730,787	1,160,673,440	2,524,104,337	532,117	5,932,315	2,833,539	139,221	9,437,192
Prior year adjustments							-7,034	-42,874		-49,908
Subtotal	thru 1954	(451,311,817)	(12,643,089,189)	(4,524,632,867)	(17,619,033,873)	(1,136,189)	(56,154,181)	(9,718,587)	(1,420,977)	(68,429,934)
11	1955	272,000,000	1,350,000,000	628,000,000	2,250,000,000	680,000	6,460,000	1,957,000	397,000	9,494,000
12	1956	283,000,000	1,570,000,000	607,000,000	2,460,000,000	708,000	7,540,000	2,059,000	315,000	10,622,000
13	1957	294,000,000	1,800,000,000	606,000,000	2,700,000,000	735,000	8,550,000	1,999,000	499,000	11,783,000
14	1958	305,000,000	1,880,000,000	525,000,000	2,710,000,000	762,000	8,460,000	1,481,000	501,000	11,204,000
15	1959	325,000,000	1,920,000,000	485,000,000	2,730,000,000	812,000	8,520,000	1,170,000	501,000	11,003,000
16	1960	334,000,000	1,950,000,000	456,000,000	2,740,000,000	835,000	8,540,000	937,000	501,000	10,813,000
17	1961	344,000,000	1,970,000,000	796,000,000	3,110,000,000	860,000	8,550,000	1,612,000	501,000	11,523,000
18	1962	353,000,000	2,040,000,000	1,097,000,000	3,490,000,000	882,000	8,840,000	2,636,000	132,000	12,490,000
19	1963	362,000,000	2,120,000,000	1,008,000,000	3,490,000,000	905,000	9,160,000	2,423,000	132,000	12,620,000
20	1964	369,000,000	2,210,000,000	1,171,000,000	3,750,000,000	922,000	9,530,000	2,810,000	133,000	13,395,000
21	1965	371,000,000	2,670,000,000	719,000,000	3,760,000,000	928,000	12,000,000	1,726,000	133,000	14,787,000
22	1966	372,000,000	2,690,000,000	718,000,000	3,780,000,000	930,000	11,960,000	1,723,000	134,000	14,747,000
23	1967	373,000,000	2,720,000,000	687,000,000	3,780,000,000	932,000	11,980,000	1,649,000	134,000	14,695,000
24	1968	374,000,000	2,690,000,000	726,000,000	3,790,000,000	935,000	11,770,000	1,742,000	135,000	14,582,000
25	1969	374,000,000	2,690,000,000	726,000,000	3,790,000,000	935,000	11,770,000	1,742,000	135,000	14,582,000
26	1970	375,000,000	2,690,000,000	725,000,000	3,790,000,000	938,000	11,770,000	1,740,000	136,000	14,584,000
27	1971	376,000,000	2,650,000,000	764,000,000	3,790,000,000	940,000	11,550,000	1,834,000	136,000	14,460,000
28	1972	377,000,000	2,650,000,000	764,000,000	3,791,000,000	942,000	11,550,000	1,834,000	137,000	14,463,000
29	1973	378,000,000	2,650,000,000	764,000,000	3,792,000,000	945,000	11,550,000	1,834,000	137,000	14,466,000
30	1974	379,000,000	2,600,000,000	814,000,000	3,793,000,000	948,000	11,260,000	1,954,000	138,000	14,300,000
31	1975	380,000,000	2,600,000,000	814,000,000	3,794,000,000	950,000	11,260,000	1,954,000	138,000	14,302,000
32	1976	380,000,000	2,600,000,000	814,000,000	3,794,000,000	950,000	11,260,000	1,954,000	139,000	14,303,000
33	1977	380,000,000	2,560,000,000	854,000,000	3,794,000,000	950,000	11,030,000	2,050,000	139,000	14,169,000
34	1978	380,000,000	2,560,000,000	854,000,000	3,794,000,000	950,000	11,030,000	2,050,000	140,000	14,170,000
35	1979	381,000,000	2,520,000,000	894,000,000	3,795,000,000	952,000	10,840,000	2,148,000	140,000	14,080,000
36	1980									
37	1981									
38	1982									
39	1983									
40	1984									
41	1985									
42	1986									
43	1987									
44	1988									
45	1989									
46	1990									
47	1991									
48	1992									
49	1993									
50	1994									
51	1995									
52	1996									
53	1997									
54	1998									
55	1999									
56	2000									
57	2001									
58	2002									
59	2003									
60	2004									
61	2005									
62	2006									
63	2007									
64	2008									
65	2009									
66	2010									
67	2011									
68	2012									
69	2013	381,000,000	2,520,000,000	894,000,000	3,795,000,000	952,000	10,840,000	2,148,000	140,000	14,080,000
TOTAL		22,296,311,817	156,673,089,189	53,936,632,867	232,906,033,873	55,730,189	681,444,181	129,768,587	11,843,977	878,786,934

12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Operating Revenue Deductions								Income Deductions		Investment Repayment from Power Revenues						
								Repayment of Investment		Plant Expenditures at End of Year						
Purchased Power										Interest Bearing		Interest Free				
Kilowatt-Hours	Cost $	Provisions for Replacement $	All Other Electric Operation & Maintenance Expenses $	Transmission Service $	Total Cols. 13, 14, 15, & 16 $	Prior Year Adjustments $	Net Revenues $	Interest 3% $	Principal $	Total $	Balance to be Repaid $	Total $	Balance to be Repaid $	Earned Surplus Cumulative $	Fiscal Year	Year of Study
										2,215,833	2,215,833				1943	
										13,713,533	13,713,533				1944	
0	0	83,377	274,614		357,991		1,560,395	411,406	1,148,989	15,668,300	14,519,311				1945	1
0	0	83,377	365,434		448,811		3,304,413	435,579	2,868,834	15,984,782	11,966,939				1946	2
0	0	83,377	457,778		541,155		2,989,742	359,008	2,630,734	16,058,233	9,409,676				1947	3
0	0	576,062	679,350		1,255,412		2,603,081	282,290	2,320,791	24,580,701	15,611,353				1948	4
0	0	207,351	657,999		865,350		6,447,224	534,816	5,912,408	34,650,756	19,769,000				1949	5
0	0	70,519	672,276		742,795		8,588,358	593,070	7,995,288	52,749,295	29,872,251				1950	6
0	0	390,200	986,180		1,376,380		9,154,081	896,168	8,257,913	61,686,975	30,552,018				1951	7
0	0	410,000	1,167,235	172,307	1,749,542		8,232,750	916,561	7,316,189	78,491,500	40,040,354				1952	8
0	0	592,400	972,922	260,775	1,826,097		6,999,073	1,201,211	5,797,862	80,812,702	36,563,694				1953	9
0	0	402,000	887,319	322,829	1,612,148	-49,908	7,775,136	1,096,911	6,678,225	85,068,750	34,141,517				1954	10
						49,908									Prior year adjustments	
0	0	(2,898,663)	(7,121,107)	(755,911)	(10,775,681)	0	(57,654,253)	(6,727,020)	(50,927,233)						Subtotal thru 1954	
40,000,000	228,000	429,000	904,574	1,493,000	3,054,574		6,439,426	1,024,246	5,415,180	147,046,000	90,703,587				1955	11
50,000,000	258,000	657,000	1,205,709	1,613,000	3,733,709		6,888,291	2,721,108	4,167,183	148,724,000	88,214,404				1956	12
232,000,000	915,000	675,000	1,286,670	968,000	3,844,670		7,938,330	2,646,432	5,291,898	149,901,000	84,099,506				1957	13
238,000,000	870,000	679,000	1,251,345	976,000	3,776,345		7,427,655	2,522,985	4,904,670	149,901,000	79,194,836				1958	14
254,000,000	910,000	684,000	1,259,490	976,000	3,829,490		7,173,510	2,375,845	4,797,665	150,290,000	74,786,171				1959	15
266,000,000	940,000	710,000	1,284,902	976,000	3,910,902		6,902,098	2,243,585	4,658,513	151,505,000	71,342,658				1960	16
274,000,000	960,000	731,000	1,381,275	976,000	4,048,275		7,474,725	2,140,280	5,334,445	224,037,000	138,540,213				1961	17
292,000,000	830,000	986,000	2,093,000	636,000	4,545,000		7,945,000	4,156,206	3,788,794	224,037,000	134,751,419				1962	18
297,000,000	840,000	986,000	2,093,000	638,000	4,557,000		8,063,000	4,042,543	4,020,457	263,260,000	169,953,962				1963	19
313,000,000	880,000	1,153,000	2,353,000	640,000	5,026,000		8,369,000	5,098,619	3,270,381		166,683,581				1964	20
325,000,000	900,000			640,000	5,046,000		9,741,000	5,000,507	4,740,493		161,943,088				1965	21
336,000,000	930,000			642,000	5,078,000		9,669,000	4,858,293	4,810,707		157,132,381				1966	22
347,000,000	950,000			642,000	5,098,000		9,597,000	4,713,971	4,883,029		152,249,352				1967	23
352,000,000	950,000			644,000	5,100,000		9,482,000	4,567,481	4,914,519		147,334,833				1968	24
352,000,000	950,000			644,000	5,100,000		9,482,000	4,420,045	5,061,955		142,272,878				1969	25
353,000,000	940,000			646,000	5,092,000		9,492,000	4,268,186	5,223,814		137,049,064				1970	26
354,000,000	940,000			646,000	5,092,000		9,368,000	4,111,472	5,256,528		131,792,536				1971	27
355,000,000	940,000			648,000	5,094,000		9,369,000	3,953,776	5,415,224		126,377,312				1972	28
356,000,000	940,000			648,000	5,094,000		9,372,000	3,791,319	5,580,681		120,796,631				1973	29
358,000,000	940,000			651,000	5,097,000		9,203,000	3,623,899	5,579,101		115,217,530				1974	30
359,000,000	940,000			651,000	5,097,000		9,205,000	3,456,526	5,748,474		109,469,056				1975	31
359,000,000	940,000			655,000	5,101,000		9,202,000	3,284,072	5,917,928		103,551,128				1976	32
359,000,000	940,000			655,000	5,101,000		9,068,000	3,106,534	5,961,466		97,589,662				1977	33
359,000,000	940,000			660,000	5,106,000		9,064,000	2,927,690	6,136,310		91,453,352				1978	34
360,000,000	940,000						8,974,000	2,743,601	6,230,399		85,222,953				1979	35
								2,556,689	6,417,311		78,805,642				1980	36
								2,364,169	6,609,831		72,195,811				1981	37
								2,165,874	6,808,126		65,387,685				1982	38
								1,961,631	7,012,369		58,375,316				1983	39
								1,751,259	7,222,741		51,152,575				1984	40
								1,534,577	7,439,423		43,713,152				1985	41
								1,311,395	7,662,605		36,050,547				1986	42
								1,081,516	7,892,484		28,158,063				1987	43
								844,742	8,129,258		20,028,805				1988	44
								600,864	8,373,136		11,655,669				1989	45
								349,670	8,624,330		3,031,339				1990	46
								90,940	8,883,060		0	92,676,100	86,824,379		1991	47
									8,974,000				77,850,379		1992	48
									8,974,000				68,876,379		1993	49
									8,974,000				59,902,379		1994	50
									8,974,000				50,928,379		1995	51
									8,974,000				41,954,379		1996	52
									8,974,000				32,980,379		1997	53
									8,974,000				24,006,379		1998	54
									8,974,000				15,032,379		1999	55
									8,974,000				6,058,379	0	2000	56
									6,058,379				0	2,915,621	2001	57
									0				0	11,889,621	2002	58
														20,863,621	2003	59
														29,837,621	2004	60
														38,811,621	2005	61
														47,785,621	2006	62
														56,759,621	2007	63
														65,733,621	2008	64
														74,707,621	2009	65
														83,681,621	2010	66
														92,655,621	2011	67
														101,629,621	2012	68
360,000,000	940,000	1,153,000	2,353,000	660,000	5,106,000	0	8,974,000	0	0	263,260,000	0	92,676,100	0	110,603,621	2013	69
20,180,000,000	53,671,000	67,085,663	137,531,072	42,819,911	301,107,646	0	577,679,288	111,139,567	355,936,100	263,260,000	0	92,676,100	0	110,603,621	TOTAL	

Notes:

General - 1943-1954 data are historical from Bureau records. 1945 is the first year of record for Shasta Power Plant where actual operation started in June, 1944. Two generators purchased for Shasta were rented to Region 1 for use at Grand Coulee from February 25, 1943, to August 15, 1947. Payment ($719,461) covered in Column 10 for 1949. Annual figures for years before 1954 include adjustments for prior years. For 1954 such adjustments are included only in the subtotals and Column 18.

Column 3 - The energy for project use includes service to the Contra Costa Canal, Delta-Mendota Canal, Folsom construction, the Shasta and Friant areas, and the Sacramento Canals.

Column 4 - The amounts of energy listed under firm include project surplus energy plus support energy purchased when the energy available in any one month is less than the energy required for preference agency firm load. Folsom and Nimbus powerplants commence operation during F. Y. 1955 and Trinity in F. Y. 1962, with an increased dependable surplus capacity as supported by Pacific Gas and Electric Company. The total dependable surplus capacity under conditions of full irrigation development has been estimated at 540,000 kw, and at variable amounts during the development period.

Column 10 - Includes collections from customers for wheeling surcharge, apparatus maintenance and an allocated portion non-operating revenues. Under ultimate conditions Column 10 includes:

Wheeling surcharge (Acct. 644.1)	$135,000
Non-operating income allocated to power operations (Acct. 580, 581)	5,000
TOTAL	$140,000

Columns 12 & 13 - Energy to support firm load is purchased from the Pacific Gas and Electric Company at a rate equal to 1.15 times the average price per kilowatt-hour for the accumulated total of all energy sold to the Company.

Column 14 - Provisions for replacement are computed on a 3 percent sinking fund basis. The provisions for replacement chargeable to power after assumed completion of the system are estimated as follows:

F.P.C. Account Numbers

322	Reservoir and Waterways (allocated portion)	$ 31,000
321-326	Hydroelectric Plant	688,000
342-349	Transmission Plant	375,000
371-379	General Plant (allocated portion)	59,000
	TOTAL	$1,153,000

Column 15 - The annual operation, maintenance, and overhead costs chargeable to power operation after completion of the power system are estimated as follows:

Production Plant

Operation	$ 659,000
Maintenance	554,000
Administration and general	270,000
Subtotal	$1,483,000

Transmission System

Operation	$ 325,000
Maintenance	310,000
Administration and general	135,000
Subtotal	$ 770,000

Other -Non-operating allocated to power	100,000
TOTAL	$2,353,000

Column 16 - The wheeling transmission service expense includes the excess wheeling charge passed on to the customer as the surcharge shown in Column 10 plus the normal charge recouped by the Bureau as part of the energy rate. The wheeling service charges to power after assumed completion of the system are estimated as follows:

Normal Charge (Acct. 753.11)	$525,000
Surcharge (Acct. 753.12)	135,000
TOTAL	$660,000

Column 18 - The adjustments applicable in F. Y. 1954 for prior years are:

Reduction in F. Y. 1953 firm revenues	$ 7,034
Reduction in F. Y. 1952-53 non-firm revenues	42,874
TOTAL	$49,908

These adjustments are made only in Column 18 for F. Y. 1954, but are reflected in the subtotal through 1954 in Column 8 and Column 9.

Column 20 - Interest is calculated at 3% per year on the unamortized interest-bearing investment at end of the previous year (Column 23). The 1949 figure includes $66,475 applicable to 1944.

Column 22 - Estimated cost of authorized features are as shown on the construction Control Schedule dated January 3, 1955:

Shasta Dam and Reservoir		$117,273,182
Keswick Dam and Reservoir		8,949,386
Friant Dam and Reservoir (incl. pipeline $65,000 a/)		21,973,000
Sly Park Dam and Conduits		6,800,000
Trinity Dam and Reservoir		90,399,000
Water Rights (Sacramento and San Joaquin Rivers)		8,902,000
Lewiston Dam and Reservoir		5,525,000
Tower House Diversion Dam		1,182,000
Tracy Pumping Plant and Intake Canal		16,831,000
Delta Fish Protection Facilities		4,500,000
Contra Costa Canal System		7,100,000
Madera Canal		3,365,600
Friant-Kern Canal		60,841,800
Delta Cross Channel		2,568,000
Delta-Mendota Canal		46,625,000
Sacramento Canals Unit		56,772,000
Lewiston-Tower House Tunnel		30,355,000
Tower House-Matheson Tunnel		31,246,000
Shasta Power Plant and Switchyard		23,481,418
Keswick Power Plant and Switchyard		12,179,516
Folsom Power Facilities:		
Nimbus Dam and Reservoir	$ 7,100,000	
Nimbus Power Plant and Switchyard	4,369,000	
Folsom Power Plant and Switchyard	23,691,000	
Folsom-Nimbus Line, 115 and 4 kv	159,000	
Folsom Plans and Studies	95,000	35,414,000
Nimbus Fish Facilities		927,000
Trinity Power Plant and Switchyard		15,033,000

Column 22 (continued)

Tower House Power Plant and Switchyard	$ 10,070,000
Central Valley Waterfowl Conservation	400,000 a/
Matheson Power Plant and Switchyard	9,457,000
Lewiston Power Plant	667,000
Tracy Switchyard	8,738,000
Shasta-Tracy East Side #3 Line, 230 kv	6,137,000
Shasta-Tracy West Side #1 and 2 Lines, 230 kv	11,054,000
Folsom Transmission Facilities, 230 kv	2,202,000
Tracy-Ygnacio Line and Substations	754,000
Trinity Transmission Lines	19,950,000
Preference Customer Metering Facilities	230,000
Central Valley Radio Network	429,000
General Property	11,112,491
Distribution Systems	60,627,713 a/
O & M During Construction	2,091,003 a/
Transfers, Credits, and Other Expenditures	-1,732,673 a/
Project Investigations	1,130,583
Total Expenditure on Control Schedule	$751,560,019
Trinity Recreational Facilities	215,000
Folsom Dam U.S.E.D. Construction	65,400,000
Sacramento Canal Relift Pumping Plants	3,441,400
	$820,616,419
a/ Not included in Repayment Analysis	61,451,043
Total Used in Repayment Analysis	$759,165,376

Column 22 (continued)

Following is the cost allocation and probable repayment of the Central Valley Project features:

Item	Cost Allocation	Probable Repayment
Nonreimbursable		
Navigation	$ 18,472,000	---
Flood Control	52,749,000	---
Fish and Wildlife	6,065,000	---
Recreation	215,000	---
Total Nonreimbursable	77,501,000	
Reimbursable		
Irrigation	405,832,000	$290,083,600
Municipal & Industrial Water	12,572,000	35,644,300 a/
Surplus Power	263,260,000	355,936,100 b/
Total Reimbursable	$681,664,000	$681,664,000
Grand Total	$759,165,000	

a/ Irrigation aid from M&I Water Sales $23,072,300
b/ Irrigation aid from Power Sales (see Col. 24) $92,676,000

Columns 23 and 25 - The principal accruals of Column 21 are first credited to amortization of the interest-bearing investment and next to amortization of the interest-free investment.

Column 26 - Surplus shown as accumulating through the 50th year after the last major features (Trinity Dam, Reservoir, and Power Plant) are placed in service in F. Y. 1963.

Reconcilement of FY '54 financial data

Column 11 - FY '54	
Operating revenue (A/C 501)	$ 9,429,061
Non-operating income allocated to power (A/C 580,581)	8,131
Total for FY '54	$ 9,437,192
Column 14 - Subtotal through FY '54	
Electric plant (Reserve A/C 251.31)	$ 2,742,592
Multipurpose plant (Reserve A/C 251.11)	156,071
Subtotal through FY '54	$ 2,898,663
Column 17 - FY '54	
Operating expenses FY '54 (A/C 502)	$ 1,158,636
Property losses amortized FY '54 (A/C 506)	4,246
Provision for replacement (A/C 503.1)	402,000
Non-operating expenses allocated to power (A/C 580,581)	47,266
Total for FY '54	$ 1,612,148
Column 21 - FY '54	
Net income (A/C 271.11)	$ 6,767,268
Adjustment of prior year income (A/C 271.11)	(49,908)
Allocated share of non-operating	
(a) Income (A/C 271.14)	8,131
(b) Expense (A/C 271.14)	(47,266)
Total for FY '54	$ 6,678,225
Excess income over expense (A/C 271.11)	$50,996,567
Allocated share of non-operating	
(a) Income (A/C 271.14)	12,793
(b) Expense (A/C 271.14)	(82,127)
Subtotal through FY '54	$50,927,233
Column 22 - Interest bearing plant-in-service, FY '54	
Electric plant in service	$65,414,950
Multipurpose plant allocated to power	32,297,671
Allocated to Project Use	(12,643,871)
Total Electric and Multipurpose plant FY '54 (Pg. 62 F.P.C. Form No. 1 Report)	$85,068,750

Prepared by E.J.T. G.R.E. Date April 29, 1955

Historical financial data certified correct.

DJH

Regional Control and Finance Officer

Recommended: actg. Regional Project Development Engineer

Approved: Regional Director

LAND-302

Table 16
MUNICIPAL AND INDUSTRIAL WATER SERVICE REPAYMENT ANALYSIS
CENTRAL VALLEY PROJECT - CALIFORNIA

Year of study (a)	Fiscal year	Water deliveries: Contra Costa canal	Water deliveries: Shasta dam area	Water deliveries: Sly Park unit	Water deliveries: Folsom service area	Water deliveries: Total	Operating revenues: Contra Costa canal ($10 a.f. after 1948)	Operating revenues: Shasta dam area ($20 a.f.)	Operating revenues: Sly Park unit ($17.50 a.f.) (b)	Operating revenues: Folsom service area ($8.00 a.f.) (c)	Operating revenues: City of Vallejo (d)	Operating revenues: Misc.	Operating revenues: Total	Operating revenue deductions: O & M expenses	Operating revenue deductions: Replacement reserve	Operating revenue deductions: Pumping energy	Operating revenue deductions: Total	Net Operating revenue	2½% Interest on investment	Net revenue	Investment repayment from M&I revenues: M & I Cumulative investment (e)	Investment repayment from M&I revenues: M & I Balance to be repaid	Investment repayment from M&I revenues: Irrigation Investment (f)	Investment repayment from M&I revenues: Irrigation Balance to be repaid	Fiscal year	Year of Study (a)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
				Acre-feet					Thousand dollars						Thousand dollars						Thousand dollars					
	1941	2,444				2,444	10,356						10,356												1941	1
	42	4,688				4,688	12,251						12.251												42	
	43	5,013				5,013	13,692						13.692												43	
	44	9,286				9,286	19,716						19.716												44	
	45	10,167				10,167	21,787						21.787												45	
	1946	10,818				10,818	40,563						40.563												1946	
	47	14,197				14,197	53,257						53.237												47	
	48	15,135				15,135	123,539						123.539								5,569.3	5,569.5			48	
1	49	15,170	324			15,494	152,741	6.491					159.232	404.024		11.639	415.663(g)	38.510(h)	139.2	-100.7	6,292.7	6,393.4			49	1
2	50	18,509	340			18,849	185,090	6.806				3.304	195.200	135.498	13.100	17.105	165.703	29.497	159.8	-130.3	6,734.7	6,965.7			50	2
3	1951	19,939	429			20,368	199.387	6.578				.706	208.671	148.527	9.200	14.900	172.627	36.044	174.1	-138.0	7,178.2	7,547.2			1951	3
4	52	21,781	464			22,245	217.807	9.273				2.786	229.866	178.784	9.800	14.796	203.380	26.486	188.7	-162.2	7,579.1	8,110.3			52	4
5	53	24,532	491			25,023	245.316	9.825				1.285	256.426	148.996	9.800	17.307	176.103	80.323	202.8	-122.5	8,356.8	7,010.5			53	5
6	54	27,184	616			27,800	271.143	12.311				222.899	506.353	166.712	14.300	20.887	201.899	304.454	175.3	129.1	9,527.0	10,051.6			54	6
Total through(i)	1954	198,863	2,664			201,527	1,566.625	53.284				230.980	1,650.889	1,182.541	56.200	96.834	1,335.575	515.314	1,039.9	-524.6	9,527.0	10,051.6			1954	Total through (i)
7	1955	30,000	650			30,650	300.000	13.000				10.000	323.000	165.700	13.400	19.0	198.100	124.900	251.3	-126.4	8,392.0	9,043.0			1955	7
8	1956	33,000	700	400		34,100	330.000	14.000	4.000		15.000		373.000	165.700	13.400	21.0	200.100	172.900	226.1	- 53.2	8,464.0	9,168.2			1956	8
9	57	36,000	750	800		37,550	360.000	15.000	8.000		22.500		415.500	165.700	13.400	23.0	202.100	213,400	229.2	- 15.8	8,771.0	9,491.0			57	9
10	58	39,000	800	900		40,700	390.000	16.000	13.800		30.000		459.500	165.700	13.400	25.0	204.100	255,400	237.3	18.1	8,787.0	9,488.9			58	10
11	59	42,000	850	1,000		43,850	420.000	17.000	15.000		35.000		497.000	165.700	13.400	26.0	205.100	291,900	237.2	54.7	9,958.0	10,605.2			59	11
12	60	45,000	900	1,100	2,600	49,600	450.000	18.000	18.500	20.800	45.000		560.300	167.200	14.300	28.0	209.500	350.800	265.1	85.7	10,397.0	10,958.5			60	12
13	1961	47,000	950	1,300	5,200	54,450	470.000	19.000	22.800	41.600	55.000		618.400			30.0	211.500	406.900	274.0	132.9	11,281.0	11,709.6			1961	13
14	62	49,000	950	1,400	7,600	58,950	490.000	19.000	24.500	60.800	62.500		666.600			31.0	212.500	454.300	292.7	161.6	11,300.0	11,567.0			62	14
15	63	51,000	950	1,600	10,000	63,550	510.000	19.000	28.000	80.000	65.000		712.000			32.0	213.500	498.500	289.2	209.3	12,306.0	12,365.7			63	15
16	64	52,000	1,000	1,700	12,200	66,900	520.000	20.000	29.800	97.600			742.400			33.0	214.500	527.900	309.1	218.8	12,308.0	12,146.9			64	16
17	65	52,000	1,000	1,800	14,400	69,200	520.000	20.000	31.500	115.200			761.700			33.0	214.500	547.200	303.7	243.5	12,308.0	11,903.4			65	17
18	1966	52,000	1,000	2,000	16,500	71,500	520.000	20.000	35.000	132.000			782.000			33.0	214.500	567.500	297.6	269.9	12,306.0	11,633.5			1966	18
19	67	53,000	1,000	2,100	18,500	74,600	530.000	20.000	36.800	148.000			809.800			34.0	215.500	594.300	290.8	303.5	12,308.0	11,330.0			67	19
20	68	53,000	1,000	2,300	20,400	76,700	530.000	20.000	40.200	163.200			828.400			34.0	215.500	612.900	283.3	329.6	12,308.0	11,000.4			68	20
21	69	54,000	1,100	2,400	22,200	79,700	540.000	22.000	42.000	177.600			856.600			34.0	215.500	641.100	275.0	366.1	12,572.0	10,896.3			69	21
22	70	55,000	1,100	2,500	24,000	82,600	550.000	22.000	43.800	192.000			882.800			35.0	216.500	666.500	272.5	393.8		10,504.5			70	22
23	1971	55,000	1,100		25,600	84,200	550.000	22.000		204.800			895.600			35.0	216.500	679.100	262.6	416.5		10,088.0			1971	23
24	72	56,000	1,100		27,200	86,800	560.000	22.000		217.600			918.400			35.0	216.500	701.900	252.2	449.7		9,636.3			72	24
25	73	56,000	1,200		28,800	88,300	560.000	24.000		228.800			931.600			36.0	217.500	714.100	241.0	473.1		9,165.2			73	25
26	74	57,000	1,200		30,000	90,700	570.000	24.000		240.000			952.300			36.0	217.500	735.300	229.1	506.2		8,659.0			74	26
27	75	57,000	1,200		31,300	92,000	570.000	24.000		250.400			963.200			36.0	217.500	745.700	216.5	529.2		8,129.8			75	27
28	1976	57,000	1,200		32,500	93,200	570.000	24.000		260.000			972.800			36.0	217.500	755.300	203.2	552.1		7,577.7			1976	28
29	77	58,000	1,200		33,600	95,300	580.000	24.000		268.800			991.600			37.0	218.500	773.100	189.4	583.7		6,994.0			77	29
30	78	58,000	1,200		34,600	96,300	580.000	24.000		276.800			999.600			37.0	218.500	781.100	174.8	606.3		6,387.7			78	30
31	79	59,000	1,200		35,500	98,200	590.000	24.000		284.000			1,016.800			38.0	219.500	797.300	159.7	637.6		5,750.1			79	31
32	80	59,000	1,300		36,400	99,200	590.000	26.000		291.200			1,026.000			38.0	219.500	806.500	143.7	662.8		5,087.3			80	32
33	1981	60,000	1,300		37,200	101,000	600.000	26.000		297.600			1,042.400			38.0	219.500	822.900	127.2	695.7		4,391.6			1981	33
34	82	60,000	1,300		37,800	101,600	600.000	26.000		302.400			1,047.200			38.0	219.500	827.700	109.8	717.9		3,673.7			82	34
35	83	61,000	1,300		38,400	103,200	610.000	26.000		307.200			1,062.000			38.0	219.500	842.500	91.8	750.7		2,923.0			83	35
36	84	61,000	1,300		38,900	103,700	610.000	26.000		311.200			1,066.000			38.0	219.500	846.500	73.1	773.4		2,149.6			84	36
37	85	61,000	1,300		39,300	104,100	610.000	26.000		314.400			1,069.200			38.0	219.500	849.700	53.7	796.0		1,353.6			85	37
38	1986	62,000	1,400		39,500	105,500	620.000	28.000		316.800			1,083.600			40.0	221.500	862.100	33.8	828.3		525.3			1986	38
39	87	62,000			39,800	105,700	620.000			318.400			1,085.200			40.0	221.500	863.700	13.1	850.6		0.0	23,072.3	22,747.0	87	39
40	88	62,000			39,900	105,800	620.000			319.200			1,086.000			40.0	221.500	864.500	0.0	864.5				21,882.5	88	40
41	89	63,000			40,000	106,900	630,000			320.000			1,096.800			40.0	221.500	875.300		875.3				21,007.2	89	41
42	90																							20,131.9	90	42
43	1991																							19,256.6	1991	43
44	92																							18,381.3	92	44
45	93																							17,506.0	93	45
46	94																							16,630.7	94	46
47	95																							15,755.4	95	47
48	1996																							14,880.1	1996	48
49	97																							14,004.8	97	49
50	98																							13,129.5	98	50
51	99																							12,254.2	99	51
52	2000																							11,378.9	2000	52
53	01																							10,503.6	2001	53
54	02																							9,628.3	02	54
55	03																							8,753.0	03	55
56	04																							7,877.7	04	56
57	05																							7,002.4	05	57
58	2006																							6,127.1	2006	58
59	07																							5,251.8	07	59
60	08																							4,376.5	08	60
61	09																							3,501.2	09	61
62	10																							2,625.9	10	62
63	2011																							1,750.6	2011	63
64	12																							875.3	12	64
65	2013	63,000	1,400	2,500	40,000	106,900	630.000	28.000	43.800	320.000	65.000	10.000	1,096.800	167.200	14.300	40.0	221.500	875.300	0.0	875.3	12,572.0	0.0	23,072.3	0.0	13	65
Totals		3,577,863	74,964	130,800	1,779,800	5,563,427	35,356.625	1,499.284	2,274.800	14,238.400	3,580.000	820.980	57,770.089	11,039.841	895.400	2,241.834	14,177.075	43,593.014	7,946.7	35,644.3	12,572.0	0.0	23,072.3	0.0		Totals

(a) The initial year of study is the first year an operation and maintenance appropriation was received.

(b) Ten dollars per acre-foot for F.Y. 1956 and 1957, $15 per acre-foot for F.Y. 1958 to 1960, and $17.50 per acre-foot thereafter. These rates were established on the assumption that the El Dorado Irrigation District will operate and maintain works.

(c) The $8.00 per acre-foot reflects a nominal value to Folsom municipal and industrial water storage facilities.

(d) Contract negotiations with the City of Vallejo for water from Cache Slough contemplate for annual lump sum payment rather than a per acre-foot charge.

(e) Cumulative estimated investment (capital costs) of the M&I plant in service at end of fiscal year.

(f) That portion of the irrigation investment to be repaid by municipal water users is the net revenue accruing after retirement of the M&I investment.

(g) Total operating revenue deductions prior to F.Y. 1949 charged in F.Y. 1949. The total shown consists of $323,581 for O&M during construction and $92,282 for appropriated O&M. For F.Y. 1950 the costs consist of $17,253 for O&M during construction and $148,450 for appropriated O&M.

(h) Cumulated annual operating revenues accrued during F.Y. 1941-1949 less cumulated operating revenue deductions for the same period.

(i) Historical data are from Control and Finance and O&M records.

Prepared By: D. E. Flipse
Checked By: L. J. Bishop
April 29, 1955

Table 17

REPAYMENT ANALYSIS
CENTRAL VALLEY PROJECT - CALIFORNIA
(Including San Luis Unit)

Thousands of Dollars

Year of study (fiscal)	Power: Net operating revenue	Power: Components of net power revenues: Interest on investment	Power: Components of net power revenues: Excess over interest	Power: Investment repayment from power revenues: Interest bearing: Electric plant in service	Power: Investment repayment from power revenues: Interest bearing: Balance to be repaid	Power: Investment repayment from power revenues: Interest free: Revenues credited to irrigation repayment	Power: Earned surplus (cumulative)	Municipal water service: Net operating revenue	Municipal water service: Components of net municipal revenues: Interest on investment	Municipal water service: Components of net municipal revenues: Excess over interest	Municipal water service: Investment repayment from municipal revenues: Interest bearing: Municipal plant in service	Municipal water service: Investment repayment from municipal revenues: Interest bearing: Balance to be repaid	Municipal water service: Investment repayment from municipal revenues: Interest free: Revenues credited to irrigation repayment	Irrigation water service: Net operating revenue	Irrigation water service: Total (a) revenues credited to irrigation repayment	Irrigation water service: Investment repayment: Irrigation plant in service	Irrigation water service: Investment repayment: Balance to be repaid	Recapitulation: Net operating revenue	Recapitulation: Components of net revenues: Interest on Investment	Recapitulation: Components of net revenues: Net revenue	Recapitulation: Investment repayment: Plant in service	Recapitulation: Investment repayment: Balance to be repaid	Recapitulation: Earned surplus (cumulative)	Year of study (fiscal)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1941																								1941
42																								42
43				2,215.8	2,215.8																2,215.8	2,215.8		43
44				13,713.5	13,713.5																13,713.5	13,713.5		44
45	1,560.4	411.4	1,149.0	15,668.3	14,519.3													1,560.4	411.4	1,149.0	15,668.3	14,519.3		45
1946	3,304.4	435.6	2,868.8	15,984.8	11,966.9													3,304.4	435.6	2,868.8	15,984.8	11,966.9		1946
47	2,989.7	359.0	2,630.7	16,058.2	9,409.7													2,989.7	359.0	2,630.7	16,058.2	9,409.7		47
48	2,603.1	282.3	2,320.8	24,580.7	15,611.4						5,569.3	5,569.3				22,662.2	22,662.2	2,603.1	282.3	2,320.8	52,812.2	43,842.9		48
49	6,447.2	534.8	5,912.4	34,650.8	19,769.0			38.5	159.2	-100.7	6,292.7	6,393.4		-45.5	-45.5	24,245.4	24,290.9	6,440.2	674.0	5,766.2	65,188.9	50,453.3		49
50	8,588.4	593.1	7,995.3	52,749.3	29,872.3			29.5	159.8	-130.3	6,734.7	6,965.7		-21.9	-21.9	125,017.5	125,084.9	8,596.0	752.9	7,843.1	184,501.5	161,922.9		50
1951	9,154.1	896.2	8,257.9	61,687.0	30,552.1			36.0	174.1	-138.0	7,178.2	7,547.2		-618.3	-618.3	151,672.6	152,358.3	8,571.8	1,070.3	7,501.6	220,537.8	190,457.6		1951
52	8,232.7	916.5	7,316.2	78,491.5	40,040.4			26.5	188.7	-162.2	7,579.1	8,110.3		-606.0	-606.0	189,320.1	190,613.8	7,651.2	1,105.2	6,546.0	275,390.7	238,764.5		52
53	6,999.1	1,201.2	5,797.9	80,812.7	36,563.7			80.3	202.8	-122.5	6,356.8	7,010.5		908.1	908.1	194,395.7	194,781.3	7,987.8	1,404.0	6,583.5	281,565.2	238,355.5		53
54	7,776.1	1,096.9	6,678.2	85,068.7	34,141.5			304.5	175.3	129.1	9,527.0	10,051.6		567.1	567.1	217,135.2	216,953.7	8,646.7	1,272.2	7,374.4	311,730.9	261,146.8		54
Total through 1954	57,654.2	6,727.0	50,927.2	85,068.7	34,141.5			515.3	1,039.9	-524.6	9,527.0	10,051.6		181.5	181.5	217,135.2	216,953.7	58,351.0	7,766.9	50,584.1	311,730.9	261,146.8		Total through 1954
1955	6,439.4	1,024.2	5,415.2	106,334.0	49,991.6			124.9	251.3	-126.4	7,178.0	7,829.0		952.1	952.1	308,826.0	307,392.4	7,516.4	1,275.5	6,240.9	422,038.0	365,212.0		1955
56	6,888.3	1,499.7	5,388.6	107,548.0	45,817.0			172.9	195.7	-22.8	7,247.0	7,920.8		1,383.1	1,383.1	311,126.0	308,608.3	8,444.3	1,695.4	6,748.9	425,920.0	362,346.1		56
57	7,938.4	1,374.5	6,563.9	108,398.0	40,103.1			213.4	198.0	15.4	7,517.0	8,175.4		2,812.8	2,812.8	319,082.0	312,752.5	10,964.6	1,572.5	9,392.1	434,997.0	362,031.0		57
58	7,427.7	1,203.1	6,224.6	108,398.0	33,878.5			255.4	204.4	51.0	7,526.0	8,133.4		3,098.3	3,098.3	319,450.0	311,022.2	10,781.4	1,407.5	9,373.9	455,374.0	353,084.1		58
59	7,173.5	1,016.4	6,157.1	108,680.0	28,003.4			291.9	203.3	88.6	8,526.0	9,044.8		3,262.2	3,262.2	347,951.0	336,261.0	10,727.6	1,219.7	9,507.9	465,157.0	373,309.2		59
60	6,902.1	840.1	6,062.0	109,559.0	22,820.4			350.8	226.1	124.7	8,910.0	9,304.1		3,129.8	3,129.8	358,929.0	344,109.2	10,382.7	1,066.2	9,316.5	477,398.0	376,233.7		60
1961	7,474.7	684.6	6,790.1	162,012.0	68,483.3			406.9	232.6	174.3	10,082.0	10,301.8		3,506.5	3,506.5	413,131.0	394,804.7	11,388.1	917.2	10,470.9	585,225.0	473,589.8		1961
62	7,945.0	2,054.5	5,890.5	162,012.0	62,592.8			454.3	257.5	196.8	10,098.0	10,121.0		3,777.3	3,777.3	413,590.0	391,486.4	12,176.6	2,312.0	9,864.6	585,700.0	464,200.2		62
63	8,063.0	1,877.8	6,185.2	190,374.0	84,769.6			498.5	253.0	245.5	10,808.0	10,585.5		4,033.1	4,033.1	473,860.0	447,723.3	12,594.6	2,130.8	10,463.8	675,042.0	543,078.4		63
64	8,368.0	2,543.1	5,824.9	195,956.0	84,526.7			527.9	264.6	263.3	17,454.0	16,968.2		4,187.1	4,187.1	663,243.0	632,919.2	13,063.0	2,807.7	10,275.3	876,653.0	734,414.1		64
65	8,913.0	2,535.8	6,377.2		78,149.5			680.0	424.2	255.8	17,962.0	17,220.4		3,968.3	3,968.3	677,700.0	643,407.9	13,561.3	2,960.0	10,601.3	891,618.0	738,777.8		65
1966	8,869.0	2,344.5	6,524.5		71,625.0			703.8	430.5	273.3	18,252.0	17,237.1		4,651.1	4,651.1	685,922.0	646,978.8	14,223.9	2,775.0	11,448.9	900,130.0	735,840.9		1966
67	8,897.0	2,148.8	6,748.2		64,876.8			735.1	430.9	304.2	18,387.0	17,067.9		5,293.8	5,293.8	689,752.0	646,515.0	14,925.9	2,579.7	12,346.2	904,095.0	727,459.7		67
68	8,300.0	1,946.3	6,353.7		58,523.1			758.2	426.7	331.5	18,387.0	16,736.4		5,932.6	5,932.6	689,752.0	639,582.4	14,990.8	2,373.0	12,617.8	904,095.0	714,841.9		68
69	8,299.0	1,755.7	6,543.3		51,979.8			790.4	418.4	372.0	18,612.0	16,589.4		6,557.2	6,557.2	696,149.0	639,422.2	15,646.6	2,174.1	13,472.5	910,717.0	707,991.4		69
70	8,302.0	1,559.4	6,742.6		45,237.2			820.1	414.7	405.4		16,184.0		7,141.3	7,141.3		632,280.9	16,263.4	1,974.1	14,289.3		693,702.1		70
1971	7,815.0	1,357.1	6,457.9		38,779.3			835.4	404.6	430.8		15,753.2		7,796.8	7,796.8		624,484.1	16,447.2	1,761.7	14,685.5		679,016.6		1971
72	7,811.0	1,163.4	6,647.6		32,131.7			862.7	393.8	468.9		15,284.3		8,427.3	8,427.3		616,056.8	17,101.0	1,557.2	15,543.8		663,472.8		72
73	7,832.0	964.0	6,868.0		25,263.7			879.4	382.1	497.3		14,787.0		9,040.3	9,040.3		607,016.5	17,751.7	1,346.1	16,405.6		647,067.2		73
74	7,465.0	757.9	6,707.1		18,556.8			904.1	369.7	534.4		14,252.6		9,628.3	9,628.3		597,388.2	17,997.4	1,127.6	16,869.8		630,197.4		74
75	7,465.0	556.7	6,908.3		11,648.3			919.0	356.3	562.7		13,689.9		9,678.6	9,678.6		587,709.6	18,062.6	913.0	17,149.6		613,047.8		75
1976	7,486.0	349.4	7,136.6		4,511.7			932.1	342.2	589.9		13,100.0		9,722.8	9,722.8		577,986.8	18,140.9	691.6	17,449.3		595,598.5		1976
77	7,406.0	135.4	7,270.6		0.0	2758.9		954.4	327.5	626.9		12,473.1		9,757.2	12,516.1		565,470.7	18,117.6	462.9	17,654.7		577,943.6		77
78	7,406.0	0.0	7,406.0			7,406.0		965.9	311.8	654.1		11,819.0		9,786.6	17,192.6		548,278.1	18,158.5	311.8	17,846.7		560,097.1		78
79	7,364.0		7,364.0			7,364.0		986.6	295.5	691.1		11,127.9		9,807.6	17,171.6		531,106.5	18,158.2	295.5	17,862.7		542,234.4		79
80								999.3	278.2	721.1		10,406.8		9,829.1	17,193.1		513,915.4	18,192.4	278.2	17,914.2		524,320.2		80
1981								1,019.2	260.2	759.0		9,647.8		9,846.1	17,210.1		496,703.3	18,229.3	260.2	17,969.1		506,351.1		1981
82								1,029.0	241.2	787.8		8,860.0		9,865.1	17,229.1		479,474.2	18,258.1	241.2	18,016.9		488,334.2		82
83								1,047.3	221.5	825.8		8,034.2		9,876.1	17,240.1		462,234.1	18,287.4	221.5	18,065.9		470,268.3		83
84								1,054.8	200.9	853.9		7,180.3		9,885.6	17,249.6		444,984.5	18,304.4	200.9	18,103.5		452,164.8		84
85								1,061.5	179.5	882.0		6,298.3		9,892.6	17,256.6		427,727.9	18,318.1	179.5	18,138.6		434,026.2		85
1986								1,060.4	157.5	922.9		5,375.4		9,893.6	17,257.6		410,470.3	18,338.0	157.5	18,180.5		415,845.7		1986
87								1,084.5	134.4	950.1		4,425.3		9,898.6	17,262.6		393,207.7	18,347.1	134.4	18,212.7		397,633.0		87
88								1,089.8	110.6	979.2		3,446.1		9,900.1	17,264.1		375,943.6	18,353.9	110.6	18,243.3		379,389.7		88
89								1,103.1	86.2	1,016.9		2,429.2		9,897.1	17,261.1		358,682.5	18,364.2	86.2	18,278.0		361,111.7		89
90								1,107.6	60.7	1,046.9		1,382.3			17,261.1		341,421.4	18,368.7	60.7	18,308.0		342,803.7		90
1991								1,112.1	34.6	1,077.5		304.8			17,261.1		324,160.3	18,373.2	34.6	18,338.6		324,465.1		1991
92								1,114.6	7.6	1,107.0		0.0	802.2		18,063.3		360,097.0	18,375.7	7.6	18,368.1		306,097.0		92
93								1,119.1	0.0	1,119.1			1,119.1		18,380.2		287,716.8	18,380.2	0.0	18,380.2		287,716.8		93
94								1,125.1		1,125.1			1,125.1		18,386.2		269,330.6	18,386.2		18,386.2		269,330.6		94
95								1,129.6		1,129.6			1,129.6		18,390.7		250,939.9	18,390.7		18,390.7		250,939.9		95
1996								1,131.1		1,131.1			1,131.1		18,392.2		232,547.7	18,392.2		18,392.2		232,547.7		1996
97								1,135.6		1,135.6			1,135.6		18,396.7		214,151.0	18,396.7		18,396.7		214,151.0		97
98								1,140.1		1,140.1			1,140.1		18,401.2		195,749.8	18,401.2		18,401.2		195,749.8		98
99								1,144.6		1,144.6			1,144.6		18,405.7		177,344.1	18,405.7		18,405.7		177,344.1		99
2000						7,364.0		1,147.1		1,147.1			1,147.1		18,408.2		158,935.9	18,408.2		18,408.2		158,935.9		2000
2001						4,317.1	3,046.9								15,361.3		143,574.6					143,574.6	3,046.9	2001
02						0.0	10,410.9								11,044.2		132,530.4					132,530.4	10,410.9	02
03							17,774.9										121,486.2					121,486.2	17,774.9	03
04							25,138.9										110,442.0					110,442.0	25,138.9	04
05							32,502.9										99,397.8					99,397.8	32,502.9	05
2006							39,866.9										88,353.6					88,353.6	39,866.9	2006
07							47,230.9										77,309.4					77,309.4	47,230.9	07
08							54,594.9										66,265.2					66,265.2	54,594.9	08
09							61,958.9										55,221.0					55,221.0	61,959.9	09
10							69,322.9										44,176.8					44,176.8	69,322.9	10
2011							76,686.9										33,132.6					33,132.6	76,686.9	2011
12							84,059.9										22,088.4					22,088.4	84,050.9	12
13							91,414.9										11,044.2					11,044.2	91,414.9	13
2014	7,364.0	0.0	7,364.0	195,956.0	0.0	0.0	98,778.9	1,147.1	0.0	1,147.1	18,612.0	0.0	1,147.1	9,897.1	11,044.2	696,149.0	0.0	18,408.2	0.0	18,408.2	910,717.0	0.0	98,778.9	2014
Total	509,644.3	38,419.4	471,224.9	195,956.0	0.0	176,490.0	98,778.9	55,574.3	11,028.4	44,545.9	18,612.0	0.0	25,933.9	493,725.1	696,149.0	696,149.0	0.0	1,058,943.7	49,447.8	1,009,495.9	910,717.0	0.0	98,778.9	Total

(a) Includes aid from power and municipal water service as well as irrigation net operating revenues.

SUMMARY

	Cost Allocation	Probable Repayment (through F.Y. 2014)
Storage, Conveyance, and Power Facilities		
Reimbursable		
Irrigation	$696,149,000	$493,725,100
M & I Water Service	18,612,000	44,545,900 (a)
Power	195,956,000	372,446,000 (b)
Subtotal	$910,717,000	$910,717,000
Non-reimbursable		
Flood Control, Navigation, Fish and Wildlife, and Recreation	$ 77,591,000	--
Total	$988,308,000	$910,717,000
Interest on Investment		$ 49,447,800 (c)
Earned Surplus		$ 98,778,900

(a) Includes $25,933,900 aid toward irrigation repayment.

(b) Includes $176,490,000 aid toward irrigation repayment.

(c) Includes $38,419,400 on power investment and $11,028,400 on M & I investment.

Prepared by: D.E. Flipse
Checked by: L.J. Bishop
April 29, 1955

805-208-45

GPO 969085

Table 18

IRRIGATION WATER SERVICE REPAYMENT ANALYSIS
CENTRAL VALLEY PROJECT – CALIFORNIA
(Including San Luis Unit)

Water deliveries — Acre Feet

Year of study (a) (1)	Fiscal year (2)	San Joaquin River (b) (3)	Sacramento Canals unit (4)	Contra Costa Canals (5)	Delta-Mendota Canal (6)	Friant-Kern Canal Class 1 (7)	Friant-Kern Canal Class 2 (8)	Madera Canal Class 1 (9)	Madera Canal Class 2 (10)	Sly Park (11)	Folsom Service area (12)	San Luis unit (13)	Total (14)
	1941			20									20
	42	380(i)		95									475
	43	750(i)		222									972
	44	120,570(i)		560					46,525				167,655
	45	126,700(i)		757					133,121				260,578
	1946	177,232(i)		667					106,880				284,779
	47	133,916(i)		613					74,781				209,310
	48	38,571(j)		2,423					20,082				61,076
1	49	211,068		3,470					92,803				307,341
2	50	163,593		4,957			138,047		140,898				447,495
3	1951	97,742		4,604	1,632		207,533		121,765				433,276
4	52	43,314		5,087	31,813	65,611	269,292	13,678	129,899				549,094
5	53	23,300		3,908	109,673	188,533	459,719	49,025	145,149				979,307
6	54	23,800		6,106	196,303	300,464	442,436	53,860	160,881				1,183,540
Total (m) through	1954	1,160,836		33,469	339,421	554,808	1,307,027	116,553	1,172,764				4,884,916
7	1955	31,500		12,000	245,000	325,000	470,000	60,000	210,000				1,353,500
8	1956	35,000		15,000	270,000	340,000	510,000	65,000	310,000	3,700			1,568,700
9	57			18,000	290,000	400,000	570,000	110,000	300,000	5,400			1,728,400
10	58		20,500	21,000	310,000	475,000	540,000	140,000	263,000	6,400			1,810,900
11	59		38,900	24,000	330,000	515,000	515,000	140,000	248,000	7,300			1,853,200
12	60		111,200	27,000	350,000	550,000	490,000	140,000	238,000	8,200	43,000		1,992,400
13	1961		177,500	30,000	375,000	575,000	475,000	140,000	228,000	9,100	85,000		2,129,600
14	62		237,500	32,000	395,000	597,000	467,000	139,000	215,000	10,100	121,000		2,248,900
15	63		292,000	34,000	415,000	599,000		137,000		11,000	164,000		2,359,000
16	64		340,500	35,000	437,000					12,000	187,000		2,464,500
17	65		362,500	35,000	338,300(n)					13,000	217,000	275,600	2,714,400
18	1966		418,600	35,000						13,900	241,000	367,500	2,867,500
19	67		448,700	34,000						14,900	284,000	459,300	3,012,200
20	68		473,800	34,000						15,800	284,000	551,200	3,150,800
21	69		496,200	33,000						16,700	304,000	643,100	3,283,300
22	70		525,500	32,000						17,500	339,000	734,900	3,446,200
23	1971		550,700	32,000							371,000	826,800	3,589,300
24	72		570,600	31,000							401,000	918,700	3,730,100
25	73		585,500	31,000							427,000	1,010,500	3,862,600
26	74		594,700	30,000							452,000	1,102,400	3,987,900
27	75		600,500	30,000							475,000		4,017,000
28	1976		605,600	30,000							497,000		4,043,600
29	77		609,000	29,000							516,000		4,065,200
30	78		611,000	29,000							534,000		4,085,200
31	79		611,700	25,000							549,000		4,099,900
32	80			26,000							564,000		4,114,900
33	1981			27,000							577,000		4,126,900
34	82			27,000							589,000		4,136,900
35	83			26,000							598,000		4,148,900
36	84			26,000							605,000		4,155,900
37	85			26,000							609,000		4,157,900
38	1986			25,000							612,000		4,159,900
39	87			25,000							614,000		4,161,900
40	88			25,000							615,000		4,162,900
41	89			24,000							616,000		4,162,900
42	90												
43	1991												
44	92												
45	93												
46	94												
47	95												
48	1996												
49	97												
50	98												
51	99												
52	2000												
53	2001												
54	02												
55	03												
56	04												
57	05												
58	2006												
59	07												
60	08												
61	09												
62	10												
63	2011												
64	12												
65	13												
66	2014	35,000	611,700	24,000	338,300	599,000	467,000	137,000	215,000	17,500	616,000	1,102,400	4,162,900
Totals		3,287,336	30,711,500	1,613,489	20,671,421	35,479,808	29,828,027	8,194,553	14,364,784	935,000	27,860,000	50,986,000	225,901,918

Operating Revenues — Thousand Dollars

Year of study (a) (1)	Fiscal year (2)	San Joaquin River ($1.50 a.f. after 1948) (b) (15)	Sacramento River (c) (16)	Sacramento Canals unit ($2.75 a.f.) (17)	Contra Costa Canal ($3.50 a.f. after 1948) (18)	Delta-Mendota Canal ($3.50 a.f.) (19)	Friant-Kern Canal Class 1 ($3.50 a.f.) (20)	Friant-Kern Canal Class 2 ($1.50 a.f.) (21)	Madera Canal Class 1 ($3.50 a.f.) (22)	Madera Canal Class 2 ($1.50 a.f.) (23)	Sly Park ($2.50 a.f.) (d) (24)	Folsom Service area (e) ($1.50 a.f.) (25)	San Luis unit ($7.50 a.f.) (26)	Misc. (27)	Total (28)
	1941				.144										.144
	42	.570			.249										.819
	43	.600			.606									2.100	3.306
	44	69.443			1.189					12.800				2.425	85.857
	45	79.480			1.622					45.000				1.369	127.471
	1946	106.385			2.045					55.459				4.343	168.232
	47	114.420			2.300					49.467				5.176	171.363
	48	57.772			6.480					30.125				6.327	102.702
1	49	318.309			12.143					139.242				4.524	474.218
2	50	245.391			17.350			207.556		211.347				16.480	698.124
3	1951	123.523			16.116	5.712		311.972		182.647				17.936	657.906
4	52	65.271			17.804	111.345	230.339	369.366	47.873	194.848				27.260	1,084.106
5	53	35.550			13.679	363.857	659.866	669.578	171.568	217.723				37.746	2,209.567
6	54	35.250			21.371	687.061	1,051.624	663.654	188.475	241.322				27.635	2,916.392
Total (m) through	1954	1,251.964			115.100	1,187.975	1,941.829	2,262.128	407.936	1,379.968				153.321	8,700.221
7	1955	47.200			42.000	857.500	1,137.500	705.000	210.000	315.000				10.000	3,324.200
8	1956	52.500			52.500	945.000	1,190.000	765.000	297.500	465.000	3.700				3,761.200
9	57		1,000.000		65.000	1,015.000	1,400.000	855.000	385.000	450.000	5.400				5,235.900
10	58			56.400	73.500	1,085.000	1,662.500	810.000	490.000	394.500	12.800				5,647.200
11	59			107.000	84.000	1,155.000	1,802.500	772.500	490.000	372.000	14.600				5,860.100
12	60			305.800	94.500	1,225.000	1,925.000	735.000	490.000	357.000	16.400	64.500			6,275.700
13	1961			488.100	105.000	1,312.500	2,012.500	712.500	490.000	342.000	22.800	127.500			6,675.400
14	62			654.000	112.000	1,382.500	2,069.500	700.500	486.500	322.500	25.200	181.500			7,046.700
15	63			803.000	119.000	1,452.500	2,096.500		479.500		27.500	231.000			7,294.500
16	64			935.800	122.500	1,529.500					30.000	260.500			7,559.800
17	65			1,061.900	122.500	1,184.100					32.500	325.500	2,067.000		9,445.000
18	1966			1,181.200	122.500						34.800	361.500	2,756.200		10,271.600
19	67			1,233.900	119.000						37.200	396.000	3,444.600		11,076.500
20	68			1,303.200	119.000						39.500	426.000	4,134.000		11,867.300
21	69			1,361.800	115.500						41.800	458.000	4,625.200		12,645.900
22	70			1,445.100	112.000						43.800	506.500	5,511.500		13,466.800
23	1971			1,514.400	112.000							556.500	6,201.000		14,273.300
24	72			1,569.200	108.500							601.500	6,890.200		15,068.800
25	73			1,609.600	108.500							640.500	7,578.800		15,828.600
26	74			1,655.400	105.000							678.000	8,268.000		16,575.900
27	75			1,652.200	105.000							712.500			16,627.100
28	1976			1,665.400	105.000							745.500			16,673.500
29	77			1,674.800	101.500							774.000			16,707.700
30	78			1,680.200	101.500							801.000			16,740.100
31	79			1,682.200	98.000							823.500			16,761.100
32	80				98.000							846.000			16,785.500
33	1981				94.500							865.500			16,799.600
34	82				94.500							883.500			16,817.600
35	83				91.000							897.000			16,827.500
36	84				91.000							907.500			16,836.100
37	85				91.000							913.500			16,844.100
38	1986				87.500							918.000			16,845.100
39	87				87.500							921.000			16,848.100
40	88				87.500							922.500			16,849.600
41	89				84.000							924.000			16,847.600
66	2014	52.500	1,000.000	1,682.200	84.000	1,184.100	2,096.500	700.500	479.500	322.500	43.800	924.000	8,268.000	10.000	16,847.900
Totals		4,396.664	38,000.000	84,457.600	5,645.100	72,352.475	124,179.329	44,743.688	28,660.956	21,167.968	2,315.200	41,790.000	382,395.000	763.321	870,877.221

Operating Revenue deductions — Thousand Dollars

Operation and maintenance expenses (29)	Replacement reserve (30)	Pumping energy (2.5 mills per kwhr.) (31)	Total (32)	Net operating revenues (33)	Other revenues credited to irrigation repayment: Power (f) (34)	M & I (g) (35)	Irrigation plant: Cumulative investment (h) (36)	Balance to be repaid (37)	Fiscal year (38)	Year of study (a) (39)
									1941	
									42	
									43	
									44	
									45	
									1946	
									47	
							22,662.2	22,662.2	48	
1,176.974(k)		2.631(k)	1,179.605(k)	-45.501(l)			24,245.4	24,290.9	49	1
663.638	52.000	4.376	720.014	-21.888			125,017.5	125,084.9	50	2
1,060.200	213.300	2.713	1,276.213	-618.307			151,672.6	152,358.3	1951	3
1,335.669	253.000	103.436	1,692.105	-607.999			189,320.1	190,613.8	52	4
734.889	253.000	313.615	1,301.504	908.063			194,395.7	194,781.3	53	5
1,676.935	172.900	499.458	2,349.293	567.099			217,135.2	216,953.7	54	6
6,648.305	944.200	926.229	8,518.734	181.487			217,135.2	216,953.7	1954	Total (m) through
1,537.400	173.700	661.000	2,372.100	952.100			308,526.0	307,392.4	1955	7
1,537.400	173.700	687.000	2,398.100	1,383.100			311,125.0	308,608.3	1956	8
1,537.400	173.700	712.000	2,423.100	2,812.800			319,082.0	313,752.5	57	9
1,611.600	200.300	737.000	2,548.900	3,098.300			319,450.0	311,022.2	58	10
1,611.600	200.300	786.000	2,597.900	3,262.200			347,951.0	336,261.0	59	11
2,041.400	297.500	807.000	3,145.900	3,129.800			358,929.0	344,109.2	60	12
2,041.400	297.500	830.000	3,168.900	3,506.500			413,131.0	394,804.7	1961	13
2,067.800	320.600	861.000	3,249.400	3,777.300			413,590.0	391,486.4	62	14
2,067.800	320.600	873.000	3,261.400	4,033.100			473,860.0	447,723.3	63	15
2,142.800	340.900	889.000	3,372.700	4,187.100			663,243.0	632,919.2	64	16
3,041.100	1,079.600	1,356.000	5,476.700	3,968.300			677,700.0	643,407.9	65	17
3,050.100	1,079.600	1,511.000	5,620.700	4,651.100			685,922.0	646,978.8	1966	18
3,050.100	1,079.600	1,673.000	5,752.700	5,293.800			689,752.0	645,515.0	67	19
3,050.100	1,079.600	1,825.000	5,954.700	5,932.600			689,752.0	639,582.4	68	20
3,050.100	1,079.600	1,977.000	6,086.700	6,557.200			696,149.0	639,422.2	69	21
3,081.600	1,104.900	2,139.000	6,325.500	7,141.300				632,280.9	70	22
		2,290.000	6,476.500	7,796.800				624,484.1	1971	23
		2,448.000	6,631.500	8,427.300				616,056.8	72	24
		2,600.000	6,786.500	9,040.300				607,016.5	73	25
		2,761.000	6,947.500	9,628.300				597,388.2	74	26
		2,762.000	6,948.500	9,678.600				587,709.6	75	27
		2,764.000	6,950.500	9,722.800				577,986.8	1976	28
		2,764.000	6,950.500	9,757.200	2,758.9			565,470.7	77	29
		2,767.000	6,953.500	9,786.600	7,406.0			548,278.1	78	30
		2,767.000	6,953.500	9,807.600	7,364.0			531,106.5	79	31
		2,768.000	6,954.500	9,829.100				513,913.4	80	32
		2,767.000	6,953.500	9,846.100				496,703.3	1981	33
		2,766.000	6,952.500	9,865.100				479,474.2	82	34
		2,765.000	6,951.500	9,876.100				462,234.1	83	35
		2,766.000	6,952.500	9,885.600				444,984.5	84	36
		2,765.000	6,951.500	9,892.600				427,727.9	85	37
		2,765.000	6,951.500	9,893.600				410,470.3	1986	38
		2,763.000	6,949.500	9,898.600				393,207.7	87	39
		2,763.000	6,949.500	9,900.100				375,943.6	88	40
		2,764.000	6,950.500	9,897.100				358,682.5	89	41
								341,421.4	90	42
								324,160.3	1991	43
						802.2		306,097.0	92	44
						1,119.1		287,716.8	93	45
						1,125.1		269,330.6	94	46
						1,129.6		250,939.9	95	47
						1,131.1		232,547.7	1996	48
						1,135.6		214,151.0	97	49
						1,140.1		195,749.8	98	50
						1,144.6		177,344.1	99	51
					7,364.0	1,147.1		158,935.9	2000	52
					4,317.1			143,574.6	2001	53
					0.0			132,530.4	02	54
								121,486.2	03	55
								110,442.0	04	56
								99,397.8	05	57
								88,353.6	2006	58
								77,309.4	07	59
								66,265.2	08	60
								55,221.0	09	61
								44,176.8	10	62
								33,132.6	2011	63
								22,088.4	12	64
								11,044.2	13	65
3,081.600	1,104.900	2,764.000	6,950.500	9,897.100	0.0	1,147.1	696,149.0	0.0	2014	66
178,678.405	55,561.500	139,912.229	377,152.134	493,725.087	176,490.0	25,933.9	696,149.0	0.0		Totals

(a) The initial year of study is the first year in which an operation and maintenance appropriation is received.

(b) Deliveries in future years are estimated requirements of Grasslands Water District assumed to come through Delta-Mendota Canal or from Friant.

(c) Figures used as representing probable average revenues.

(d) One dollar per acre-foot for F.Y. 1956 and 1957; $2.00 per acre-foot for F.Y. 1958, 1959 and 1960; and $2.50 per acre-foot after F.Y. 1960. These rates are established on the assumption that the El Dorado Irrigation District will operate and maintain works.

(e) The $1.50 an acre-foot figure reflects the nominal value to Folsom irrigation water storage and diversion facilities.

(f) The financial assistance required from power is paid from net power revenues that become available after retirement of the power investment.

(g) The amount of financial assistance from municipal and industrial water revenues is the net available after the retirement of the M&I investment. This amount is applied toward repayment of the irrigation plant investment annually as it becomes available.

(h) Cumulated estimated investment in irrigation plant in service at end of fiscal year.

(i) For calendar year.

(j) For six months, January through June 1948, in order to report on fiscal year basis.

(k) Operating revenue deductions through 1949 are cumulated and shown in totals as the expenditure during fiscal year 1949.

(l) Represents the difference between cumulated total operating revenues and operating revenue deductions through fiscal year 1949.

(m) Water deliveries, operating revenues, and operating revenue deductions are from O&M or Control and Finance records.

(n) A portion of the Delta-Mendota Canal Service area is assumed to be served through San Luis facilities. It is estimated that 98,700 acre-feet would be exchanged beginning in 1965.

Prepared by: D. E. Flipse

Checked by: L. J. Bishop

April 29, 1955

805-208-46

GPO 969085

LAND-302

Table 19

CENTRAL VALLEY PROJECT-CALIFORNIA

(Including San Luis Unit)

POWER SYSTEM AVERAGE RATE AND REPAYMENT STUDY

AVERAGE POWER RATE USED TO COVER REVENUE DEDUCTIONS AND THE RETURN OF COSTS TO BE BORNE BY POWER

PRELIMINARY

1	2	3	4	5	6	7	8	9
		Sale of Electric Energy - Kilowatt-hours				Operating Revenues		
			Sale of Project Surplus Energy				Surplus	
Year of Study	Fiscal Year	Project Use	Firm	Non-firm	Total Cols. 3, 4, & 5	Project Use $	Firm 4.23 Mills After 1978 $	Non-firm 2.50 Mills After 1964 $
	1943							
	1944							
1	1945		215,130,507	513,374,934	728,505,441		1,079,574	770,062
2	1946	2,792,000	800,110,000	647,746,234	1,450,648,234	6,980	2,699,625	971,619
3	1947	3,672,000	800,722,966	494,009,873	1,298,404,839	9,180	2,704,580	741,015
4	1948	4,792,000	800,358,993	539,492,257	1,344,643,250	11,980	2,801,732	969,781
5	1949	9,158,058	1,615,315,483	0	1,624,473,541	27,950	6,492,953	0
6	1950	9,725,325	1,721,241,245	0	1,730,966,570	26,456	9,314,271	0
7	1951	12,105,066	2,195,025,115	0	2,207,130,181	30,263	10,480,630	0
8	1952	59,906,166	1,937,419,813	513,803,597	2,511,129,576	149,834	8,283,251	1,461,221
9	1953	136,461,092	1,407,034,280	655,532,532	2,199,027,904	341,429	6,372,284	2,014,224
10	1954	212,700,110	1,150,730,787	1,160,673,440	2,524,104,337	532,117	5,932,315	2,833,539
Prior year adjustments							-7,034	-42,874
Subtotal thru 1954		(451,311,817)	(12,643,089,189)	(4,524,632,867)	(17,619,033,873)	(1,136,189)	(56,154,181)	(9,718,587)
11	1955	272,000,000	1,350,000,000	628,000,000	2,250,000,000	680,000	6,460,000	1,957,000
12	1956	283,000,000	1,570,000,000	607,000,000	2,460,000,000	708,000	7,540,000	2,059,000
13	1957	294,000,000	1,800,000,000	606,000,000	2,700,000,000	735,000	8,550,000	1,999,000
14	1958	305,000,000	1,880,000,000	525,000,000	2,710,000,000	762,000	8,460,000	1,481,000
15	1959	325,000,000	1,920,000,000	485,000,000	2,730,000,000	812,000	8,520,000	1,170,000
16	1960	334,000,000	1,950,000,000	456,000,000	2,740,000,000	835,000	8,540,000	937,000
17	1961	344,000,000	1,970,000,000	796,000,000	3,110,000,000	860,000	8,550,000	1,612,000
18	1962	353,000,000	2,040,000,000	1,097,000,000	3,490,000,000	882,000	8,840,000	2,636,000
19	1963	362,000,000	2,120,000,000	1,008,000,000	3,490,000,000	905,000	9,160,000	2,423,000
20	1964	369,000,000	2,210,000,000	1,171,000,000	3,750,000,000	922,000	9,530,000	2,810,000
21	1965	565,000,000	2,450,000,000	745,000,000	3,760,000,000	1,412,000	10,740,000	1,863,000
22	1966	627,000,000	2,490,000,000	650,000,000	3,767,000,000	1,568,000	10,810,000	1,625,000
23	1967	692,000,000	2,520,000,000	564,000,000	3,776,000,000	1,730,000	10,910,000	1,410,000
24	1968	753,000,000	2,200,000,000	797,000,000	3,750,000,000	1,882,000	9,500,000	1,993,000
25	1969	814,000,000	2,200,000,000	735,000,000	3,749,000,000	2,035,000	9,500,000	1,838,000
26	1970	879,000,000	2,200,000,000	668,000,000	3,747,999,000	2,198,000	9,500,000	1,670,000
27	1971	940,000,000	1,930,000,000	868,000,000	3,738,000,000	2,350,000	8,330,000	2,170,000
28	1972	1,002,000,000	1,930,000,000	805,000,000	3,737,000,000	2,505,000	8,330,000	2,013,000
29	1973	1,064,000,000	1,930,000,000	743,000,000	3,737,000,000	2,660,000	8,330,000	1,858,000
30	1974	1,129,000,000	1,730,000,000	872,000,000	3,731,000,000	2,822,000	7,340,000	2,180,000
31	1975	1,129,000,000	1,730,000,000	872,000,000	3,731,000,000	2,822,000	7,340,000	2,180,000
32	1976	1,130,000,000	1,730,000,000	871,000,000	3,731,000,000	2,825,000	7,340,000	2,178,000
33	1977	1,130,000,000	1,650,000,000	947,000,000	3,727,000,000	2,825,000	6,980,000	2,368,000
34	1978	1,131,000,000	1,650,000,000	946,000,000	3,727,000,000	2,828,000	6,980,000	2,365,000
35	1979	1,131,000,000	1,580,000,000	1,012,000,000	3,723,000,000	2,828,000	6,680,000	2,530,000
36	1980	1,132,000,000		1,011,000,000		2,830,000		2,528,000
37	1981	1,132,000,000		1,011,000,000		2,830,000		2,528,000
38	1982	1,132,000,000		1,011,000,000		2,830,000		2,528,000
39	1983	1,132,000,000		1,011,000,000		2,830,000		2,528,000
40	1984	1,133,000,000		1,010,000,000		2,832,000		2,526,000
41	1985	1,133,000,000		1,010,000,000		2,832,000		2,526,000
42	1986	1,133,000,000		1,010,000,000		2,832,000		2,526,000
43	1987	1,133,000,000		1,010,000,000		2,832,000		2,526,000
44	1988	1,133,000,000		1,010,000,000		2,832,000		2,526,000
45	1989	1,134,000,000		1,009,000,000		2,835,000		2,523,000
46	1990	1,134,000,000		1,009,000,000		2,835,000		2,523,000
47	1991	1,134,000,000		1,009,000,000		2,835,000		2,523,000
48	1992	1,135,000,000		1,008,000,000		2,837,000		2,521,000
49	1993	1,135,000,000		1,008,000,000		2,837,000		2,521,000
50	1994	1,135,000,000		1,008,000,000		2,837,000		2,521,000
51	1995	1,135,000,000		1,008,000,000		2,837,000		2,521,000
52	1996	1,136,000,000		1,007,000,000		2,840,000		2,518,000
53	1997	1,136,000,000		1,007,000,000		2,840,000		2,518,000
54	1998	1,136,000,000		1,007,000,000		2,840,000		2,518,000
55	1999	1,136,000,000		1,007,000,000		2,840,000		2,518,000
56	2000	1,137,000,000		1,006,000,000		2,842,000		2,516,000
57	2001							
58	2002							
59	2003							
60	2004							
61	2005							
62	2006							
63	2007							
64	2008							
65	2009							
66	2010							
67	2011							
68	2012							
69	2013							
70	2014	1,137,000,000	1,580,000,000	1,006,000,000	3,723,000,000	2,842,000	6,680,000	2,516,000
Total		57,542,311,817	116,673,089,189	59,269,632,867	233,485,033,873	143,850,189	502,714,181	147,250,587

1	2	10	11	12	13	14	15	16	17
		Operating Revenues		Operating Revenue Deductions					
				Purchased Power					
Year of Study	Fiscal Year	Other Electric Revenue $	Total Cols. 7, 8, 9 & 10 $	Kilowatt-Hours	Cost $	Provisions for Replacement $	All other Electric Operation & Maintenance Expenses $	Transmission Service $	Total Cols. 13, 14, 15, & 16 $
1	1945	68,750	1,918,386	0	0	83,377	274,614		357,991
2	1946	75,000	3,753,224			83,377	365,434		448,811
3	1947	76,122	3,530,897			83,377	457,778		541,155
4	1948	75,000	3,858,493			576,062	679,350		1,255,412
5	1949	791,671	7,312,574			207,351	657,999		865,350
6	1950	-9,574	9,331,153			70,519	672,276		742,795
7	1951	19,568	10,530,461			390,200	986,180		1,376,380
8	1952	87,986	9,982,292			410,000	1,167,235	172,307	1,749,542
9	1953	97,233	8,825,170			592,400	972,922	260,775	1,826,097
10	1954	139,221	9,437,192	0	0	402,000	887,319	322,829	1,612,148
Prior year adjustments			-49,908						
Subtotal thru 1954		(1,420,977)	(68,429,934)	0	0	(2,898,663)	(7,121,107)	(755,911)	(10,775,681)
11	1955	397,000	9,494,000		228,000	429,000	904,574	1,493,000	3,054,574
12	1956	315,000	10,622,000	50,000,000	258,000	657,000	1,205,709	1,613,000	3,733,709
13	1957	499,000	11,783,000	232,000,000	915,000	675,000	1,286,670	968,000	3,844,670
14	1958	501,000	11,204,000	238,000,000	870,000	679,000	1,251,345	976,000	3,776,345
15	1959	501,000	11,003,000	254,000,000	910,000	684,000	1,259,490	976,000	3,829,490
16	1960	501,000	10,813,000	266,000,000	940,000	710,000	1,284,902	976,000	3,910,902
17	1961	501,000	11,523,000	274,000,000	960,000	731,000	1,381,275	976,000	4,048,275
18	1962	132,000	12,490,000	292,000,000	830,000	986,000	2,093,000	636,000	4,545,000
19	1963	132,000	12,620,000	297,000,000	840,000	986,000	2,093,000	638,000	4,557,000
20	1964	132,000	13,394,000	313,000,000	880,000	1,153,000	2,353,000	640,000	5,026,000
21	1965	132,000	14,147,000	325,000,000	900,000	1,222,000	2,472,000	640,000	5,234,000
22	1966	132,000	14,135,000	336,000,000	930,000			642,000	5,266,000
23	1967	133,000	14,183,000	347,000,000	950,000			642,000	5,286,000
24	1968	133,000	13,508,000	322,000,000	870,000			644,000	5,208,000
25	1969	134,000	13,507,000	322,000,000	870,000			644,000	5,208,000
26	1970	134,000	13,502,000	322,000,000	860,000			646,000	5,200,000
27	1971	135,000	12,985,000	314,000,000	830,000			646,000	5,170,000
28	1972	135,000	12,983,000	314,000,000	830,000			648,000	5,172,000
29	1973	136,000	12,984,000	311,000,000	810,000			648,000	5,152,000
30	1974	136,000	12,478,000	306,000,000	800,000			519,000	5,013,000
31	1975	137,000	12,479,000	306,000,000	800,000			520,000	5,014,000
32	1976	137,000	12,480,000	301,000,000	780,000			520,000	4,934,000
33	1977	138,000	12,311,000	297,000,000	770,000			441,000	4,905,000
34	1978	139,000	12,312,000	297,000,000	770,000			442,000	4,906,000
35	1979	140,000	12,178,000	290,000,000	750,000			370,000	4,814,000
70	2014	140,000	12,178,000	290,000,000	750,000	1,222,000	2,472,000	370,000	4,814,000
Total		11,962,977	805,777,934	17,076,000,000	46,401,000	71,688,663	145,834,072	32,209,911	296,133,646

18	19	20	21	22	23	24	25	26	27	28
		Income Deductions		Investment Repayment from Power Revenues						
		Repayment of Investment		Plant Expenditures End of Year						
				Interest Bearing		Interest Free				
Prior Year Adjustments $	Net Revenues $	Interest 3% $	Principal $	Total $	Balance to be repaid $	Total $	Balance to be repaid $	Earned Surplus Cumulative $	Fiscal Year	Year of Study
				2,215,833	2,215,833				1943	
				13,713,533	13,713,533				1944	
	1,560,395	411,406	1,148,989	15,668,300	14,519,311				1945	1
	3,304,413	435,579	2,868,834	15,984,762	11,966,939				1946	2
	2,989,742	359,008	2,630,734	16,058,233	9,409,676				1947	3
	2,603,081	282,290	2,320,791	24,580,701	15,611,353				1948	4
	6,447,224	534,816	5,912,408	34,650,756	19,769,000				1949	5
	8,588,358	593,070	7,995,288	52,749,295	29,872,251				1950	6
	9,154,081	896,168	8,257,913	61,686,975	30,552,018				1951	7
	8,232,750	916,561	7,316,189	78,491,500	40,040,354				1952	8
	6,999,073	1,201,211	5,797,862	80,812,702	36,563,694				1953	9
-49,908	7,775,136	1,096,911	6,678,225	85,068,750	34,141,517				1954	10
49,908									Prior year adjustments	
0	(57,654,253)	(6,727,020)	(50,927,233)						Subtotal thru 1954	
	6,439,426	1,024,246	5,415,180	106,334,000	49,991,587				1955	11
	6,888,291	1,499,748	5,388,543	107,548,000	45,817,044				1956	12
	7,938,000	1,374,511	6,563,819	108,398,000	40,103,225				1957	13
	7,427,655	1,203,097	6,224,558	108,398,000	33,878,667				1958	14
	7,173,510	1,016,360	6,157,150	108,680,000	28,003,517				1959	15
	6,902,098	840,106	6,061,992	109,559,000	22,820,525				1960	16
	7,474,725	684,616	6,790,109	162,012,000	68,483,416				1961	17
	7,945,000	2,054,502	5,890,498	162,012,000	62,592,918				1962	18
	8,063,000	1,877,788	6,185,212	190,374,000	84,769,706				1963	19
	8,368,000	2,543,091	5,824,909	195,956,000	84,526,797				1964	20
	8,913,000	2,535,804	6,377,196		78,149,601				1965	21
	8,869,000	2,344,488	6,524,512		71,625,089				1966	22
	8,897,000	2,148,753	6,748,247		64,876,842				1967	23
	8,300,000	1,946,305	6,353,695		58,523,147				1968	24
	8,299,000	1,755,694	6,543,306		51,979,841				1969	25
	8,302,000	1,559,395	6,742,605		45,237,236				1970	26
	7,815,000	1,357,117	6,457,883		38,779,353				1971	27
	7,811,000	1,163,381	6,647,619		32,131,734				1972	28
	7,832,000	963,952	6,868,048		25,263,686				1973	29
	7,465,000	757,911	6,707,089		18,556,597				1974	30
	7,465,000	556,698	6,908,302		11,648,295				1975	31
	7,486,000	349,449	7,136,551		4,511,744				1976	32
	7,406,000	135,352	7,270,648		0	176,490,000	173,731,096		1977	33
	7,406,000	0	7,406,000				166,325,096		1978	34
	7,364,000		7,364,000				158,961,096		1979	35
			7,364,000				151,597,096		1980	36
			7,364,000				144,233,096		1981	37
			7,364,000				136,869,096		1982	38
			7,364,000				129,505,096		1983	39
			7,364,000				122,141,096		1984	40
			7,364,000				114,777,096		1985	41
			7,364,000				107,413,096		1986	42
			7,364,000				100,049,096		1987	43
			7,364,000				92,685,096		1988	44
			7,364,000				85,321,096		1989	45
			7,364,000				77,957,096		1990	46
			7,364,000				70,593,096		1991	47
			7,364,000				63,229,096		1992	48
			7,364,000				55,865,096		1993	49
			7,364,000				48,501,096		1994	50
			7,364,000				41,137,096		1995	51
			7,364,000				33,773,096		1996	52
			7,364,000				26,409,096		1997	53
			7,364,000				19,045,096		1998	54
			7,364,000				11,681,096		1999	55
			7,364,000				4,317,096		2000	56
			4,317,096				0	3,064,904	2001	57
			0					10,410,904	2002	58
								17,774,904	2003	59
								25,138,904	2004	60
								32,502,904	2005	61
								39,866,904	2006	62
								47,230,904	2007	63
								54,594,904	2008	64
								61,958,904	2009	65
								69,322,904	2010	66
								76,686,904	2011	67
								84,050,904	2012	68
								91,414,904	2013	69
0	7,364,000	0	0	195,956,000	0	176,490,000	0	98,778,904	2014	70
0	509,644,288	38,419,384	372,446,000	195,956,000	0	176,490,000	0	98,778,904	Total	

Notes:

General - 1943-1954 data are historical from Bureau records 1945 is the first year of record for Shasta Powerplant where actual operation started in June 1944. Two generators purchased for Shasta were rented to Region 1 for use at Grand Coulee from February 25, 1943, to August 15, 1947. Payment ($749,451) covered in Column 10 for 1949. Annual figures for years before 1954 include adjustments for prior years. For 1954 such adjustments are included only in the subtotals and Column 18. Reconcilement of the FY-54 financial data is shown on Table 15.

Column 3 - The energy for project use includes service to the Contra Costa Canal, Delta-Mendota Canal, Folsom construction, the Shasta and Friant areas, the Sacramento Canals, and the San Luis Unit.

Column 4 - The amounts of energy listed under firm include project surplus energy plus support energy purchased when the energy available in any one month is less then the energy required for preference agency firm load. Folsom and Nimbus powerplant commence operation during F.Y. 1955 and Trinity in F.Y. 1961, with an increased dependable surplus capacity as supported by Pacific Gas and Electric Company. The total dependable surplus capacity under conditions of full irrigation development has been estimated at 340,000 kw, and at variable amounts during the development period.

Column 10 - Includes collections from customers for wheeling surcharge, apparatus maintenance and an allocated portion non-operating revenues. Under ultimate conditons Column 10 includes:

Wheeling surcharge (Acct. 644.1)	$135,000
Non-operating income allocated to power operations (Acct. 580,581)	5,000
TOTAL	$140,000

Column 12 & 13 - Energy to support firm load is purchased from the Pacific Gas and Electric Company at a rate equal to 1.15 times the average price per kilowatt-hour for the accumulated total of all energy sold to the Company.

Column 14 - Provisions for replacement are computed on a 3 percent sinking fund basis. The provisions for replacement chargeable to power after assumed completion of the system are estimated as follows:

F.P.C. Account Numbers

322	Reservoir and Waterways (allocated portion)	$ 31,000
321-326	Hydroelectric Plant	688,000
342-349	Transmission Plant	444,000
371-379	General Plant (allocated portion)	59,000
	TOTAL	$1,222,000

Column 15 - The annual operation, maintenance, and overhead costs chargeable to power operation after completion of the power system are estimated as follows:

Production Plant	
Operation	$ 659,000
Maintenance	554,000
Administration and general	270,000
Subtotal	$1,483,000
Transmission System	
Operation	$ 376,000
Maintenance	362,000
Administration and general	151,000
Subtotal	$ 889,000
Other - Non-operating allocated to power	100,000
TOTAL	$2,472,000

Column 16 - The wheeling transmission service expense includes the excess wheeling charge passed on to the customer as the surcharge shown in Column 10 plus the normal charge recouped by the Bureau as part of the energy rate. The wheeling service charges to power after assumed completion of the system are estimated as follows:

Normal Charge (Acct. 753.11)	$235,000
Surcharge (Acct. 753.12)	135,000
TOTAL	$370,000

Column 18 - The adjustments applicable in F.Y. 1954 for prior years are:

Reduction in F.Y. 1953 firm revenues	$ 7,034
Reduction in F.Y. 1952-53 non-firm revenues	$ 42,874
TOTAL	$ 49,908

Column 20 - Interest is calculated at 3 percent per year on the unamortized interest-bearing investment at end of the previous year (column 23). The 1949 figure includes $66,475 applicable to 1944.

Column 22 - The estimated costs of the authorized features of the Central Valley Project total $759,165,376 and are tabulated on Table 15. The costs for the San Luis Unit features as listed in the PF-2 dated June 29, 1954, and revised Jan. 20, 1955, are indicated below:

San Luis Dam and Reservoir	$ 52,116,000
San Luis Pumping Plant	37,333,000
Transmission lines	8,920,000
General property	1,073,000
Service lateral pumping plants	18,472,000
San Luis canal and pump intake canal	78,487,000
Pleasant Valley canal and pump intake canal	4,629,000
Pleasand Valley pumping plant	4,579,000
Channels, levees, and flood works	23,534,000
Total San Luis Unit	$229,143,000
Authorized Central Valley Project	759,165,376
Total used in Repayment	$988,308,376

Column 22 (Continued)

Following is the cost allocation and probable repayment of the Central Valley Project features:

Item	Cost Allocation	Probable Repayment
Nonreimbursable		
Navigation	$ 18,472,000	----
Flood Control	52,749,000	----
Fish and Wildlife	6,065,000	----
Recreation	305,000	----
Total Nonreimbursable	77,591,000	
Reimbursable		
Irrigation	$696,149,000	$493,725,100
Municipal & Industrial Water	18,612,000	44,545,900 a/
Surplus Power	195,956,000	372,446,000 b/
Total Reimbursable	$910,717,000	$910,717,000
Grand Total	$988,308,000	

a/ Irrigation aid from M&I Water Sales $25,933,900

b/ Irrigation aid from Power Sales(see Col. 24) $176,490,000

Columns 23 & 25 - The principal accruals of Column 21 are first credited to amortization of the interest-bearing investment and next to amortization of the interest-free investment.

Column 26 - Surplus shown as accumulating through the 50th year after the last major features (San Luis Unit) are placed in service in F.Y. 1964.

APRIL 29,1955

805-208-47

GPO 969085

Table 20

MUNICIPAL AND INDUSTRIAL WATER SERVICE REPAYMENT ANALYSIS
CENTRAL VALLEY PROJECT - CALIFORNIA (Including San Luis Unit)

Year of study (a)	Fiscal year	Water deliveries: Contra Costa canal	Water deliveries: Shasta dam area	Water deliveries: Sly Park unit	Water deliveries: Folsom service area	Water deliveries: San Luis Unit	Water deliveries: Total	Operating revenues: Contra Costa canal ($10 a.f. after 1948)	Operating revenues: Shasta dam area ($20 a.f.)	Operating revenues: Sly Park unit ($17.50 a.f.) (b)	Operating revenues: Folsom service area ($8.00 a.f.) (c)	Operating revenues: City of Vallejo (d)	Operating revenues: San Luis Unit ($15.00 a.f.)	Operating revenues: Misc.	Operating revenues: Total	Operating revenue deductions: O & M expenses	Operating revenue deductions: Replacement reserve	Operating revenue deductions: Pumping energy	Operating revenue deductions: Total	Net operating revenue	2½% Interest on unpaid balance	Net revenue	Investment repayment from M&I revenues: M & I: Cumulative investment (e)	Investment repayment from M&I revenues: M & I: Balance to be repaid	Investment repayment from M&I revenues: Irrigation Plant: Investment	Investment repayment from M&I revenues: Irrigation Plant: Balance to be repaid (f)	Fiscal year	Year of study (a)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
					Acre-feet						Thousand dollars						Thousand dollars							Thousand dollars				
	1941	2,444					2,444	10.356							10.356												1941	
	42	4,688					4,688	12.251							12.251												42	
	43	5,013					5,013	13.692							13.692												43	
	44	9,286					9,286	19.716							19.716												44	
	45	10,167					10,167	21.787							21.787												45	
	1946	10,818					10,818	40.563							40.563												1946	
	47	14,197					14,197	53.237							53.237												47	
	48	15,135					15,135	123.539							123.539								5,569.3	5,569.3			48	
1	49	15,170	324				15,494	152.741	6.491						159.232	404.024		11.839	415.863(g)	38.510(h)	139.2	-100.7	6,292.7	6,393.4			49	1
2	50	18,509	340				18,849	185.090	6.806					3.304	195.200	135.498	13.100	17.105	165.703	29.497	159.8	-130.3	6,734.7	6,965.7			50	2
3	1951	19,939	429				20,368	199.387	8.578					.706	208.671	148.527	9.200	14.900	172.627	36.044	174.1	-138.0	7,178.2	7,547.2			1951	3
4	52	21,781	464				22,245	217.807	9.273					2.786	229.866	178.784	9.800	14.796	203.380	26.486	188.7	-162.2	7,579.1	8,110.3			52	4
5	53	24,532	491				25,023	245.316	9.825					1.285	256.426	148.996	9.800	17.307	176.103	80.323	202.8	-122.5	6,356.8	7,010.5			53	5
6	54	27,184	616				27,800	271.143	12.311					222.899	506.353	166.712	14.300	20.887	201.899	304.454	175.3	129.1	9,527.0	10,051.6			54	6
Total through (i)	1954	198,863	2,664				201,527	1,566.625	53.284					230.980	1,850.889	1,182.541	56.200	96.834	1,335.575	515.314	1,039.9	-524.6	9,527.0	10,051.6			1954	Total through (i)
7	1955	30,000	650				30,650	300.000	13.000					10.000	323.000	165.700	13.400	19.0	198.100	124.9	251.3	-126.4	7,178.0	7,829.0			1955	7
8	1956	33,000	700	400			34,100	330.000	14.000	4.000		15.000			373.000	165.700	13.400	21.0	200.100	172.9	195.7	- 22.8	7,247.0	7,920.8			1956	8
9	57	36,000	750	800			37,550	360.000	15.000	8.000		22.500			415.500	165.700	13.400	23.0	202.100	213.4	198.0	15.4	7,517.0	8,175.4			57	9
10	58	39,000	800	900			40,700	390.000	16.000	13.500		30.000			459.500	165.700	13.400	25.0	204.100	255.4	204.4	51.0	7,526.0	8,133.4			58	10
11	59	42,000	850	1,000			43,850	420.000	17.000	15.000		35.000			497.000	165.700	13.400	26.0	205.100	291.9	203.3	88.6	8,526.0	9,044.8			59	11
12	60	45,000	900	1,100	2,600		49,600	450.000	18.000	16.500	20.800	45.000			560.300	167.200	14.300	28.0	209.500	350.8	226.1	124.7	8,910.0	9,304.1			60	12
13	1961	47,000	950	1,300	5,200		54,450	470.000	19.000	22.800	41.600	55.000			618.400	167.200	14.300	30.0	211.500	406.9	232.6	174.3	10,082.0	10,301.8			1961	13
14	62	49,000	950	1,400	7,600		58,950	490.000	19.000	24.500	60.800	62.500			666.800	167.200	14.300	31.0	212.500	454.3	257.5	196.8	10,098.0	10,121.0			62	14
15	63	51,000	950	1,600	10,000		63,550	510.000	19.000	28.000	80.000	65.000			712.000	167.200	14.300	32.0	213.500	498.5	253.0	245.5	10,808.0	10,585.5			63	15
16	64	52,000	1,000	1,700	12,200		66,900	520.000	20.000	29.800	97.600				742.400	167.200	14.300	33.0	214.500	527.9	264.6	263.3	17,454.0	16,968.2			64	16
17	65	52,000	1,000	1,800	14,400	11,800	81,000	520.000	20.000	31.500	115.200		177.000		938.700	178.200	23.500	57.0	258.700	680.0	424.2	255.8	17,962.0	17,220.4			65	17
18	1966	52,000	1,000	2,000	16,500	12,100	83,600	520.000	20.000	35.000	132.000		181.500		963.500			58.0	259.700	703.8	430.5	273.3	18,252.0	17,237.1			1966	18
19	67	53,000	1,000	2,100	18,500	12,400	87,000	530.000	20.000	36.800	148.000		186.000		995.800			59.0	260.700	735.1	430.9	304.2	18,387.0	17,067.9			67	19
20	68	53,000	1,000	2,300	20,400	12,700	89,400	530.000	20.000	40.200	163.200		190.500		1,018.900			59.0	260.700	758.2	426.7	331.5	18,387.0	16,736.4			68	20
21	69	54,000	1,100	2,400	22,200	13,100	92,800	540.000	22.000	42.000	177.600		196.500		1,053.100			61.0	262.700	790.4	418.4	372.0	18,612.0	16,589.4			69	21
22	70	55,000	1,100	2,500	24,000	13,400	96,000	550.000	22.000	43.800	192.000		201.000		1,083.800			62.0	263.700	820.1	414.7	405.4		16,184.0			70	22
23	1971	55,000	1,100		25,600	13,700	97,900	550.000	22.000		204.800		205.500		1,101.100			64.0	265.700	835.4	404.6	430.8		15,753.2			1971	23
24	72	56,000	1,100		27,200	14,000	100,800	560.000	22.000		217.600		210.000		1,128.400			64.0	265.700	862.7	393.8	468.9		15,284.3			72	24
25	73	56,000	1,200		28,600	14,300	102,600	560.000	24.000		228.800		214.500		1,146.100			65.0	266.700	879.4	382.1	497.3		14,787.0			73	25
26	74	57,000	1,200		30,000	14,600	105,300	570.000	24.000		240.000		219.000		1,171.800			66.0	267.700	904.1	369.7	534.4		14,252.6			74	26
27	75	57,000	1,200		31,300	14,900	106,900	570.000	24.000		250.400		223.500		1,186.700			66.0	267.700	919.0	356.3	562.7		13,689.9			75	27
28	1976	57,000	1,200		32,500	15,200	108,400	570.000	24.000		260.000		228.000		1,200.800			67.0	268.700	932.1	342.2	589.9		13,100.0			1976	28
29	77	58,000	1,200		33,600	15,500	110,800	580.000	24.000		268.800		232.500		1,224.100			68.0	269.700	954.4	327.5	626.9		12,473.1			77	29
30	78	58,000	1,200		34,600	15,800	112,100	580.000	24.000		276.800		237.000		1,236.600			69.0	270.700	965.9	311.8	654.1		11,819.0			78	30
31	79	59,000	1,200		35,500	16,100	114,300	590.000	24.000		284.000		241.500		1,258.300			70.0	271.700	986.6	295.5	691.1		11,127.9			79	31
32	80	59,000	1,300		36,400	16,400	115,600	590.000	26.000		291.200		246.000		1,272.000			71.0	272.700	999.3	278.2	721.1		10,406.8			80	32
33	1981	60,000	1,300		37,200	16,700	117,700	600.000	26.000		297.600		250.500		1,292.900			72.0	273.700	1,019.2	260.2	759.0		9,647.8			1981	33
34	82	60,000	1,300		37,800	17,100	118,700	600.000	26.000		302.400		256.500		1,303.700			73.0	274.700	1,029.0	241.2	787.8		8,860.0			82	34
35	83	61,000	1,300		38,400	17,400	120,600	610.000	26.000		307.200		261.000		1,323.000			74.0	275.700	1,047.3	221.5	825.8		8,034.2			83	35
36	84	61,000	1,300		38,900	17,700	121,400	610.000	26.000		311.200		265.500		1,331.500			75.0	276.700	1,054.8	200.9	853.9		7,180.3			84	36
37	85	61,000	1,300		39,300	18,000	122,100	610.000	26.000		314.400		270.000		1,339.200			76.0	277.700	1,061.5	179.5	882.0		6,298.3			85	37
38	1986	62,000	1,400		39,600	18,300	123,800	620.000	26.000		316.800		274.500		1,358.100			76.0	277.700	1,080.4	157.5	922.9		5,375.4			1986	38
39	87	62,000			39,800	18,600	124,300	620.000			318.400		279.000		1,364.200			78.0	279.700	1,084.5	134.4	950.1		4,425.3			87	39
40	88	62,000			39,900	18,900	124,700	620.000			319.200		283.500		1,369.500			78.0	279.700	1,089.8	110.6	979.2		3,446.1			88	40
41	89	63,000			40,000	19,200	126,100	630.000			320.000		288.000		1,384.800			80.0	281.700	1,103.1	86.2	1,016.9		2,429.2			89	41
42	90					19,500	126,400						292.500		1,389.300			80.0	281.700	1,107.6	60.7	1,046.9		1,382.3			90	42
43	1991					19,800	126,700						297.000		1,393.800			80.0	281.700	1,112.1	34.6	1,077.5		304.8			1991	43
44	92					20,100	127,000						301.500		1,398.300			82.0	283.700	1,114.6	7.6	1,107.0		0.0	25,933.9	25,131.7	92	44
45	93					20,400	127,300						306.000		1,402.800			82.0	283.700	1,119.1	0.0	1,119.1				24,012.6	93	45
46	94					20,800	127,700						312.000		1,408.800			82.0	283.700	1,125.1		1,125.1				22,887.5	94	46
47	95					21,100	128,000						316.500		1,413.300			82.0	283.700	1,129.6		1,129.6				21,757.9	95	47
48	1996					21,400	128,300						321.000		1,417.800			85.0	286.700	1,131.1		1,131.1				20,626.8	1996	48
49	97					21,700	128,600						325.500		1,422.300			85.0	286.700	1,135.6		1,135.6				19,491.2	97	49
50	98					22,000	128,900						330.000		1,426.800			85.0	286.700	1,140.1		1,140.1				18,351.1	98	50
51	99					22,300	129,200						334.500		1,431.300			85.0	286.700	1,144.6		1,144.6				17,206.5	99	51
52	2000					22,600	129,500						339.000		1,435.800			87.0	288.700	1,147.1		1,147.1				16,059.4	2000	52
53	01																									14,912.3	2001	53
54	02																									13,765.2	02	54
55	03																									12,618.1	03	55
56	04																									11,471.0	04	56
57	05																									10,323.9	05	57
58	2006																									9,176.8	2006	58
59	07																									8,029.7	07	59
60	08																									6,882.6	08	60
61	09																									5,735.5	09	61
62	10																									4,588.4	10	62
63	2011																									3,441.3	2011	63
64	12																									2,294.2	12	64
65	13																									1,147.1	13	65
66	2014	63,000	1,400	2,500	40,000	22,600	129,500	630.000	26.000	43.800	320.000	65.000	339.000	10.000	1,435.800	178.200	23.500	87.0	288.700	1,147.1	0.0	1,147.1	18,612.0	0.0	25,933.9	0.0	2014	66
Totals		3,640,863	76,364	133,300	1,819,800	936,000	6,606,327	35,986.625	1,527.284	2,318.600	14,558.400	3,645.000	14,040.000	830.980	72,906.889	11,757.041	1,369.700	4205.834	17,332.575	55,574.314	11,028.4	44,545.9	18,612.0	0.0	25,933.9	0.0		Totals

(a) The initial year of study is the first year an operation and maintenance appropriation was received.

(b) Ten dollars per acre-foot for F.Y. 1956 and 1957; $15 per acre-foot for F.Y. 1958 to 1960; and $17.50 per acre-foot thereafter. These rates were established on the assumption that the El Dorado Irrigation District will operate and maintain works.

(c) The $8.00 per acre-foot reflects a nominal value to Folsom municipal and industrial water storage facilities, and should not be considered as a water rate.

(d) Contract negotiations with the City of Vallejo for water from Cache Slough contemplate an annual lump sum payment rather than a per acre-foot charge.

(e) Cumulated estimated investment (capital costs) of the M & I plant in service at end of fiscal year.

(f) That portion of the irrigation investment to be repaid by municipal water users is the net revenue accruing after retirement of the M&I investment.

(g) Total operating revenue deductions prior to F.Y. 1949 charged in F.Y. 1949. The total shown consists of $323,581 for O&M during construction and $92,282 for appropriated O&M. For F.Y. 1950 the costs consist of $17,253 for O&M during construction and $148,450 for appropriated O&M.

(h) Cumulated annual operating revenues accrued during F.Y. 1941-1949 less cumulated operating revenue deductions for the same period.

(i) Historical data are from Control and Finance and O&M records.

Prepared by: D. E. Flipse

Checked by: L. J. Bishop

April 29, 1955

established for San Joaquin Valley and Delta areas;[1/] a rate of $2.75 an acre-foot for Sacramento Canals Unit service areas; a lump sum payment for Sacramento River diversions; $2.50 an acre-foot for Sly Park diversions with the water users paying the operation and maintenance expenses of the canals; a nominal value of $1.50 an acre-foot for Folsom storage; and a tentative rate of $7.50 an acre-foot for service to the San Luis Unit. This water rate for the San Luis Unit is well within the estimated average payment capacity of the water users.[2/] The irrigation rate structure would meet project operation and maintenance costs and, by the end of the projected repayment period concluding 50 years (10 year development and 40 year repayment) after the San Luis Unit is considered operational in 1965, repay about $493,725,100 or about 70 percent of the irrigation allocation. The remainder of the allocation would be amortized by applying: (1) $25,933,900 in net revenues available during the repayment period from the municipal and industrial water service function after amortizing that allocation with interest; and (2) $176,490,000 in

1/ Class 1 water is that available under normal delivery schedules; and class 2 water that delivered on a when, and if available basis.

2/ Payment capacity is estimated as about $56.00 per irrigable acre of which $19.00 would be required to meet distribution system, drains, deep well, capital, and operating costs. The remainder, $37.00 per acre, would be available to repay water service charges of $7.50 per acre-foot for an estimated total of $17.00 per acre.

net commercial power revenues (the balance needed) after amortizing the commercial power allocation with interest. Table 18 summarizes the estimated irrigation repayment by years and indicates repayment is completed in Fiscal Year 2014.

Power repayment of the Central Valley Project including the San Luis Unit.--Total commercial power costs of $195,956,000 are reimbursable with interest. The power repayment analysis is predicated on power rates under established power service contracts.

Estimated project revenues from power would repay the $195,956,000 commercial power allocation and interest of $38,419,400 (at 3.0 percent) by Fiscal Year 1977. Thereafter, and by the end of the payout period, Fiscal Year 2014, $176,490,000 in net revenues would be applied toward retirement of the irrigation investment and $98,778,900 credited as project earned surplus. A year by year projection of estimated revenues and expenses is presented in table 19.

Municipal and industrial repayment of the Central Valley Project including the San Luis Unit.--The reimbursable municipal and industrial water service allocation is $18,612,000. The water rate structure contemplated to meet repayment objectives provides for $17.50 an acre-foot for Sly Park deliveries with the operation and maintenance expenses paid by the water users; $20.00 an acre-foot in the Shasta Dam area; $10.00 an acre-foot in the Contra Costa Canal area; a fixed annual lump sum payment for City of Vallejo deliveries, a nominal value of $8.00 an acre-foot for Folsom storage; and a tentative rate of $15.00 an acre-foot in the San Luis Unit service area. On the basis of these rates, and estimated water deliveries and expenses as given in table 20, net revenues by the end of the project pay-out period in Fiscal Year 2014 would repay the $18,612,000 allocation with interest of $11,028,400 (at 2.5 percent), and contribute $25,933,900 toward repayment of the irrigation investment. Repayment of the municipal and industrial water service investment is completed in Fiscal Year 1992; thereafter, net revenues are credited toward repayment of the irrigation investment.

Recapitulation of Allocations and Probable Repayment of the Central Valley Project Including the San Luis Unit

Table 17 presents a composite repayment study of the Central Valley Project including the San Luis Unit. A further brief summary and recapitulation of these data, which serve to demonstrate the financial soundness of the project is presented in the following tabulation:

*

Allocation and Repayment Analysis

Function	Cost allocation	Net operating revenues through fiscal year 2014: For repayment	Net operating revenues through fiscal year 2014: Interest and/or earned surplus
Reimbursable			
Irrigation	$696,149,000	$493,725,100	--
Commercial power	195,956,000	372,446,000	$137,198,300 a/
M&I water service	18,612,000	44,545,900	11,028,400
Total reimbursable	$910,717,000	$910,717,000	$148,226,700
Nonreimbursable			
Navigation	$ 18,472,000	--	--
Flood control	52,749,000	--	--
Fish and wildlife	6,065,000	--	--
Recreation	305,000	--	--
Total nonreimbursable	$77,591,000	--	--
Total project (without distribution systems)	$988,308,000	$910,717,000	$148,226,700

a/ Includes $38,419,400 interest and $98,778,900 in earned surplus.

CHAPTER X

ALTERNATIVE PLANS AND ULTIMATE DEVELOPMENT

Alternative plans and ultimate development are discussed together in this chapter because of the interlocking nature of the two subjects. In planning for initial service to San Luis Unit consideration must be given to adoption of the facilities to serve the future needs of the area to the south in the San Joaquin Valley (Avenal Gap Unit), and of Southern California.

Alternative Plans

More than a million acre-feet of water annually will be required for the San Luis service area to supplement indigenous supplies. The key to the operating plan is the off-season storage capacity provided by San Luis Reservoir. By means of this storage, use is made of otherwise wasted Delta surplus water, and of Tracy Pumping Plant and Delta-Mendota Canal capacities. Since no equivalent alternative storage sites exist in the vicinity of the proposed service area, plans of development without San Luis Reservoir would require storage reservoirs in the Sacramento River or lower San Joaquin River tributary watersheds, pumping plants, and long canals of sufficient capacity throughout their lengths to meet peak demands of the irrigation season. These facilities might be obtained in several different ways, depending upon the upstream storage sites selected and the solution proposed for crossing the Sacramento-San Joaquin Delta.

Alternative Plans and Ultimate Development

One multiple-purpose plan in which service to the San Luis Unit is contemplated as one facet of a much larger development is the Feather River plan of development of the California Division of Water Resources. This plan involves use of San Luis Reservoir in combination with a large reservoir on Feather River, a tributary of the Sacramento River. Two other plans, one involving a possible future Folsom-Ione-Mendota Canal and the other a possible future Folsom-Newman Canal were presented in the Central Valley Basin report[1/] of the Department of the Interior. Summaries of the three plans follow.

Feather River Plan.--In May 1951 the State Engineer prepared for the State Water Resources Board the Report on Feasibility of Feather River Project and Sacramento-San Joaquin Delta Diversion Projects Proposed as Features of the California Water Plan. The report was presented to the State Legislature, which authorized construction of the project as a part of the Central Valley Project "separate and apart from other features thereof",[2/] and directed the Department of Public Works to continue investigations required for construction of the project. Results of these further studies are presented in the February 1955 report by the Division of Water Resources entitled Program for Financing

1/ Senate Document 113, 81st Congress, Second Session.

2/ The effect of this legislation is to make the provisions of the Central Valley Project Act of 1933 (Calif. Water Code, Div. 6, Part 3), as amended, applicable to financing and operation of the Feather River and Sacramento-San Joaquin Delta Projects, while separating them financially and operationally from the features of the Central Valley Project being constructed or under construction by the Bureau of Reclamation pursuant to Federal Law.

<u>and Constructing the Feather River Project as the Initial Unit of the California Water Plan</u>. San Luis Reservoir was added as a feature of the Feather River Plan in this report.

The Feather River Plan presented in the February 1955 report includes a large multi-purpose reservoir near Oroville on the Feather River (a tributary of the Sacramento River), a large reservoir on San Luis Creek for irrigation use, a long conduit with associated pumping plants to transfer water from the Delta to the upper San Joaquin Valley and southern California, and a shorter conduit with associated pumping plants to transfer water from the Delta to the Santa Clara-Alameda area near the southern end of San Francisco Bay. The major features of the plan would cost between $1,350,000,000 and $1,850,000,000 depending upon the alternative routes and service connections selected. Plate 13 illustrates the locations of those major components of the principal plan which lie north of the Tehachapi Mountains.

The February 1955 report envisions construction of the Feather River Plan in six steps. The first three steps would include construction of Oroville Reservoir and Powerplant, a cross channel to convey water across the Sacramento-San Joaquin Delta, the Feather River Project Aqueduct from the Delta to Wheeler Ridge at the southern end of the San Joaquin Valley, and the conduit from the Delta to the Pajaro River at the southern end of Santa Clara County. These steps would provide flood control and power generation at Oroville, firm up the existing water supply of the Feather River service area, furnish the

Santa Clara-Alameda area with a continuous flow of 350 cubic feet per second (240,000 acre-feet per year), and provide a portion of the west side of the San Joaquin Valley with 1,000,000 acre-feet of water per year on an irrigation demand basis and another portion with 840,000 acre-feet per year on a uniform flow basis. The final three steps would supply 1,840,000 acre-feet annually to southern California on a uniform flow basis. The nature of the physical works required in the final three steps would depend upon the delivery route and point of service.

Relationship of Feather River Plan and San Luis Unit.--In most respects San Luis Unit as proposed by the Bureau of Reclamation would be the physical equivalent of a portion of the Feather River Plan. The initial step of the State plan includes a reservoir with a capacity of 1,000,000 acre-feet at the San Luis site, and the dam which forms the reservoir would be designed for later raising to provide a reservoir capacity of 2,000,000 acre-feet. A forebay at San Luis Reservoir also would be provided. The part of the Feather River Aqueduct from San Luis Creek to Kettleman City would be a concrete-lined canal with a capacity of 7,000 cubic feet per second. Gravity water service from this canal would be provided at about elevation 380.

Physically, quite similar facilities are proposed under the Feather River and San Luis plans for service to the west side of the valley. Both plans envisage San Luis Reservoir with an initial capacity of 1,000,000 acre-feet and provision for later enlargement to about

2,000,000 acre-feet. One plan proposes a main canal leaving the reservoir at elevation 380 with a capacity of 7,000 cfs; the other plan proposes a main canal at elevation 350 with a capacity of 6,800 cfs and small relift pumps to raise water above that elevation. The principal difference in the plans is that the Feather River Aqueduct would be built initially to ultimate capacity throughout its entire length (with pumps being installed in stages), while the San Luis plan is based on stage construction whereby only part of the main canal would be constructed to ultimate capacity. A second construction stage would be required to enlarge and extend the canal to meet Avenal Gap demands, and additional stages would be required to adapt the canal to service to southern California. In other words, San Luis Unit is equivalent to an initial stage of a part of the Feather River plan. Such differences as exist between the proposed physical structures are the result of different assumed construction sequences rather than any difference in basic objectives or methods of service.

Folsom-Ione-Mendota Canal.--The Folsom-Ione-Mendota Canal as presented in the Central Valley Basin report would extend from Folsom Reservoir on the American River to Mendota Pool, a distance of 166 miles. With ultimate development of the Central Valley Basin, this canal could collect and redistribute surplus flows conserved by several major reservoirs planned to be built in the future. This development is illustrated on plate 13.

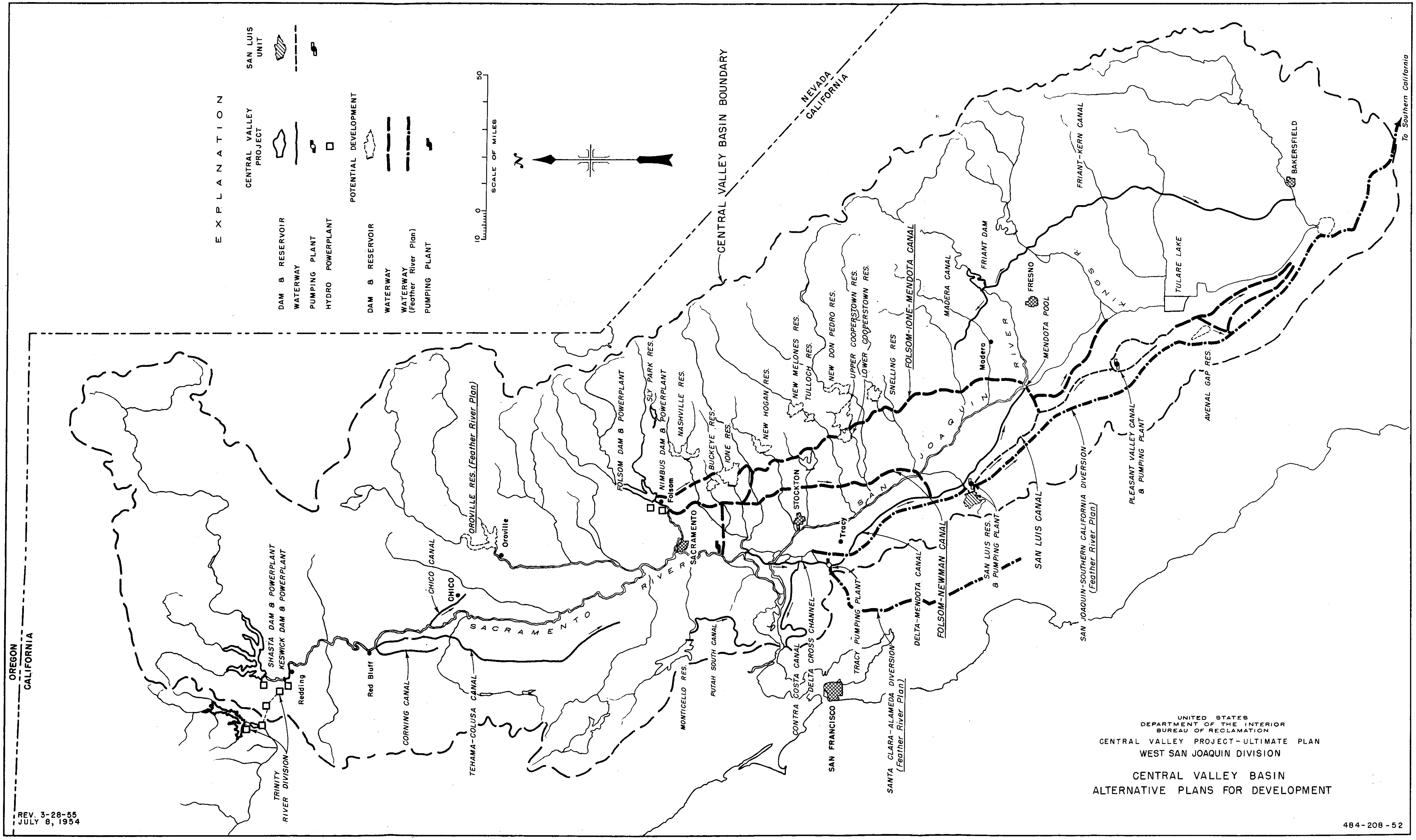
Alternative Plans and Ultimate Development

Although the water delivered by this canal could be pumped from Mendota Pool to San Luis Canal, it is not considered to be a justifiable alternate for the proposed San Luis Unit at this time. The required capital expenditure for reservoirs and the Canal would be many times that required for the San Luis Reservoir which it would replace. Thus the Folsom-Ione-Mendota Canal, if constructed at all, is much more closely related to final phases of the Central Valley development than it is to the immediate needs of the San Luis Unit.

Folsom-Newman Canal.--The Folsom-Newman Canal would extend 132 miles from the American River below Folsom Reservoir to a point near Newman on the Delta-Mendota Canal. The canal and pumping connection with the Sacramento River are also illustrated on plate 13. This canal could not deliver enough water for San Luis Unit without storage in the Sacramento River watershed or storage upstream on some of the San Joaquin tributaries it would cross. As with the Folsom-Ione-Mendota Canal it is not considered to be economically justified at the present time. Both the Folsom-Newman Canal and the Folsom-Ione-Mendota Canal were presented in the Interior Department's Comprehensive Basin Report of 1948 as alternatives to part or all of the capacity of an alternative canal which would parallel the existing Delta-Mendota Canal.

Ultimate Development

Adjacent to San Luis Unit on the south and west lies Avenal Gap Unit. This unit, illustrated on plate 14, has an area of 479,000 gross irrigable acres. The part of the Unit near Coalinga has developed


EXPLANATION
CENTRAL VALLEY PROJECT
SAN LUIS UNIT
DAM & RESERVOIR
WATERWAY
PUMPING PLANT
HYDRO POWERPLANT
POTENTIAL DEVELOPMENT
DAM & RESERVOIR
WATERWAY
WATERWAY (Feather River Plan)
PUMPING PLANT
SCALE OF MILES
10 0 50
N
CENTRAL VALLEY BASIN BOUNDARY
NEVADA
CALIFORNIA
OREGON
CALIFORNIA
To Southern California
BAKERSFIELD
FRIANT-KERN CANAL
TULARE LAKE
KINGS R.
FRESNO
FRIANT DAM
MADERA CANAL
Madera
MENDOTA POOL
SAN JOAQUIN RIVER
AVENAL GAP RES.
PLEASANT VALLEY CANAL & PUMPING PLANT
SAN JOAQUIN-SOUTHERN CALIFORNIA DIVERSION (Feather River Plan)
SAN LUIS CANAL
SAN LUIS RES. & PUMPING PLANT
FOLSOM-NEWMAN CANAL
DELTA-MENDOTA CANAL
FOLSOM-IONE-MENDOTA CANAL
SNELLING RES.
LOWER COOPERSTOWN RES.
UPPER COOPERSTOWN RES.
NEW DON PEDRO RES.
TULLOCH RES.
NEW MELONES RES.
NEW HOGAN RES.
IONE RES.
BUCKEYE RES.
NASHVILLE RES.
NIMBUS DAM & POWERPLANT
SLY PARK RES.
FOLSOM DAM & POWERPLANT
Folsom
SACRAMENTO
STOCKTON
Tracy
TRACY PUMPING PLANT
SANTA CLARA-ALAMEDA DIVERSION (Feather River Plan)
SAN FRANCISCO
CONTRA COSTA CANAL
DELTA CROSS CHANNEL
PUTAH SOUTH CANAL
MONTICELLO RES.
SACRAMENTO RIVER
OROVILLE RES. (Feather River Plan)
Oroville
CHICO CANAL
CHICO
TEHAMA-COLUSA CANAL
CORNING CANAL
Red Bluff
Redding
SHASTA DAM & POWERPLANT
KESWICK DAM & POWERPLANT
TRINITY RIVER DIVISION
REV. 3-28-55
JULY 8, 1954
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL VALLEY PROJECT-ULTIMATE PLAN
WEST SAN JOAQUIN DIVISION
CENTRAL VALLEY BASIN
ALTERNATIVE PLANS FOR DEVELOPMENT
484-208-52

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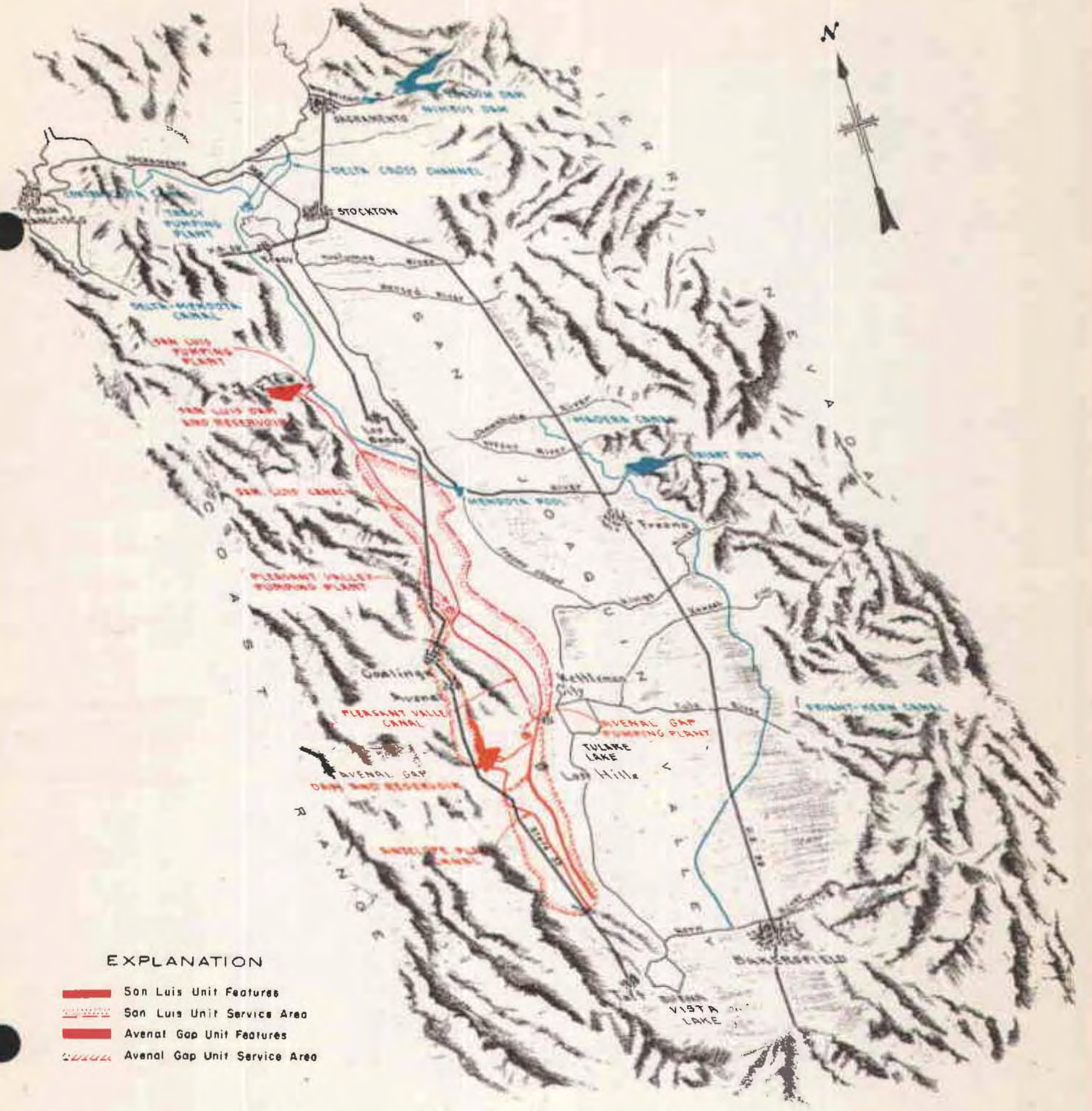
irrigation from ground water to a limited extent, and there are isolated instances of irrigation from ground water on the narrow strip north and west of the Pleasant Valley Pumping Plant and in the vicinity of Devil's Den. Otherwise Avenal Gap Unit is almost completely undeveloped.

The available ground-water data indicates that deeper wells would be required in the Avenal Gap Unit than in the San Luis Unit and the wells would be less productive. Shallow ground-water basins are fewer in number and poorer in performance and the streams in the area are drier, shorter, and more erratic than those of the San Luis Unit. Thus it appears that the import requirements per acre will be greater for the Avenal Gap Unit than for the San Luis Unit. On this basis the total annual Avenal Gap import requirement probably will be 1,500,000 acre-feet or more under conditions of full development.

This water could be provided through repetition of the San Luis operating principle. The winter surpluses in the Delta could be pumped through an enlarged Delta-Mendota Canal (or a second canal adjacent to the Delta-Mendota) into the San Luis Canal and thence into the potential Avenal Gap Reservoir. In addition to Delta-Mendota Canal, the lower reaches of the San Luis Canal and San Luis Reservoir would require enlarging. Or, the area might be served by the Feather River Aqueduct. Another possibility would be to import the water to the head of San Luis Canal through the proposed Folsom-Newman Canal and not enlarge the northern end of the Delta-Mendota Canal or construct a parallel canal. Another alternate would involve the Folsom-Ione-Mendota Canal instead of, or as an addition to, the Folsom-Newman.

The choice of alternative import plans depends upon the timing of the Avenal Gap Unit demand for water. An immediate urgent demand for water might render selection of the Delta-Mendota route desirable. Later demands could be met utilizing the Feather River Aqueduct, or the Folsom-Newman Canal, or still later the Folsom-Ione-Mendota Canal could serve as the conveyance feature for the Avenal Gap surface water supply.

In view of the uncertainty of timing of the demand in the Avenal Gap area, future use provisions on San Luis Unit features have been held to a minimum. North of the Pleasant Valley Pumping Plant only minor modifications were required to provide for ultimate capacity in the San Luis Canal to serve areas south of the San Luis Unit. From there on the canal was designed with only the capacity necessary for San Luis Unit, but right-of-way purchases or special easement reservation should be on the basis of a larger canal because land costs will increase considerably in the area after a firm supply of irrigation water is provided. The earth embankment for San Luis Dam would be zoned to provide for future enlargement of the reservoir to 2,000,000 acre-feet. Many of the future development possibilities could utilize the increased storage and the rezoning is an inexpensive way to prepare for such use. These future use provisions of San Luis Unit features would cost about $7,000,000 or about three percent of the estimated Federal expenditures of $229,143,000, none of which was allocated to future use.



WEST SAN JOAQUIN DIVISION

SAN LUIS AND AVENAL GAP UNITS

CENTRAL VALLEY PROJECT
ULTIMATE PLAN
CALIFORNIA

LAND-302

COOPERATING AGENCIES REPORTS

DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

NATIONAL PARK SERVICE

LAND-302

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Office of the Regional Director
Portland, Oregon

Preliminary Evaluation Report

on

F I S H   A N D   W I L D L I F E   R E S O U R C E S

in Relation to the

Water Development Plan for the

SAN LUIS UNIT

West San Joaquin Division

Central Valley Project
California

December 1954

Report of the Fish and Wildlife Service

P R E F A C E

This report is a preliminary evaluation of the San Luis Unit, West San Joaquin Division of the Central Valley Project. Data on the proposed development were obtained from the planning agency, Region 2 of the Bureau of Reclamation, during the period 1949 through 1954. Biological field data relating to the reservoir site and the service area were collected by the Service at intervals throughout this period. In addition, considerable field data relating to the fishery aspects of the Tracy Pumping Plant (which is completed but is to be utilized with the present project) have been collected by the Service and the California Department of Fish and Game principally since 1946. For the most part, the latter data have been summarized in two reports:

(1) Erkkila, Leo F., James W. Moffett, Oliver B. Cope, Bernard R. Smith, and Reed S. Nielson 1950. Sacramento-San Joaquin Delta Fishery Resources: Effects of Tracy Pumping Plant and Delta Cross Channel. U. S. Fish and Wildlife Service Special Scientific Report - Fisheries No. 56; and

(2) Calhoun, A. J. 1953. Distribution of Striped Bass in Relation to Major Water Diversions. California Fish and Game, Volume 39, Number 3, pages 279-299 (July).

These previous analyses have been freely used in evaluating the effects of the present project on fishery resources of the Delta.

The initial San Luis Unit service area considered in this report includes 496,124 acres of a gross area of 975,000 acres on the west side of the San Joaquin Valley which, though deficient or lacking in water supplies, is suited to irrigational agriculture. The remainder of the gross area to be served by the ultimate development extends south of the initial area, into Kern County and includes higher lands west of the initial area which would require higher pump lifts. Extension of the canal system, enlargement of San Luis Reservoir, construction of another storage reservoir at the Avenal Gap site, and construction of a more extensive drainage system would be required for the ultimate development. None of the proposed ultimate features have been evaluated in the present report.

No fishery resource of any significance exists in the reservoir site or on the service area without the project; consequently, the fishery evaluation of the report essentially is concerned with the resources of the Delta to be affected by increased pumping through the Tracy plant and with the resources to be created by the formation of San Luis Reservoir.

The wildlife evaluation is concerned mainly with potential waterfowl values on San Luis Reservoir and on the wasteway reservoirs of the proposed service area. Populations of other wildlife groups are either too small or too little known to permit monetary evaluation either without or with the project, but such groups are considered insofar as possible.

The extensive assistance furnished by the California Department of Fish and Game in supplying data utilized in the project evaluations is appreciated.

Report of the Fish and Wildlife Service

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DESCRIPTION OF THE PROJECT

1. The initial developments proposed for the San Luis Unit, West San Joaquin Division, Central Valley Project, will be located on the west side of the San Joaquin Valley in Merced, Fresno, and Kings Counties, California. The San Luis Unit is proposed to conserve and distribute water for domestic uses and for irrigation of a gross area of 496,124 acres lying south of the town of Los Banos, Merced County, at elevations of about 200 to 485 feet.[1/] The lower lands adjoining this area to the east are served by existing canals, including the Delta-Mendota Canal of the Central Valley Project. Foothills of the Coast Range form the higher western boundary.

2. Project purposes will be served by construction of San Luis Pumping Plant, San Luis Canal, San Luis Dam and Reservoir, and Pleasant Valley Pumping Plant and supply conduit. Wasteways, siphons, and floodwater wasteway reservoirs will be required in connection with the main canals. Small regulating reservoirs also will be built adjoining San Luis Canal. A drainage system will be required under project operation, and preliminary plans and estimates have been prepared.

3. Water for the San Luis Unit will be pumped into the Delta-Mendota Canal from the Sacramento-San Joaquin Delta near Tracy mainly during the winter and spring heavy-runoff period when surplus flows are

---

1/ This and subsequent elevations refer to United States Department of the Interior, Geological Survey mean sea level datum.

available (table 1). These waters will travel a distance of about 67 miles in the Delta-Mendota Canal to a point just south of San Luis Creek, the location of the project intake canal.

Table 1. Average quantities of water pumped at the Tracy Pumping Plant for the San Luis Unit and for all purposes with the San Luis Unit and average quantities pumped from the Delta-Mendota Canal into San Luis Reservoir.[a]

Month	Average quantities of water pumped: At Tracy for all purposes	At Tracy expressly for San Luis Unit	From Delta-Mendota Canal into San Luis Reservoir
	(Thousands of Acre-Feet)		
October	219	151	127
November	240	164	151
December	34	34	32
January	269	256	240
February	233	210	190
March	264	166	66
April	244	88	20
May	243	65	0
June	225	40	0
July	236	25	0
August	231	61	0
September	195	88	0

a/ Based on the Bureau's Operation Study No. SL-30 covering the water years 1921-22 through 1940-41.

4. San Luis Pumping Plant will lift water from the intake canal at elevation about 171 feet, to the head of San Luis Canal at elevation 350 feet, a lift of about 180 feet; or into San Luis Reservoir through the outlet works for off-season storage (table 1), a lift varying with the reservoir pool elevation from about 110 to 280 feet.

5. The San Luis Dam site is on San Luis Creek at streambed elevation of about 242 feet. The proposed dam will be an earthfill structure consisting of a main dam and four saddle dams with a crest elevation of 459 feet and a maximum height of 217 feet. The main dam will have a crest length of 7,470 feet. The three saddle dams in the left (north) abutment will have crest lengths of 1,020, 1,050, and 1,300 feet in order from the far left toward the main dam. The saddle dam in the right abutment will have a crest length of 1,100 feet. An overflow spillway will be built in a saddle in the far left abutment and will serve to spill very infrequent flood flows into San Luis Creek through a tributary channel. The spillway will be partly regulated by a top-seal radial gate having a capacity of 2,200 second-feet at a pool elevation of 450.0 feet. Additional spillway capacity will be provided by two 50-foot overflow weirs having crest elevations of 452.2 feet. The outlet works will consist of a cut-and-cover type conduit and will be located under the right abutment. The upstream elevation of the conduit invert will be at 280 feet. The system of outlet works is designed to deliver the required flow into the proposed San Luis Canal at a canal water surface elevation of 350 feet. When the elevation of the reservoir water surface is such that this condition cannot be met by gravity, the San Luis Pumping Plant will be used to lift the water into the canal.

6. San Luis Reservoir will store 1,000,000 acre-feet with a water surface area of 10,300 acres at normal pool elevation of 450 feet. At a

reservoir pool elevation of 350 feet, which is the water surface elevation of the canal, the reservoir storage will be 183,000 acre-feet with a water surface area of 5,500 acres. Evacuation of the reservoir between water surface elevations of 350 to 280 feet, the latter being the top of dead storage, will be by gravity to the pumping plant from which the water will be lifted to the San Luis Canal. The dead-storage pool will store 2,000 acre-feet with a surface area of 230 acres. It is estimated that 5,000 acre-feet of sediment will accumulate in the reservoir area during 100 years of reservoir operation, but silt will be distributed over the entire reservoir and will not reduce the storage pool by this amount. A summary of the characteristics of the reservoir is presented in table 2.

Table 2. Characteristics of San Luis Reservoir, initial stage.

Pool Level	Elevation (feet, msl)	Storage (acre-feet)	Area (acres)	Shoreline (miles)
Maximum (flood surcharge)	452.2	1,026,800	10,400	37
Normal high	450	1,000,000	10,300	37
Average annual maximum[a/]	440.8	920,000	10,000	35
Average annual minimum[a/]	334.6	110,000	4,400	18
Level at San Luis Canal water surface	350	183,000	5,500	21
Dead storage	280	2,000	230	7
Streambed	242	--	--	--

a/ Based on the Bureau's operation study No. SL-30 covering the water years 1921-22 through 1940-41.

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7. The reservoir pool level will fluctuate, on the average, about 106 feet annually as indicated in table 2. The distribution of fluctuations over the average year is indicated in table 3 and figure 1. Table 3 also presents data for individual years of the 20-year study which show typical month-to-month fluctuations.

Table 3. San Luis Reservoir water surface elevations for average months and by months of typical years.

	Mean water surface elevations for the month[a/]					
		Small annual fluctuation			Large annual fluctuation	
Month	Mean of 20 years	Low level 1932-33	Middle level 1926-27	High level 1921-22	Rising level 1924-25	Falling level 1938-39
October	344.8	312	339	370	319	376
November	368.2	318	363	393	347	399
December	381.6	338	376	403	371	408
January	399.3	369	392	417	395	418
February	423.9	398	417	438	421	438
March	437.2	413	431	448	435	448
April	440.8	417	435	449	440	449
May	437.2	415	432	446	438	442
June	425.2	405	422	436	429	426
July	401.4	381	399	414	406	398
August	368.2	344	366	384	376	363
September	342.2	314	344	368	356	338

a/ Based on the Bureau's operation study No. SL-30 for the water years 1921-22 through 1940-41.

Levels presented in table 3 are all mean monthly levels and should be interpreted as applying to about the 15th day of each month. Study of table 3 and of table 4, which follows, indicates that the reservoir fluctuations from month to month will be very similar in all years. The Bureau's operation study shows that the high stage will be reached in

April in all 20 years studied. As shown in the tables and in figure 1, a fairly constant level will result during March through May of most years. At other times of the year, fluctuations are typically severe from month to month as shown in table 4.

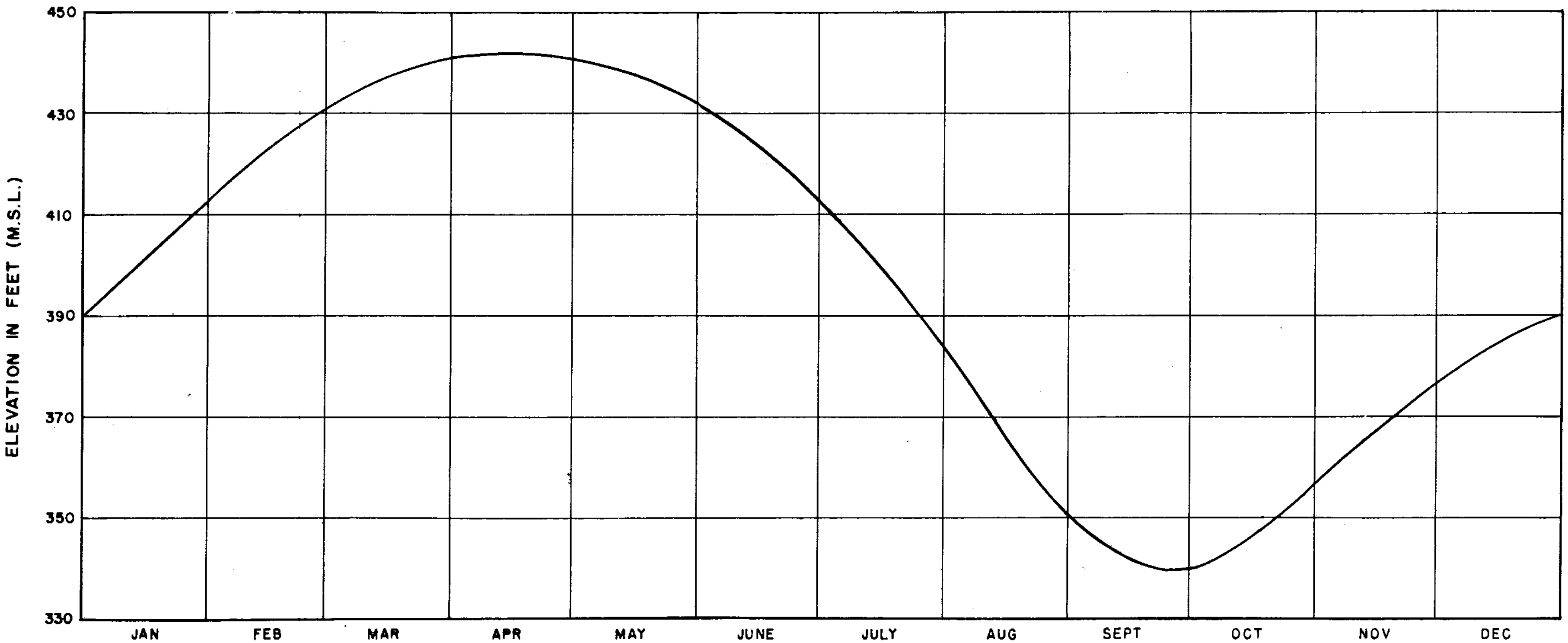
Table 4. Fluctuations in surface levels of San Luis Reservoir.

Month	Differences in mean monthly surface levels in feet[a] Mean	Median	Range
October	23.4	24	6 to 30
November	13.4	11	6 to 26
December	17.7	14	10 to 31
January	24.6	25	18 to 29
February	13.3	14.5	6 to 16
March	3.6	4	1 to 8
April	-3.6	-3	0 to -11
May	-12.0	-10	-9 to -22
June	-23.8	-23	-20 to -28
July	-33.2	-34	-27 to -39
August	-26.0	-26	-16 to -38
September	b/ 8.6	4	-17 to 18

a/ Based on the Bureau's operation study No. SL-30, water years 1921-22 through 1940-41. Negative figures indicate recessions.

b/ Direction of change ignored; the true average for September is 2.5 feet. This average covers only 19 years rather than 20.

8. Flooding of San Luis Creek by the proposed reservoir is of little consequence, for the stream is without flow for the greater part of each year. The lands of the reservoir area, presently planted to grain or utilized for native hay or pasture, will have no value for these purposes with the project, except as they may be utilized under



(Based on Bureau of Reclamation Operation Study #SL 30 for Water Years 1921-22 through 1940-41)

See Table 3, Page 6

AVERAGE MONTHLY WATER SURFACE ELEVATION

SAN LUIS RESERVOIR

FIGURE 1

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a suggested plan for waterfowl management discussed in the wildlife section of this report.

9. San Luis Canal with a total length of about 100 miles will extend from the reservoir south almost to Kettleman City. It will consist of four reaches and will be lined the entire length. The first reach will have a capacity of 6,000 second-feet and will terminate at Panoche Wasteway, about 4 miles beyond Panoche Creek. The second reach, beginning at Panoche Wasteway, will have a capacity of 4,600 second-feet and will terminate at the Five Points Wasteway southwest of the town of Five Points. The third reach will extend from the Five Points Wasteway to Arroyo Pasajero and will have a capacity of 1,700 second-feet. The final reach, extending from Arroyo Pasajero nearly to Kettleman City, will have a capacity of 700 second-feet. The lengths of these reaches are about 45, 30, 13, and 15 miles, respectively.

10. Pleasant Valley Canal, a distribution canal with a length of about 20 miles, will be supplied by the Pleasant Valley Pumping Plant from a point on the main canal southwest of the town of Five Points. The canal will be located at an average elevation of 455 feet and will roughly parallel the third and fourth reaches of the San Luis Canal. Pleasant Valley Canal will have a capacity of 600 second-feet. The towns of Coalinga and Avenal may pump water from the Pleasant Valley Canal near the Arroyo Pasajero crossing and near the terminus, respectively, for municipal and industrial purposes.

11. Panoche and Five Points Wasteways will extend, respectively, about 9 and 16 miles from the points on the canal mentioned above to retention reservoirs. These reservoirs will retain floodwater in addition to waste water, as indicated below. The reservoir for Panoche Wasteway will be located about 1 mile southeast of the town of Mendota; the other, about 3 miles south of the town of San Joaquin.

12. San Luis Canal and the Pleasant Valley Canal will have terminal regulating reservoirs of 50-acre-foot capacity each and terminal waste-ways connecting to nearby reservoirs with capacities of 590 and 500 acre-feet, respectively. Small regulating reservoirs of 50- to 100-acre-foot capacity also will be built contiguous to the main canal at points more or less equally spaced along its length to conserve excess water that otherwise would have to be wasted in the case of power failure or other operational difficulties.

13. Flood retention reservoirs are planned to intercept discharges of creeks of the project service area. Two small ones of 900- and 300-acre-foot capacities will be built above the San Luis Canal on Laguna Seca Creek and on an unnamed creek near the northern end of the service area, and another of 2,000 acre-feet will be built above the canal on Tumey Gulch Creek. Another small flood retention reservoir of 270-acre-foot capacity will be built on Arroyo Largo near the end of the Pleasant Valley Canal. A larger reservoir of 11,760-acre-foot capacity and a surface area of 1,706 acres will be built below the canal on Little

Panoche Creek. Other larger reservoirs will be built below the canal on Panoche Creek (35,000 acre-feet), Cantua Creek (12,590 acre-feet), and Arroyo Pasajero (35,000 acre-feet). These reservoirs will have surface areas of 3,900, 4,000, and 2,920 acres, respectively. As indicated above, Panoche Creek and Cantua Creek Reservoirs will retain waste water as well as floodwater.

14. The major streams of the service area fan out and are obliterated near the proposed San Luis Canal crossings, so that floodways will have to be built between the canal and the proposed flood-retention reservoirs. The floodways will be confined by low dikes about one-half mile apart.

15. All of the wasteways, floodways, and minor reservoirs to be built in connection with the canal will be only intermittently watered. The single-purpose flood retention reservoirs and the floodways probably will be least frequently watered. The regulating reservoirs, the wasteways, and particularly the wasteway retention reservoirs will be watered more frequently and for longer periods, but no definite information on the degree of watering is available.

16. Six or more siphons will be required on the San Luis Canal. Siphons are proposed to pass under Los Banos Creek, Ortigalita Creek, Little Panoche Creek, Panoche Creek, Cantua Creek, and finally under the Southern Pacific Railroad (Coalinga spur line) and Arroyo Pasajero at a point northeast of the town of Huron. The lengths of the siphons will range from about 500 to 2,000 feet. A siphon will be required on the

Pleasant Valley Canal at the crossing of the railroad and Arroyo Pasajero.

17. Irrigation distribution systems to the service area will be supplied from the main canal by pumping to the high side and by gravity to the low side. Excepting the Pleasant Valley Canal, these systems probably will be of concrete pipe construction as now used in adjoining areas.

18. Preliminary plans for a drainage system including a main interceptor drain following the lower edge of the service area from south to north have been prepared. Such a system is expected to be required after a few years of project operation. However, construction of the system, which is proposed to drain initially into the San Joaquin River near Mendota Pool and ultimately, by extension of the main drain, into Dutch Slough in the lower Delta, is contingent upon demonstrated need.

19. It is anticipated by the Bureau of Reclamation that under development of a full water supply for the proposed service area, the farm sizes will be smaller than without the development, and more of the area will be devoted to nonagricultural uses including farmsteads, rights-of-way, and urban and industrial developments. The projected land-use pattern under such conditions has been estimated by the Bureau and is presented in table 5.

Table 5. Anticipated major land uses with the development of the initial San Luis Unit service Area.

Land use	Acres	Acres
All - gross area		496,124
Nonagricultural		
Secondary and farm roads	22,360	
Railroad rights-of-way	900	
State highway rights-of-way	2,800	
Distribution rights-of-way	5,700	
Farm ditches	3,860	
Cities and towns	7,000	
Farmsteads, gins, packing sheds, etc.	11,580	54,200
Gross agricultural area		441,924
Nonirrigable (class 6) land not included above		1,924
Irrigable agricultural land		440,000

20. The crop pattern of the irrigable lands in the proposed service area is expected to become more balanced with the development of full water supply. The long-term projection of the crop pattern with the proposed development is estimated by specialists of the Bureau to be as presented in table 6.

Table 6. Estimated crop pattern of San Luis initial service area with full water supply.

Crop	Acres
Cotton	132,000
Alfalfa	88,000
Irrigated grain and hay	44,000
Irrigated pasture	44,000
Deciduous fruits and grapes	22,000
Field crops	66,000
Truck crops	88,000
Subtotal	484,000
Less duplicated area	44,000
Total irrigable area	440,000

Increased livestock production is possible in the San Luis service area with the proposed development and the crop pattern indicated above; however, it is uncertain whether or not the livestock production will be accomplished locally. It is estimated by the Bureau that the feeds that will be produced under the projected crop pattern will support 230,000 animal units annually.

DESCRIPTION OF THE PROJECT AREA

Physical Features

21. The proposed service area embraces a strip averaging roughly 13 miles wide and 65 miles long between the towns of Los Banos and Kettleman City. The site of the proposed reservoir is on San Luis Creek just north of the service area and about 12 miles west of Los Banos.

22. The topography of the project area consists essentially of large coalescing alluvial fans formed by the intermittent streams of the Coast Range to the west. The fans slope northeastward toward the valley floor with a gradient of about 25 feet per mile through the proposed service area. The floor of the west side of the valley slopes northeastward at a rate of about 5 feet per mile toward the sloughs and channels of the rivers. The stream channels are poorly defined in their lower reaches, thus special provisions are necessary for the control of flash floods in any plans for canal construction. Farming operations have aggravated this condition, but it is also a natural characteristic of this drainage area.

23. All of the streams of the project area are intermittent, and flow records for these streams are meager. The California Division of Water Resources estimates that the total mean seasonal natural runoff of all of the tributary streams along the west side of the San Joaquin Basin is only about 134,400 acre-feet. The distance along the base of the foothills involved in this estimate is over 300 miles, nearly twice the length affected by the project.

24. Despite the lack of surface water supply, irrigation is extensively practiced. The water supply for this irrigation is derived almost entirely from wells ranging in depth from a few hundred to over 2,000 feet. Flood flows to the streams are utilized at times on some streamside areas, and some water has been supplied to the northern part of the area on an interim basis from the Delta-Mendota Canal. The sources of the ground water are rainfall and runoff from the Sierra Nevada and the Coast Range. Seepage from existing irrigation canals on the valley floor also may contribute to the deep aquifers. The firm ground-water supply is estimated to be not greater than about 213,000 acre-feet annually. On the basis of present use, the underground sources are being rapidly depleted by an annual ground-water withdrawal of about 1,000,000 acre-feet.

25. The soils of the proposed service area are loose and friable. Soil textures are sandy or silty loam on the upper portions of the alluvial fans and adjacent to the streambeds but become increasingly heavier toward the fringes of the fans. The fringe soils are not only heavy, but they have accumulated greater amounts of alkali, and their subsoils tend to become compacted so that water penetrates more slowly than at the center of the fans. Some residual soils occur on the higher ground within the proposed service area, but soils of alluvial origin are characteristic of the area.

26. Sediments on the alluvial fans of the service area have been derived from shales, sandstones, and conglomerates which contain variable amounts of soluble salts, mainly sulfates. The soils of the area have retained these salts in important amounts. The quantity of these salts is the principal basis on which the lands of the area are classified as to adaptability to irrigational agriculture, but topography, drainage, soil texture, soil depth, and alkalinity also were considered in the adaptability classes. The distribution of these classes for the initial service area of 496,124 acres is summarized in table 7.

Table 7. Land classes of the San Luis Unit service area.

	Land classes				
Gross area	1	2	3	6	Total
Acres	199,000	231,000	64,000	2,000	496,000
Percent	40.1	46.6	12.9	0.4	100

27. Class 1 lands occur on the higher, smoother parts of the recent alluvial fans; they consist of deep, permeable, highly fertile soils capable of providing a high range of available moisture and having low concentrations of soluble salts. Most of the soils of class 1 produce good to excellent yields. Class 2 lands are located on the high interfan areas or on the lower edges of the fans for the most part. These soils have moderate deficiencies due mainly either to a fine texture or a soluble salt content of 0.2 to 0.5 percent. About 8,800 acres of the

class 2 lands have moderate topographic deficiencies. Yields of the class 2 lands are fair to good, and although the number of crops that are adapted to them are fewer than for class 1 lands, a large selection of crops can be successfully cultivated. Most of the class 3 lands occur along the lower edges of the fans in the interfan areas and along the eastern edge of the project area where soluble salts have accumulated to the extent of 0.5 to 0.8 percent. Soil texture is usually fine, subsoil compact is slight to moderate, and available moisture is limited. Yields of class 3 lands are poor to fair, and crop adaptability is greatly restricted. The class 6 lands consist of stream channels, very rough lands, and low hills; they are unsuited to irrigational agriculture.

28. The climate of the proposed service area is semiarid. Total annual precipitation averaged 8.34 inches over a 75-year period at Los Banos and 7.09 inches over a 35-year period at Coalinga. The range in annual precipitation was 2.85 to 16.68 inches over the period of record at Los Banos. All precipitation on the area occurs as rain falling mainly in the period November through March. In the Coast Range at higher elevations to the west precipitation is much heavier and averages as much as 22 inches annually at some points. On the service area, air temperatures average about 80° F. for the month of July and 48° F. for December, while the recorded range is 14° F. to over 110° F. The frost-free period coincides nearly with the period March through November, averaging about 250 days at Los Banos and Coalinga and nearly 310 days at Kettleman City.

Commercial Features

29. The project service area is accessible from State Highway 33 which traverses it in a north-south direction, crossing the San Luis Canal alignment about midway of its length. This highway roughly parallels U. S. Highway 99 nearly the entire length of the Central Valley south of the city of Stockton. Two State highways, numbered 180 and 198, traverse the service area in an east-west direction and connect State Highway 33 with U. S. Highway 99. Another State highway, 152, passes through the San Luis Reservoir site, north of the service area, and connects U. S. Highway 99 with U. S. Highway 101 and State Highway 1, the latter two being north-south coastal routes.

30. The San Joaquin Valley route of the Southern Pacific Railroad runs through the valley east of the project areas. The service area and reservoir site are most accessible by railroad from the city of Fresno which is some 35 miles east of the northern part of the service area over State Highway 180. Southwest Airways maintains a daily service out of San Francisco to the town of Coalinga which is about 10 miles west of the southern part of the service area. United Air Lines serves the city of Fresno on its regularly scheduled north-south flights through the Central Valley.

31. Populations of the counties in which project development is proposed (1950 census) are as follows: Merced County, 69,780; Fresno County, 276,515; and Kings County, 46,768. No sizable cities or towns

are located within the proposed service area. Several small towns are located within 10 road miles of the service area, but only four of these had 1950 populations in excess of 1,000; they are: Coalinga, population 5,539, located as given above; Avenal, population 3,982, located about 6 miles west of the southern part of the service area; Mendota, population 1,516, located nearly on the east boundary of the area near its midpoint; and Dos Palos, population 1,394, located 10 miles north of the service area. Fresno, with a 1950 population of 91,669, is the largest city within 50 miles of the proposed service area.

32. The proposed reservoir site is also in a sparsely populated area, but large urban centers are located within easy driving distances. Populations, road distances, and directions of such areas with respect to the reservoir are given in table 8.

Table 8. Populations and locations of urban centers with respect to the proposed San Luis Reservoir site.

City	1950 population	Road miles and direction from the reservoir site
Greater San Francisco-Oakland	1,700,000 (Approx.)	120 NW
San Jose	95,280	63 NW
Fresno	91,669	85 SE
Stockton	70,853	73 N

Many other cities and towns are located within 50 road miles of the San Luis Reservoir site. Those having 1950 populations in excess of 1,000 are listed in table 9 in order of their size together with their location by county.

Table 9. Populations and locations of cities and towns within 50 road miles of the proposed San Luis Reservoir site.

City or town	Population	Road miles and direction from the reservoir site	County
Modesto	17,389	46 N	Stanislaus
Merced	15,278	47 NE	Merced
Turlock	6,235	41 NE	Stanislaus
Gilroy	4,951	35 W	Santa Clara
Hollister	4,903	31 SW	San Benito
Chowchilla	3,893	47 E	Madera
Los Banos	3,868	12 E	Merced
Atwater	2,856	45 NE	Merced
Ceres	2,351	50 N	Stanislaus
Gustine	1,984	17 N	Merced
Newman	1,815	21 N	Stanislaus
Morgan Hill	1,627	44 NW	Santa Clara
Livingston	1,502	43 NE	Merced
Dos Palos	1,394	28 SE	Merced
Patterson	1,343	33 N	Stanislaus
San Juan Bautista	1,031	39 SW	San Benito

33. Most of the lands of the project area are in private ownership and are utilized mainly for crop production. The service area is not prominent in livestock or dairy production, but some sheep are grazed on the area and a small amount of beef and dairy production is carried on there. Irrigational agriculture had its beginning in the early 1920's, and by 1939 the first Federal crop census showed about 90,000 acres irrigated in that year. Rapid development in the years following is reflected in the 1950 crop survey of the Bureau of Reclamation shown in table 10.

Table 10. 1950 crop survey of initial San Luis service area.

Crop	Net acres	Net acres
Irrigated		
Cotton	73,257	
Alfalfa	2,547	
Grain and hay	162,413	
Pasture	108	
Deciduous fruits and grapes	743	
Field crops	18,087	
Truck crops	16,364	
Fallow	127,424	
		400,943
Nonirrigated		
Grain and hay	11,677	
Native pasture	63,861	
Dry-farmed fallow	7,590	
Abandoned cropland	1,124	
		84,252
Net agricultural lands		485,195
Nonagricultural lands		10,929
Gross land area		496,124

34. By 1950 over 400,000 acres had been developed for irrigational agriculture, of which over 273,000 acres were in small grain and hay, cotton, garden truck, field crops, etc., while about 127,000 were fallowed. Large-scale operations characterize the agriculture of the surveyed area; consequently, only a relatively small proportion of the proposed service area is now devoted to nonagricultural uses such as farmsteads, rights-of-way, and towns. The historic crop pattern has been evolved to provide complete utilization of the available water

supplies and facilities. The wells produce water about 11 months of the year. Irrigated grain is grown to utilize water during winter and spring, whereas cotton, truck, or field crops or a combination of these are grown to make use of the water during spring, summer, and fall. Preirrigation for grain takes place in October through December and for cotton in January through March. Grain is irrigated during March and April, cotton and other crops during May through September.

FISHERIES

Introduction

35. All of the streams of the project areas are intermittent, and such fish populations as exist in them are confined to the headwaters and to the sloughs of the valley floor below the project lands. The intermediate reaches which traverse the project areas are dry much of the year and are practically or actually devoid of fish life; consequently, no fishery value exists in them under without-the-project conditions. However, since the water to be utilized with the project will be diverted from the Sacramento-San Joaquin Delta via the existing Tracy Pumping Plant and the Delta-Mendota Canal, all the fisheries of the Delta which are affected by the pumping plant will be affected by the San Luis Unit and must be evaluated without and with the project. These fisheries include those for the king salmon, striped bass, shad, catfish, largemouth black bass, and many other species of lesser importance.

36. Pumping at Tracy will be markedly increased with the San Luis Unit during the months of October, November, and January through March; and it will be increased to an important extent in other months in many years (table 1). Such pumping will increase the losses of young fish at the pumping plant and aggravate the fishery protection problem there. Losses to the affected fisheries are of great concern to conservation interests. Small fish which escape through the salvage facilities

at Tracy Pumping Plant will contribute to the fishery resources of San Luis Reservoir and the canals; consequently, fish screens are not required at the San Luis Pumping Plant, and it is considered impractical to screen the San Luis Reservoir outlet or any of the San Luis Canal turnouts. Although fishery resources will be created in San Luis Reservoir and in the canals with the project, these are not expected to replace the loss to the Delta fisheries either in kind or magnitude.

37. The transport of the project water via the Delta-Mendota Canal will improve this existing canal as fish habitat by providing a continuous flow throughout the year except during December when water will be carried only in dry years. Thus the fishery resources of the Delta-Mendota Canal will be somewhat improved with the project. However, since fishing in the canal is discouraged and fishing is accomplished only by trespass on the patrolled right-of-way, no fishery value is assigned to this canal or to the proposed project canals. The proposed minor reservoirs, wasteways, and floodways of the service area are not expected to have value as fish habitat because of their intermittent character.

38. Each of the affected Delta fisheries of importance is evaluated below without and with the project. The San Luis Reservoir is evaluated with the project.

Without the Project

King Salmon

39. Young king salmon migrating to the sea from the spawning areas in the middle reaches of the rivers pass through the upper Delta waters where a large proportion of them are subjected to the influence of the Tracy Pumping Plant. The individual fry or fingerling, under conditions without the pumping plant, did not tarry long in the Delta. Yet the migrations of the various segments of the run do not coincide, so that young salmon, passing through Delta waters in considerable numbers during the months February through July, come under the influence of the pumping plants for a considerable period each year. Sacramento River salmon, which constitute by far the largest run, move through the Delta mainly during March, while the San Joaquin River fish move through mainly during April and May.

40. Under the full without-the-project diversion schedule, increased numbers of young Sacramento River salmon will be drawn by the Tracy plant into the maze of upper Delta channels (by way of Georgiana Slough and the Bureau's Delta-Cross Channel) where currents will be much slower than in the river. Both the increased regulation of tributary streamflow in upstream reservoirs and the increased consumptive use of water in upstream areas, assumed for future conditions, will reduce the amount of water that passes through the Delta and thereby increase the proportion of the Delta inflow that is diverted by the plant. In regard to regulation, it must be emphasized that both without- and with-the-project

conditions assume full operation of all reservoirs recently completed and under construction as well as Trinity Reservoir (2.5 million acre-feet capacity) which now is only proposed but is essential for operation of the San Luis Unit. Low gradient, weak river discharges, and tides combine to slow the water movement of the upper Delta, but diversion at the Tracy plant and other conditions assumed without the project will aggravate this condition and lengthen the period of time young salmon will spend in the upper Delta as well as increase the number of them that follow this slow route. This delay is expected to bring about increased losses from predation, disease, and food competition as well as increased loss from nonFederal pumping plants throughout the Delta. Direct losses of young salmon at the Tracy Pumping Plant are expected to be held to a minimum by the fish facilities being developed there as discussed below.

41. The San Joaquin River salmon will be more directly affected by the Tracy plant without the San Luis Unit diversions than the Sacramento River salmon since their migration path normally follows upper Delta channels that pass very near the plant and their time of migration coincides with the start of the heavy pumping season.

42. All affected migrant salmon are expected to be in advanced fry or fingerling stages (mostly of a length greater than 35 mm.) so that something over 90 percent of those drawn into the direct pump influence can be salvaged by the fish facilities now being developed for the Tracy plant. However, losses are expected to occur not only from failure of

the fish facilities to screen them but also from handling required to return them to safe waters and from the indirect causes mentioned above.

43. The king salmon resource without the San Luis Unit has been evaluated on the basis of commercial catch records; results of postal card surveys; tagging, marking, and spawning ground findings; and other data collected by the California Department of Fish and Game and by the Service. Losses to the resource expected as a result of the operation of the Tracy plant have been calculated on the basis of anticipated upper Delta water relations defined by the Bureau of Reclamation's operation study No. SL-30.

44. Commercial values of the king salmon are estimated at $2,386,000 annually with the Tracy Pumping Plant and without the San Luis Unit diversions, while sport fishing values are estimated at $8,606,000 annually for these conditions.

Striped Bass

45. The Tracy Pumping Plant is expected to have its most important effect on the striped bass population of the Delta inasmuch as striped bass support the most valuable sport fishery of the Delta and a large part of their annual production is subject to the influences of the pumps throughout every stage of development.

46. The upper Delta from which the pumped waters are drawn is a reproduction and nursery area of first importance to striped bass. An estimated 70 percent of the population spawns in waters directly subject

to influence of the Tracy pumps. The fertilized eggs of the species are semi-buoyant and are carried wherever currents carry them from the points of spawning which are located at the surface in slowly moving, essentially fresh waters. The peak of the striped bass spawning is usually in mid-May, and growth of young bass is rapid. They are considered to remain in the waters of the upper Delta until such time as they are flushed into the lower Delta by streamflows. This time varied considerably under historical conditions, but it is delayed by operation of the pumping plant and by upstream water manipulation as discussed under King Salmon above. These water relations assumed for without-the-project conditions will provide slower Delta currents and increased effects on young fish. The effects of these relations will be more pronounced with young bass than with young salmon since young bass first appear in the Delta waters when the spring flood runoff is subsiding, while young salmon move through mainly on the flood.

47. Considerable loss of striped bass eggs and larvae is anticipated at the pumping plant, and although the young bass of a length greater than one inch will be salvaged by the facilities being developed at Tracy, fairly heavy losses are also expected with these larger fish for the reasons noted for young salmon. Even without the San Luis Unit, diversions at Tracy are large during the period May through August when the young bass are developing (table 1).

48. Extensive data on the life history of the striped bass in the Delta and its value in terms of fisherman expenditures and use have

been collected by the California Department of Fish and Game. Special studies of the relations of the bass to the Tracy Pumping Plant have been made by the Fish and Wildlife Service and the California Department of Fish and Game as described in the Preface. These data together with Bureau of Reclamation data on water relations in the Delta under Tracy Pumping Plant operation have been used to calculate anticipated losses of the annual production of striped bass and of the annual values of the resource. Some fraction of the loss of striped bass and of warm-water fishes in particular will contribute to the fishery of the Delta-Mendota Canal and waters it supplies. This form of salvage has been considered in the evaluations.

49. The value of the striped bass fishery, which is entirely a sport fishery, is estimated at $15,858,000 annually with the Tracy Pumping Plant and without the San Luis Unit diversions.

American Shad

50. Shad utilize the upper Delta as a nursery area, and the eggs are deposited in the lower reaches of the Delta tributaries. Since the eggs are laid down in shallow riffles where currents are weak, they are delayed in reaching the Delta channels. Only small losses of shad eggs are anticipated at the Tracy Pumping Plant. In respect to period of spawning and growth rate shad are very similar to striped bass. However, the young shad are delicate and easily killed which precludes salvaging any appreciable proportion of those that are attracted to the Tracy pumps.

51. The values of shad have been estimated from commercial catch records of the California Department of Fish and Game and fragmentary data on the sport fishery as modified by analogy with estimated values of the king salmon fishery.

52. The commercial value of shad with the Tracy plant and without the San Luis Unit diversions is estimated at $55,000 annually. The sport fishery for shad is evaluated at $197,000 annually under without-the-project conditions.

Catfish

53. Catfish deposit their eggs in nests in protected locations throughout the Delta mainly during July, and the young fish are guarded by both parents for a considerable period. Young and parents both maintain positions near the channel beds and in shallows where the water currents are weak. Only a small loss of catfish at the pumping plant is anticipated.

54. Values of the catfish fishery, which now is entirely a sport fishery, have been based on postal card surveys and research data of the California Department of Fish and Game as modified by estimated losses of the population expected to result from operation of the Tracy plant. The fishery value of the catfish with the Tracy plant and without the San Luis Unit diversions is estimated at $2,319,000 annually.

Largemouth Black Bass and Sunfishes

55. Black bass and sunfishes produce adhesive eggs which are deposited in nests in relatively quiet, protected waters during June and July. The eggs and fry are cared for by the parents, so that very few of the young in these stages are expected to be lost to the Tracy plant. The larger young are expected to be affected much in the same manner as similar sizes of striped bass. However, no effective loss to the sunfish population is anticipated inasmuch as these fish are considered to be underexploited and extremely productive of young.

56. Values of black bass and sunfishes are based on California Department of Fish and Game postal-card survey data modified to reflect anticipated losses at the Tracy plant. The annual value of the fishery for these species is estimated at $496,000 with the Tracy plant and without the San Luis Unit diversions.

Miscellaneous Upper Delta Fisheries

57. The steelhead trout, although of major importance as a game fish and known to migrate through Delta waters, is not considered to be affected by Tracy Pumping Plant because of its habit of migrating downstream in the second year of its life. Several additional species of fish of minor importance to commercial or sport fishing occur in upper Delta waters and may be affected by Tracy Pumping Plant. These include Sacramento smelt, freshwater smelt, top smelt, white sturgeon, green sturgeon, starry flounder, Pacific herring, Pacific anchovy, black

crappie, carp, splittail, Sacramento squawfish, Sacramento sucker, hardhead, Sacramento blackfish, and hitch. Most of these fishes either involve insignificant fishery values or the effects of the pumping plant on them is not considered significant. Probable exceptions are the Sacramento smelt and freshwater smelt which are found throughout the upper Delta throughout the year and are considered to be a very important food of striped bass. No information is available which would permit an evaluation of these smelt, but it appears likely that their populations may sustain losses comparable to those of the striped bass. White sturgeon possibly may be affected by the project, but although they recently (1954) have been returned to the game-fish list of California, they are mainly of importance as a novelty of the game-fish fauna. The rough fishes such as carp, splittail, Sacramento squawfish, hardhead, and Sacramento blackfish are exploited to some extent both commercially and for sport, but their values are very low and their populations are not considered to be easily depleted by Tracy Pumping Plant diversion.

With the Project

King Salmon

58. Diversions of water at Tracy will be increased for the San Luis Unit during all months (table 1). Of particular concern with regard to salmon is that pumping will be increased 1.7 times during March which will increase the fraction of the Delta inflow that is diverted to 2.7 times the without-the-project condition. Obviously, since about

three-fourths of the young salmon pass through the Delta during this month, king salmon will be greatly affected by the project. The effects would be doubly serious were it not for the fact that only part (up to one-half) of the Sacramento River flow, which carries most of the migrant salmon in March, is subject to diversion under foreseeable conditions (releases to the lower Delta required for navigation and salinity repulsion necessarily come from Sacramento River water). Losses will occur, of course, in months other than March with the project, but they will not be as marked in relation to without-the-project conditions. The losses anticipated are mainly of an indirect nature as discussed in previous sections, but direct losses are anticipated also. Losses will be particularly severe in years when runoff is just sufficient to balance all demands of the Delta including those of the project. In wet years surplus water will rapidly flush most of the migrants past the pump influence, while in dry years water supplies will be inadequate to supply all project demands and a smaller than average proportion of the migrants will be diverted.

59. Annual values of the king salmon with the San Luis Unit are estimated to be $2,327,000 for the commercial fishery and $8,394,000 for the sport fishery on the basis of data indicated under the without-the-project discussion.

Striped Bass

60. Pumping at Tracy for the San Luis Unit will be concentrated mainly during the period October through March (table 1) and consequently will not increase the effect of the pumping plant on striped bass to the degree that it will on salmon since their spawning period peaks in mid-May. However, since the young bass will be subjected to the direct influence of the pumps for a much longer period of their life, they are expected to experience heavier total losses than the salmon as a result of project diversions.

61. The annual value of the striped bass fishery with the project is estimated at $15,339,000 on the basis of data indicated in the without-the-project discussion.

American Shad

62. San Luis Unit diversions are expected to cause losses to the shad population of about the same severity as for the striped bass population on a relative basis. Annual values of the shad fisheries are estimated at $53,000 for the commercial and $191,000 for the sport fishery under conditions with the project.

Catfish

63. Only small losses to the catfish resource are anticipated with the San Luis Unit diversions. As indicated in the without-the-project discussion, catfish are not very susceptible to the effects of the Tracy

plant, and increased diversions with-the-project will be most marked in the season when the young catfish have passed the stages of greatest vulnerability.

64. The estimated annual value of the catfish resource of the upper Delta with the project is $2,290,000.

Largemouth Black Bass and Sunfishes

65. Effects of the increased diversion at Tracy with the San Luis Unit on black bass and sunfishes are expected to be similar to those on catfish. A small loss to the black bass population is anticipated, but a loss is not expected with the sunfishes as indicated under the without-the-project discussion.

66. The value of the fishery for largemouth black bass and sunfishes is estimated at $492,000 annually with the project.

Miscellaneous Upper Delta Fisheries

67. The project effects on Sacramento smelt and freshwater smelt are expected to be important and similar in degree to the effects on striped bass, but no means of evaluating the expected loss is available. Effects of the project on the other miscellaneous fisheries of the upper Delta (listed in the without-the-project discussion) are considered to be insignificant.

San Luis Reservoir

68. The waters to be stored in San Luis Reservoir will originate almost entirely from the Sacramento-San Joaquin Delta during the period October through April (table 1). San Luis Creek will contribute little to the reservoir storage.

69. The waters pumped from the Delta will contain appreciable quantities of nutrients added from numerous sources throughout the Central Valley and upper Delta. Considerable quantities of fish-food organisms are expected to enter the reservoir along with the pumped water. Larval and small fish also can be expected to be pumped into the reservoir from the canal (although pumping into the reservoir will be confined to the season when few larval fish will be passing through the Tracy fish screens, a stock of small fish undoubtedly will be present in the canal system as a result of previous passage through the screens in the larval stage). A great variety in this stock of small fish is anticipated including at least the following species: striped bass, shad, smelt (at least 2 spp.), white catfish, brown bullhead, large-mouth black bass, bluegill, black crappie, green sunfish, warmouth, and several species of minnows and other nongame fishes.

70. The temperatures of the water of San Luis Reservoir are expected to be comparable to those obtaining in Millerton Lake which, on the basis of monthly averages of the 3 years 1948 through 1950, ranged from 40° F. (in February) to 75° F. (in July) at the surface. The seasonal variation in water temperatures of San Luis Reservoir is

expected to be less than at Millerton Lake, and the mean temperatures are expected to be higher. The bottom water in particular is expected to be higher in San Luis Reservoir because of the differences in temperatures of the reservoir inflow. The Millerton Lake supply (San Joaquin River) rises more directly from the snowfields and is consequently colder (time and other conditions being equal) than the Delta waters from which the San Luis Reservoir supply will be pumped. Further, these colder waters enter Millerton Lake throughout the year, although mainly in winter and spring, reaching peak inflow usually in May or June. By contrast, the pumping into San Luis Reservoir will take place in the period October through April, reaching a peak in January (table 1), so that spring and summer warming of the reservoir waters will not be modified by a continuous inflow of cold waters as are those of Millerton Lake.

71. The reservoir pool level fluctuations will be severe, but the level will be fairly stable from about March 15 through May 15 which is, fortunately, the period when the basses, crappies, sunfishes, and possibly catfishes can be expected to spawn (tables 3 and 4). In addition, the reservoir is of such form that the littoral area (here defined as the area having water depth of 30 feet or less) is at a maximum when water surface levels are at or near the annual minimum so that the reservoir is expected to be productive of fish foods.

72. Based on its anticipated productiveness, its proximity to large population centers of the San Francisco Bay area, and its ready

access, San Luis Reservoir is expected to be exploited fully as regards its fishery resources. It is estimated that its use will approximate 59,000 fisherman-days annually which leads to an estimated fishery value for San Luis Reservoir of $531,000 annually.

Summary of Annual Fishery Values

73. The values of fishery resources without and with the San Luis Unit are summarized in table 11.

Table 11. Summary of fishery values without and with the San Luis Unit.

Type of fishery	Without the project	With the project	Difference
King salmon			
Commercial	$ 2,386,000	$ 2,327,000	$-59,000
Sport	8,606,000	8,394,000	-212,000
Striped bass	15,858,000	15,339,000	-519,000
American shad			
Commercial	55,000	53,000	-2,000
Sport	197,000	191,000	-6,000
Catfish	2,319,000	2,290,000	-29,000
Black bass and sunfishes	496,000	492,000	-4,000
San Luis Reservoir	--	531,000	531,000
Total	$29,917,000	$29,617,000	$-300,000

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WILDLIFE

Introduction

74. None of the San Luis Project areas are considered to be outstanding game habitat. Hot, dry summers limit the species that are able to exist on these areas. Irrigation practices already have altered the species composition of bird life on the service area, and further intensification of agriculture with the project is expected to produce further changes in game use. One of the major changes is expected to occur in waterfowl utilization of the presently unused sites of the San Luis Reservoir and the Panoche and Five Points Wasteways.

75. The proposed reservoir area is a large, shallow, dish-shaped area about 4 miles in diameter. Below the 350-foot contour the floor of the reservoir is relatively flat except in the immediate vicinity of the dam site where the valley is almost pinched off by the adjacent bluffs. Most of the flat land is in grain or rangeland. San Luis Creek, an intermittent stream with a general northeasterly course in the reservoir area, is flanked by scattered sycamores, willows, and cottonwoods. North- and east-facing slopes of the reservoir support moderate stands of scrub oak and chaparral whitethorn.

76. Present irrigation practices are rapidly using up the available ground water in the project service area. Replenishment of ground water to the area considered in the initial stage of project development is only about 213,000 acre-feet from all sources. Without the

project the acreage suitable for irrigated farming would be substantially reduced, and crops probably would revert to a pattern of one-third cotton and two-thirds barley.

77. Approximately 401,000 acres of a total of 440,000 acres of productive land in the proposed initial service area were developed for irrigation in 1950. It is estimated that much of the remaining 39,000 acres has been at least partially developed by this date and that the project will act to intensify and supplement present irrigation rather than initiate a new practice in the area. Primary crops now grown include irrigated grain and hay and cotton. Crops of secondary importance are field and truck crops, alfalfa, deciduous fruit and grapes, and irrigated pasture. Under full water supply with the project the largest increases are anticipated in alfalfa, truck crops, cotton, irrigated pasture, and field crops. A small increase in deciduous fruits and grapes is expected also. Irrigated grain and grain-hay acreage probably will be decreased by about 245,000 acres. The 1950 and the projected land-use pattern of the service area are presented in tables 10 and 6, respectively.

78. The entire area is located in the Lower Sonoran Life Zone and is basically desert or semiarid grassland or shrub grassland. Most of the area is relatively free of weeds though portions of the area are infested with Russian knapweed, alkali mallow, Jimson weed, Russian thistle, Johnson grass, and pigweed. Watergrass occurs on ditchbanks and flood and seepage areas that are generally moist.

79. Under historical conditions the bulk of the area was in shortgrass prairie, the normal habitat of the mountain plover. Irrigation development has almost eliminated this bird in the service area, and it is likely that project development will almost entirely destroy the small amount of mountain plover habitat that remains. Though harvest of this species is not permitted, there is much aesthetic value associated with it. This small killdeer-like plover is being hard pressed to retain a spot in the scheme of wildlife resources inhabiting the Central Valley of California.

Without the Project

Big Game

80. The proposed reservoir site and the service area are not used by big game as either summer or winter habitat. Columbian black-tailed deer are seen occasionally in the brushlands to the west of the reservoir, but these animals have been reported for the lowlands of the San Joaquin Valley so rarely that it is doubtful if any permanent populations exist. The region is considered to have no big-game value.

Upland Game

81. Upland-game-bird species are rare in the proposed reservoir and project service areas. Pheasants occur only in a very small portion of the eastern edge of the project near the town of Ora Loma as the result of annual plantings of this species on lands adjacent to the

service area. Conditions are reportedly too hot and dry for successful reproduction of this species except in a very small area along the eastern edge of the project generally north of the town of Mendota. Valley quail are scarce and band-tailed pigeons are entirely absent from the project areas. Mourning doves occur throughout the reservoir and service areas in considerable numbers, especially during migration when many are taken by hunters. Population and habitat-use data are insufficient to attempt an evaluation of this species. California black-tailed jackrabbits are fairly common throughout the area, and small numbers of cottontails frequent the more brushy uplands along the westerly edge as well as the bottomlands adjacent to the San Joaquin River.

Fur Animals

82. Fur-animal populations in the proposed project areas are negligible. No value is assigned to this group.

Waterfowl

83. Waterfowl use of the proposed San Luis Reservoir site and the service area is limited to that occurring in a few scattered wetlands and along existing irrigation and drainage ditches. Some grazing by geese and baldpates may occur in the upper end of the service area because of the proximity of ponded water in the Los Banos-Dos Palos area. The use for this purpose is believed to be minor and is considered in the general discussion of depredation by waterfowl under with-the-project conditions.

With the Project

Big Game

84. No change in big-game use is expected with the project.

Upland Game

85. Upland-game habitat in the San Luis Reservoir will be destroyed, at least for the annual period of inundation. Upland species might make some use of the reservoir lands, however, if such lands are planted to crops under the suggested plan for waterfowl management discussed below. With this management plan there would be cover for upland game approaching the reservoir to obtain drinking water. Quail will not normally venture out on reservoir flats without protective cover, and, since without management the shoreline would become a wide mud flat without vegetation, it may be desirable to construct and maintain quail guzzlers at about 3-mile intervals around the periphery of the reservoir.

86. It is believed that the anticipated increases in orchards, vineyards, truck crops, and alfalfa with the project will improve dove habitat in the service area to a degree commensurate with losses occurring as the result of habitat inundation by the reservoir.

87. Irrigation practices with the project will further destroy the habitat suitable for the mountain plover, though partial mitigation for this loss may result from an increase in the amount of land in irrigated pasture. No attempt has been made to evaluate this non-harvestable species.

88. Pheasants and valley quail are expected to benefit to a minor degree by increases in the alfalfa acreage as well as from the subdivision of some of the larger tracts which will provide more edgings. Low nesting success due to high summer temperatures is characteristic of this region and limits potential benefits to these species. While alfalfa normally provides good nesting cover for pheasants, much of its value is lost due to the frequency of cutting which disrupts nesting and often results in the crippling or destruction of the hen or the brood. Grain crops, on the other hand, generally will not be harvested until the broods have left the nest. Under anticipated project conditions, ditch, floodway, and wasteway banks will provide additional food as well as nesting and escape cover. In addition, there will be a more abundant water supply available throughout the service area.

89. Cottontail rabbits are expected to increase under project conditions, but such an increase probably will be accompanied by a corresponding decrease in the black-tailed jackrabbit population.

90. As the principal function of the project is to firm up the water supply to an area already under irrigation, it is not anticipated that there will be any appreciable change in upland-game values on the service area.

Fur Animals

91. The addition of more irrigation canals and ditches should increase the habitat available to fur species; however, due to the poor

quality and small number of furs harvested, no measurable change in the existing negligible fur-animal values is expected with the project.

Waterfowl

92. The Central Valley of California, a major wintering area for waterfowl of the Pacific Flyway, supports millions of birds for several months during fall and spring migrations. Waterfowl use with the project may be expected to be concentrated on the San Luis Reservoir and the wasteway reservoirs. All of these areas will have value for waterfowl whether or not they are managed specifically for these species. Delta water pumped into the San Luis Reservoir and waters surplus to irrigation needs collected in the wasteway reservoirs are expected to be fairly rich in nutriment required to support aquatic life and thus provide attraction to waterfowl and shore birds as a source of food.

93. Considerable waterfowl use data have been collected on the Grasslands located just north of the project service area and only a few miles east of the proposed reservoir site. This inland saline area is estimated to support over 30 million waterfowl days of use annually under existing conditions. Waterfowl begin to arrive in the Grasslands as early as the middle of August, and by the opening of the hunting season around the middle of October there are generally in excess of 100,000 birds. A further buildup takes place until late November when in excess of 300,000 birds may occur. Populations of this magnitude make it extremely desirable to provide areas to buffer the depredation which waterfowl make on the adjacent croplands.

94. Because of the location of the San Luis Reservoir near the axis of the Pacific Flyway and its proximity to the Grasslands, it should have a high value as a resting and feeding area. While the reservoir presumably will produce considerable aquatic food, it is probable that many of the birds would also feed in valley areas within easy flight range. The San Luis Reservoir is expected to support approximately 7 million waterfowl days' use annually without specific developments for wildlife purposes. During the period of greatest depredation in August, September, and early October the reservoir will be at a low elevation which will provide the maximum acreage of shallow water. Herding waterfowl to the area or attracting them to it by distributions of grain throughout the shallow waters might well function as a depredation control measure for a considerable radius including the depredation area around Los Banos.

95. The reservoir and wasteway areas, when appraised in the light of current use of adjacent habitat, are estimated to have a waterfowl value of $30,000 annually with the project without wildlife development. Management for waterfowl, with the planting of food crops, however, is expected to provide additional benefits under with-the-project conditions. Such treatment of the main reservoir and the wasteway reservoirs is considered in more detail in the following discussions.

Potential Waterfowl Management Areas

96. San Luis Reservoir differs from other reservoirs in the State in that it will be filled largely with water brought from the Delta via

the Tracy Pumping Plant, the Delta-Mendota Canal, and the San Luis Pumping Plant. Natural runoff from the watershed will contribute little to reservoir storage. A graph of the 20-year mean of elevations by months (figure 1) illustrates that there will be a gradual increase in water surface elevation from approximately October 1 to about April 15, after which there will be a period of receding levels until late September. The cycle of fluctuation will be similar in most years (tables 3 and 4) because of the control related to the pumping operation.

97. The probability of such a uniform cycle of fluctuation of the reservoir level suggests a number of measures which might prove valuable to waterfowl management in the Central Valley. This is especially important because of the depredation problem in the adjacent agricultural lands.

98. In addition to the possible feeding of grain, management consideration involves the planting of the drawdown area of the reservoir to some suitable food crop such as sorghum or watergrass coincident with the receding water levels from approximately mid-April through mid-September. During this period water surface elevations will drop about 100 feet which will dewater an area in excess of 5,000 acres. Rising water levels from late September to mid-January at the close of the average hunting season will reflood about 3,500 acres, approximately 3,000 of which will be reflooded during the hunting season, mid-October through mid-January.

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99. Not all of the dewatered area will be suitable for waterfowl food-crop production because of terrain features in the reservoir area. Only that land of low gradient between the 340[2/] and 390 contours appears to offer possibilities for such use. Roughly, this area will gross about 2,300 acres. During water-level recession, elevations 390 and 340 would be reached the last weeks in July and September, respectively, as shown in figure 1. Over the 50-foot difference in elevation the recession amounts to a drop of approximately 0.8 foot per day during this 2-month period. A recession of this order will dewater approximately 38 acres per day of those lands which may be suitable for crop production. Seeding of this acreage would have to be conducted on a daily or semi-weekly schedule to take advantage of suitable soil working conditions as well as to provide for the gradual ripening of grain to coincide as closely as possible with the reflooding schedule.

100. The average yield of sorghum for the State of California during the period 1944-52 was 39.3 bushels per acre which at 56 pounds per bushel amounts to about 2,200 pounds per acre. Late season plantings involving numerous adverse conditions for the production of this crop would probably reduce the yield by about 50 percent, resulting in a production of about 1,100 pounds per acre. If, however, irrigation were supplied with a low head pump system, this production may be made to more nearly approach the State average.

2/ 20-year mean low elevation, Bureau of Reclamation operation study No. SL-30.

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101. Successful crop production on the emerged reservoir lands would be dependent on a number of factors, and the effect each might have can only be surmised. It has been pointed out by Department of Agriculture personnel that there is a rather rapid decomposition of the soil structure under conditions of inundation. In this regard it is anticipated that soil conditions will not differ too radically from those accompanying rice production. Undoubtedly more than average care would have to be exercised in following schedules for disking and planting. Maximum yields will require application of fertilizers to replace nutrients leached out by the annual inundation of fields. Too, factors affecting growth such as high temperature and low humidity preclude the planting of a single crop throughout the entire recession period. Grains might be planted during the early summer period, provided there are suitable lands available, followed by a crop such as sorghum, discussed above, which representatives of the Soil Conservation Service feel has fairly good qualifications to meet conditions occasioned by mid-and late-summer plantings. Grain sorghums are grown in hot and semiarid regions throughout the world and are able to stand more heat and drought than other common cereal grains.

102. Much of the early and mid-season plantings would mature before the advent of rising water levels about the first of October. Immature late plantings, though not productive of seed, would provide forage for geese and other grazing species of waterfowl. Also, it may be pointed out here that management of the reservoir lands as described

above would tend to increase the yield of fish in the reservoir through the addition of nutrients to the water, as the lands are flooded.

103. Rough estimates for the period of the hunting season indicate that there will be a rise of approximately 0.6 foot per day or the equivalent reflooding of about 26 acres. At this rate it will take a minimum of 3 days to reach a depth of approximately 2 feet which might be considered as an average maximum tipup depth for waterfowl. Actually, dabbling ducks frequently feed in depth in excess of this figure, especially where submerged vegetation reaches nearly to the surface. Such might be the case where standing grain is inundated, so that a period of a week or more would be provided for the birds to clean up the feed at any given elevation before the depth becomes so great as to make the feed inaccessible.

104. It is estimated, based on an assumed consumption of 4 ounces of grain per bird per day, that a sorghum production of 1,100 pounds per acre could support about 4,400 bird-days per acre or a total of about 9 million waterfowl-use days for the 2,000-acre production area. This estimate assumes full utilization of the carrying capacity of the reservoir on the basis of waterfowl food production under management. With management, therefore, it is estimated there would be a total annual use of the San Luis Reservoir of about 16 million waterfowl days.

105. The value of the San Luis Reservoir under natural conditions without wildlife management is estimated to be about $25,000. With

development for waterfowl it is believed that the value of the reservoir can be increased by approximately $32,000. The estimated cost of production under management would equal approximately $30,000, leaving a net benefit of about $2,000 annually over the value without management. Use, however, would increase from 7 million to 16 million waterfowl days. The total annual waterfowl use value for San Luis Reservoir is estimated at $57,000 with wildlife development as proposed. Additional benefits also might be considered to accrue from the construction of the San Luis Reservoir in the form of savings by eliminating the need to purchase comparable lands for waterfowl use.

106. The reservoir also will assist in controlling waterfowl depredations on adjacent agricultural lands. Under existing conditions portions of the Grasslands are flooded in late August and September before the opening of the waterfowl hunting season as a depredation control measure. The purpose of such flooding is to provide areas to which birds might be attracted or herded from nearby agricultural lands before the crops are harvested. The cost of this practice, amounting to about $10,000 annually, is borne by the Fish and Wildlife Service, the California Department of Fish and Game, a group of local rice growers and the Grasslands Water District. The utility of such areas for hunting during the waterfowl season is reduced, bringing up another possibility of management. By flooding additional acreage in the Grasslands over and above the acreage presently flooded, the utilization

of these flooded areas together with the probable use of the reservoir and wasteway areas might have a greater effect on the reduction of depredation and still retain much of the value of the Grasslands areas for hunting purposes. This would entail an increase in cost of water for the flooding of such lands but might decrease the cost of herding of waterfowl by aircraft and increase the revenues to landowners from the sale of hunting privileges.

107. Additional waterfowl value with the project is expected to result from wasteway reservoirs, especially those on Panoche Creek and Cantua Creek. These areas, resembling closely the existing San Luis Wasteway, together will measure approximately 8,000 acres, including a small acreage in the wasteway channels. It is estimated the wasteways under management comparable to that exercised on the existing San Luis Wasteway will be utilized to the extent of about 325 use-days per acre annually. At this rate the total use of these areas by all species of waterfowl would equal approximately 2,600,000 days having a day-use value of $10,000. One-half this value or $5,000 is assigned the reservoirs without management. In addition, these areas probably would assist in depredation control. Though recognized, no monetary value has been assigned to such use.

108. If management of these areas for waterfowl is handled similarly to the San Luis Wasteway, it is expected that they would provide shooting in the amount of at least 9,600 hunter-days annually.

Based on the 1952-53 average per-acre harvest of the area hunted in the San Luis Wasteway the estimated annual kill in the Panoche and Cantua Creek Wasteways would equal roughly 20,000 waterfowl.

109. Other areas of minor value to waterfowl not included in the above evaluation are the Little Panoche and Arroyo Pasajero floodways totaling about 4,600 acres. The purpose of these areas is to channelize and store floodwaters for short periods and bleed them back into the San Joaquin River as rapidly as conditions will allow. Undoubtedly these areas will provide for some use by waterfowl during various periods throughout the year. Such use will be very erratic and may not occur at all during periods of low precipitation, consequently, no value is assigned to these and other smaller flood retention areas, regulating reservoirs, or terminal reservoirs.

110. The following table indicates that the estimated average annual net waterfowl value for the San Luis Reservoir and the wasteway reservoirs without management is approximately $30,000. The evaluated net gain attributable to management exclusive of other benefits not expressed in monetary terms would increase the net annual value to approximately $37,000.

Table 12. Average annual net waterfowl values, San Luis Reservoir and Panoche and Five Points Wasteways, with the project.

Area	Without waterfowl management	With waterfowl management
San Luis Reservoir	$25,000	a/ $27,000
Panoche and Five Points Wasteways	5,000	10,000
Total	$30,000	$37,000

a/ The gross value of $57,000 is reduced to $27,000 by deduction of $30,000 for waterfowl management costs.

Summary of Annual Wildlife Values

111. A comparison of annual wildlife values without and with the proposed San Luis Unit is presented in table 13.

Table 13. Summary of net wildlife values without and with the San Luis Unit.

Wildlife group	Without the project	With the project	
		Without wildlife management	With wildlife management
Big game a/	---	---	---
Upland game a/	b/ ---	---	---
Fur animals a/	---	---	---
Waterfowl	---	$30,000	$37,000
Total	---	$30,000	$37,000

a/ Dashes for these groups indicate that no monetary evaluation has been made; values in these cases are considered to be negligible.

b/ Doves have a fairly high value without the project that is not measurable because of the lack of basic data. Further, it is believed that such value will not be changed essentially with the project.

DISCUSSION

General

112. In the evaluations of the San Luis Reservoir, adequate public access to permit full utilization of the fish and wildlife resources is assumed as being a normal practice on Federal reservoirs; however, recommendations covering public access are included for the sake of completeness.

Fisheries

113. Public access to the project canals or to the Delta-Mendota Canal has not been assumed, and the fishery resources of these canals have not been evaluated. The Bureau of Reclamation normally excludes the public from its canals for reasons of safety, although the Delta-Mendota Canal provides some fishing to trespassers, especially in its lower, unlined portions. It is believed that consideration should be given to permitting public access to certain portions of the canals near population centers that are both productive of fish and can be readily provided with adequate safeguards to prevent injury or loss of human life. Establishment of such fishing sites would require cooperation of local civic or county agencies and the California Department of Fish and Game in selecting potential sites and in controlling the use once the sites are prepared. The need for such sites is expected to become greater with time, but immediate demand for such sites appears likely

in the lower reaches of the San Luis Canal where no local fishing sites are available. Therefore, it is considered in the public interest to recommend cooperation of the Bureau of Reclamation in establishment of such fishing sites if and when they are sought by responsible local agencies.

114. As indicated in the FISHERIES section, increased diversion of water at the Tracy Pumping Plant for the San Luis Unit is expected to have adverse effects on fishery resources, especially king salmon and striped bass. Evaluations of these effects have been made assuming completion of fish facilities now being developed at the Tracy Plant under without-the-project conditions. Further, it has been assumed that these fish facilities will be at least 90-percent efficient in salvaging young salmon and striped bass of lengths of 1 inch or longer which enter the facilities. If such facilities should fail to be completed or prove to be less efficient than assumed here, losses to fishery resources would be greater than those indicated. On the other hand, if the Tracy fish facilities can be made to be more efficient by salvaging a higher proportion of the affected fish or by reducing the indirect losses due, for example, to predation, losses to fishery resources would be smaller than indicated here. Consequently, it appears necessary to recommend that studies of the varied relationships of the Tracy Pumping Plant to the affected fishery resources be continued beyond the stage of development of salvage facilities to insure that damage to such resources is reduced to and held at a minimum. Also, in this regard, it is considered

desirable that preservation and propagation of fish and wildlife resources be included among the purposes for which the project is recommended to be authorized in accordance with the Act of August 27, 1954 (Public Law 674, 83rd Congress, 1st Session).

Wildlife

115. Some losses to waterfowl, especially broods, may occur in the San Luis Canal. Experience with the Delta-Mendota Canal indicates that nonflying ducks may become trapped in the canal, be unable to negotiate the steep concrete sides, and consequently perish while fighting the heavy flows. Rafts have been installed in the Delta-Mendota by the Bureau of Reclamation as resting places for these waterfowl. It appears that similar structures will be required in the San Luis Canal, and studies should be made by the Bureau of Reclamation with the co-operation of the Fish and Wildlife Service and the California Department of Fish and Game to determine the proper design and location of such structures as it may be the responsibility of the Bureau to provide.

116. The proposed San Luis Reservoir as well as the wasteways and wasteway reservoirs, particularly those on Panoche Creek and Cantua Creek, appear to have considerable potential value for waterfowl management. These are discussed more fully under that part of the report entitled Potential Waterfowl Management Areas. Owing to the magnitude of the depredation problem in the general area as well as the need for hunting sites for the unattached hunter, these areas hold great promise

to alleviate some of these pressures. Heavy increases in recreational demand make it desirable to develop these areas as valuable adjuncts to the waterfowl program for the State of California.

117. San Luis Reservoir, to be located immediately adjacent to areas of high waterfowl use, including State and Federal waterfowl management areas, appears to possess natural qualities that, through management, would result in particularly high waterfowl value. Since there are no California reservoirs of a distinctly similar nature either as to location, physical characteristics, or proposed operation, certain assumptions have been made in the analysis of waterfowl potentials. However, these assumptions are based on general knowledge of waterfowl use and management experience in the Central Valley. It is felt that wildlife agencies can develop a sound and workable waterfowl plan for the reservoir. To do so would require that suitable lands of the reservoir area be made available to Federal or State conservation agencies for the necessary development.

Report of the Fish and Wildlife Service

RECOMMENDATIONS

118. It is recommended that:

(1) The following language be incorporated in the report of the Regional Director, Bureau of Reclamation: That Federal lands and project waters in the project area be open to free use for hunting and fishing so long as title to the lands and structures remains in the Federal Government, except for sections reserved for safety, efficient operation, or protection of public property.

(2) The following language be incorporated in the report of the Regional Director, Bureau of Reclamation: That leases of Federal land in the project area reserve the right of free public access for hunting and fishing.

(3) The Bureau of Reclamation cooperate with local public agencies in establishing, insofar as practicable, safe, controlled fishing sites on the main project canals.

(4) The following language be incorporated in the recommendations of the report of the Regional Director of the Bureau of Reclamation: That additional detailed studies of fish and wildlife resources affected by the project be conducted as necessary, after the project is authorized, in accordance with Section 2 of the Act of August 14, 1946 (60 Stat. 1080); and that such reasonable modifications in the authorized project facilities be made by the Secretary as he may find appropriate to preserve and propagate these resources.

(5) The proposed wasteway and wasteway reservoir areas be made available to conservation agencies for game management and public hunting purposes under multiple-use agreements similar in nature to the existing agreement between the Bureau, the State, and private interests covering the use of the San Luis Wasteway.

(6) Such of the project lands within the San Luis Reservoir as are suitable be made available to the Fish and Wildlife Service or the California Department of Fish and Game to be utilized for game management, refuge, or public hunting purposes to the extent that such purposes do not interfere with the primary uses of the reservoir.

(7) Suitable portions of the project be placed under wildlife management pursuant to the terms of a General Plan as provided for in Section 3 of the Act of August 14, 1946 (60 Stat. 1080).

(8) The report of the Regional Director, Bureau of Reclamation, include the preservation and propagation of fish and wildlife resources among the purposes of the project as authorized by the Act of August 27, 1954 (Public Law 674, 83rd Congress, 1st Session).

CONCLUSIONS

119. It is concluded that the San Luis Unit will be detrimental to fishery resources in the net amount of $300,000 annually. Wildlife resources are expected to benefit with the San Luis Unit in the net amount of $30,000 annually. These annual values are contingent upon free public access as defined in Recommendations (1) and (2).

120. If fishing sites are established on project canals as suggested in Recommandation (3), some added fishery values would result which would reduce the anticipated losses with the project.

121. If Recommendations (4) and (7) are followed and means are found feasible for reducing the losses of fish in relation to the Tracy Pumping Plant over those presently anticipated, comparable reductions in the estimated monetary losses will result. These same recommendations (4)and (7) are intended to solve in part the potential problem of young waterfowl and other young animals becoming lost in the canals.

122. If Recommendations (5) and (6) are followed, it is estimated that an additional direct benefit to waterfowl in the amount of $7,000 annually would result. Possible extended benefits through the reduction of crop depredation have not been directly estimated.

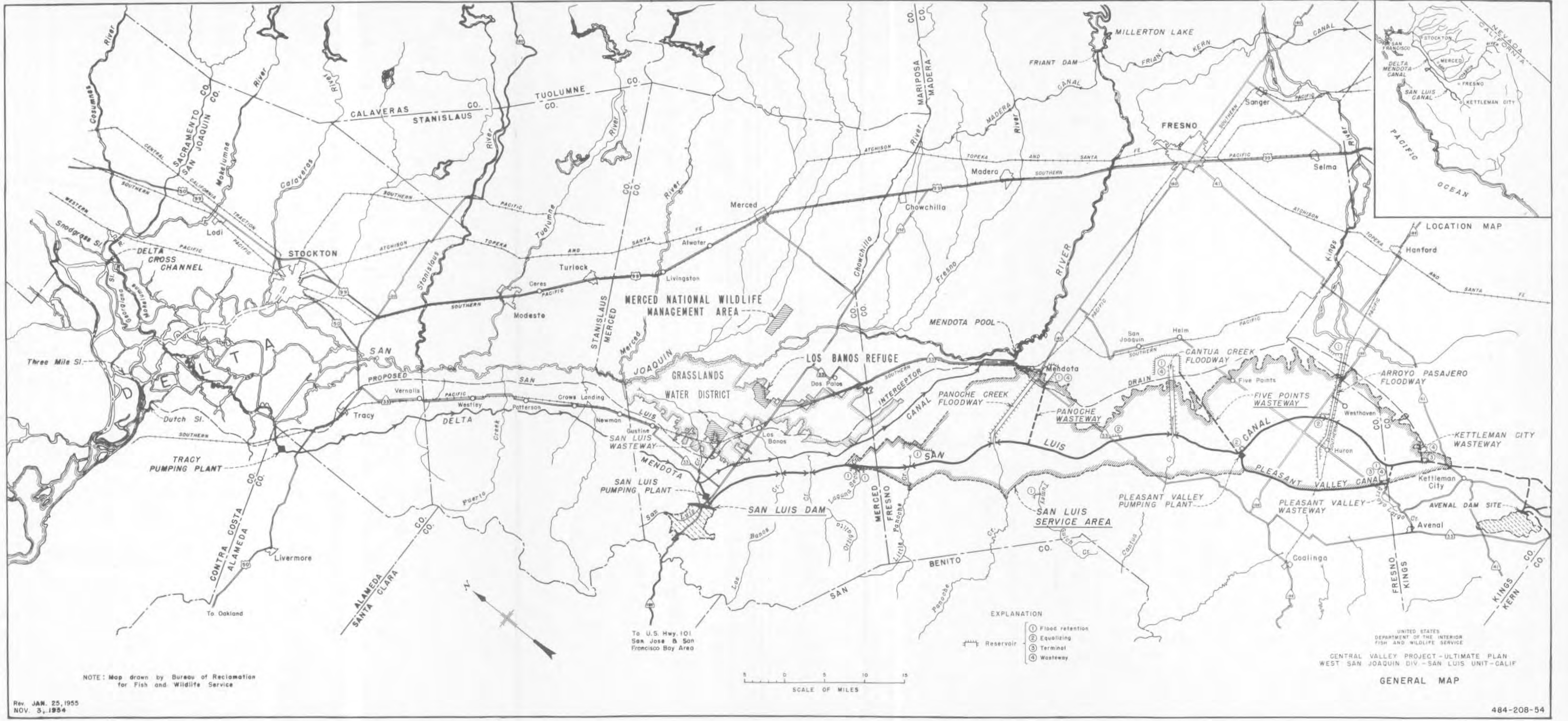
123. This report has been prepared on the basis of data obtained from the Bureau of Reclamation through August 1954. The Service should

be notified of any changes in plans for the project, so that a revised report may be prepared if required.

Leo L. Laythe, Regional Director

By: (Sgd.) Samuel J. Hutchinson
Samuel J. Hutchinson
Acting Regional Director
December 31, 1954

LAND-302



GPO 958842

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
REGION FOUR
180 New Montgomery Street
San Francisco 5, California

Project Report

RECREATION POTENTIALITIES

SAN LUIS UNIT - PROPOSED
CENTRAL VALLEY PROJECT, CALIFORNIA
for
Bureau of Reclamation
Region 2

Prepared by

E. M. Hilton
and
William L. Bigler
Reservoir Planning and Management Division

October 1953
(Revised February 1955)

Code No. XLIV/106

LAND-302

In reply refer to:
L-7423

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
REGION FOUR
San Francisco, California
180 New Montgomery Street

March 4, 1955

Mr. Clyde H. Spencer
Regional Director, Region 2
Bureau of Reclamation
Sacramento, California

Dear Mr. Spencer:

In compliance with the suggestions made in your letter of February 21 we are pleased to transmit herewith a revised report on the recreation potentialities of the proposed San Luis Reservoir, San Luis Unit, Central Valley Project, Merced County, California.

We have made the revisions to our original report which was submitted to you in October of 1953 and which have recently been discussed with members of your staff.

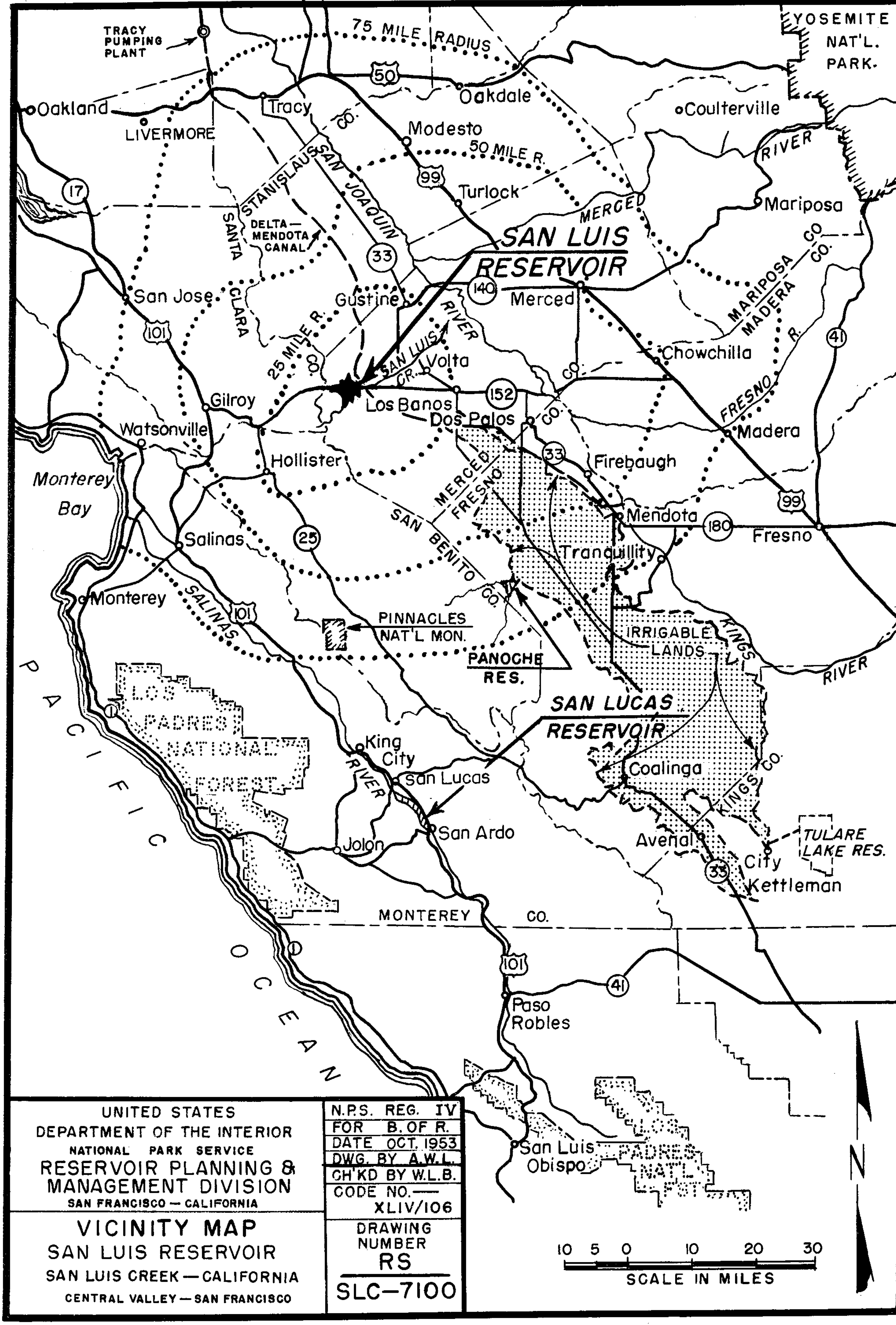
We have also added an estimate of the cost of minimum basic recreation facilities in accordance with the present policy of submitting such estimates to the Congress as non-reimbursable items and an estimate of non-Federal recreation development costs.

The estimates covering attendance and costs are necessarily conjectural as they deal with many intangibles that are difficult to evaluate and involve an attempt to foresee conditions that may or may not materialize.

Sincerely yours,

(Sgd) Lawrence C. Merriam

Lawrence C. Merriam
Regional Director



UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
RESERVOIR PLANNING & MANAGEMENT DIVISION
SAN FRANCISCO — CALIFORNIA

VICINITY MAP
SAN LUIS RESERVOIR
SAN LUIS CREEK — CALIFORNIA
CENTRAL VALLEY — SAN FRANCISCO

N.P.S. REG. IV
FOR B. OF R.
DATE OCT. 1953
DWG. BY A.W.L.
CH'KD BY W.L.B.
CODE NO.— XLIV/106

DRAWING NUMBER
RS
SLC—7100

Report of the National Park Service

C O N T E N T S

Report of the National Park Service

PROPOSED
SAN LUIS RESERVOIR
SAN LUIS UNIT, CENTRAL VALLEY PROJECT
MERCED COUNTY, CALIFORNIA

PROJECT REPORT
ON RECREATION POTENTIALITIES
for
UNITED STATES BUREAU OF RECLAMATION

INTRODUCTION

Under authority of the Park, Parkway, and Recreation Area Study Act of 1936 and in compliance with interbureau agreement, the National Park Service has prepared the following report on the recreation potentialities of the proposed San Luis Reservoir, San Luis Unit, Central Valley Project, Merced County, California.

Field investigations were made of the reservoir site August 25, 1952, by Mr. Bigler and Bureau of Reclamation officials, and by Messrs. Hilton and Bigler on July 20, 1953, with Mr. Ed. Sullivan, Assistant District Manager of the Bureau's Fresno office, Mr. Joe Carson, Engineer in Charge of Investigation and Planning, Fresno, and Mr. Vernon S. Cotter, Merced County Planning Director. During a meeting with the Merced County Planning Commission on September 24, 1952, Bureau officials explained the project in detail and National Park Service representatatives remarked on recreation possibilities. Mr. Lowell Sumner, Biologist, Region Four Office, National Park Service, secured aerial photographs of the reservoir site on October 17, 1952. Mr. Bigler consulted with State

Division of Highways district officials at Stockton, March 30, on relocation of Highway No. 152 which will be inundated by the proposed reservoir.

CONCLUSIONS AND RECOMMENDATIONS

The San Luis Reservoir site is in a hot, semiarid area, having but little vegetation, and is located near the base of the eastern slope of the Coast Range, 12 miles west of the town of Los Banos.

The primary purpose of the reservoir is for irrigation; industrial and domestic water supplies are secondary.

The area to be inundated consists of dry farmlands drained by intermittent streams.

The project will not affect any existing or proposed national, state, or local park or monument.

At present the area may be considered to have no true recreation values. The only object of interest that might be classed of importance is the historic, privately-owned San Luis adobe building which will be inundated.

A primary state highway crossing the Coast Range (summit at Pacheco Pass) will be inundated for 5.7 miles. Location of a new highway which probably will skirt the north shore for 10.5 miles is as yet indefinite.

Contemplated enlargement of the reservoir, a number of years after initial construction, would raise the water surface from 450 to

535 feet thus limiting permanent construction to elevations above the 535-foot level.

The reservoir will form an attractive body of water which will contrast with its arid surroundings. It offers a rather high potential for recreation day use mainly to the rural and town residents of the western portion of Merced County. Based upon forecasts of population increases, the total annual day-use visitation by 1960 is estimated as 126,000.

Cost of ultimate recreation developments is estimated to be $464,500. This estimate is necessarily conjectural as it deals with many intangibles that are difficult to evaluate and involves and attempt to foresee conditions that may or may not materialize. Immediate use of the reservoir when built, and demand for minimum basic recreation facilities can be foreseen. However, construction of complete facilities should be made only as need develops and probably will be spread over many years.

Considering the interest of the Merced County Planning Commission, the location within that county and that the reservoir will serve primarily the local people, it is recommended that negotiations be started with the county to be the administering agency.

It is recommended that archeological and historical investigations of the reservoir area be made prior to reservoir development.

Further study and planning are necessary. They should include more adequate definition of public use areas, application of necessary state and county health and zoning laws, and more detailed surveys of areas to be developed. Master plans should be prepared and studies correlated with both the construction and administering agencies as well as other interested local organizations.

GENERAL DESCRIPTION OF THE AREA

The San Luis Reservoir site is on San Luis Creek, an intermittent tributary of the San Joaquin River, 12 miles west of Los Banos and 29 miles east of Gilroy. The area is wholly within Merced County. Lands to be flooded are under private ownership, except for the highway right-of-way, and consist of rather large holdings.

State Highway 152 passes through the dam site and the central part of the reservoir location. Relocation of this road, one of the main arteries from the San Joaquin Valley over the Coast Range to the Santa Clara Valley, probably will require 10.5 miles of construction above the future north shore of the reservoir.

Purpose and Operation of the Reservoir

Irrigation storage is the primary purpose for which the reservoir is to be constructed; industrial and domestic water supply are secondary. Surplus winter and spring flows of the Sacramento River would be pumped into the Delta-Mendota Canal and relifted approximately 200 feet into the San Luis Reservoir from a point on the canal 66.5 miles southeast of the Tracy Pumping Plant. In its initial stage of development, the reservoir will supply a net irrigable area of

440,000 acres or a gross irrigable area of 489,200 acres of arid lands on the eastern side of the San Joaquin Valley.

At some future time enlargement of the reservoir from 1,000,000 acre-feet gross capacity to 2,000,000 acre-feet is anticipated. Such enlargement would raise the surface elevation from 450 to 535 feet, thus limiting construction of permanent recreation facilities to elevations above 535 feet. The additional storage would serve by means of the proposed San Luis-West Side canal, and branches therefrom, a gross area of 975,000 acres, extending southeasterly 113 miles to the vicinity of Kettleman City.

The following data are for a reservoir of 1,000,000 acre-foot capacity.

Water surface at:	Elevation (feet)	Capacity (acre-feet)	Surface area (acres)
Maximum pool	450	1,000,000	10,300
Average ann. max. pool	439	892,000	9,900
Average ann. min. pool	344	153,000	5,120
Minimum pool	305	25,000	1,400

At maximum pool elevation, the reservoir would be about 5.5 miles long and have a maximum width of 7.0 miles. At minimum pool elevation, the water surface would be reduced to a pool about 1.3 miles wide and 2.5 miles long.

During the main recreation-use period of April to September, inclusive, the average water surface areas, pool elevations, and draw-down during a 20-year period (October 1921 to September 1941 data) would be as follows:

Month	Pool elevations (feet)	Surface area (acres)	Drawdown (from max. pool) (nearest foot)
April	438.6	9,900	11
May	429.3	9,500	21
June	414.4	8,900	36
July	386.5	7,600	64
August	360.2	6,150	90
September	343.7	5,120	106
Average (recre. season)	395.5	8,100	55

During 10 of the 20 years, an average drawdown of 52 feet from maximum pool elevation may be expected; for 4 years, 37 feet; and for six years of less than normal precipitation, an average drawdown of 72 feet may be expected in the recreation season.

Recession will be most noticeable in the upper areas during the earlier months whereas large expanses below high water will not be exposed in the lower portions of the reservoir due to steeper side slopes. In the eastern portions, recession will extend about 1,000 feet horizontally by the middle of the season, and this distance will not be exceeded greatly even at dead storage, although the upper half of the reservoir area will be dry.

Dam Structure

This dam will be an earth fill structure, 208 feet in height above streambed elevation. Crest length, including 4 auxiliary dams, will be approximately 1.4 miles.

Report of the National Park Service

The estimated cost based on 1954 cost figures for a 1,000,000-acre-foot reservoir exclusive of recreational facilities is $52,026,000.

Physical Characteristics

The reservoir site lies in an alluvial pocket at the eastern base of the Coast Range. Except for the vicinity of the dam site, it is surrounded by hills which vary from the lower, undulating slopes on the east to the more rugged slopes of the Diablo Range on the west. The reservoir bottom is dry-farmed for grain or used as range land. The slopes above high water are range land, extremely arid in the summer and fall. The area is void of trees or other growth which might provide shade during the hot summer months except for fringes of cottonwoods, with some willows at intermittent locations along the streams, occasional oaks at higher elevations which become more profuse above the eastern extremity. Agriculture and grazing have practically eliminated any vestige of brush.

Pacheco Pass, elevation 1,386 feet, is 2-1/2 miles from the western shore. A number of intermittent streams with comparatively small drainage areas enter the plain, only two of which continue on to the great valley area: Cottonwood Creek from the north, and San Luis Creek from the south being joined by the former near the dam site. To the west, from 3 to 4 miles distant, elevations approach 2,000 feet; to the north and 1 mile from the Cottonwood arm, 1,066 feet. Northwest of the dam, an unnamed hill is 1,321 feet. Basalt Hill, occupied by a State fire-lookout, is about 1 mile east of the San Luis Creek arm of the reservoir.

At high water the reservoir will be roughly kite-shaped, 7 miles on the north-south axis, and about 5.5 miles on the transverse axis. The irregular shoreline, with numerous small bays and coves, will vary from a length of 33 miles at maximum pool to an average of 28 miles during the recreation season, and to 8.5 miles at dead storage.

Climate

High summer temperatures prevail at the reservoir site and its environs. Precipitation is light and is distributed from October to April. The 1952 annual average at Los Banos was 12.10 inches, 3.76 inches above normal. The hot summer sun beats on the arid, barren hills around the area and temperatures during the recreation season may be expected to be practically the same as for Los Banos, which is 12 miles east of the dam site, at elevation 125. The Los Banos 1952 records shown in the following table are very close to normal.

	TEMPERATURE				PRECIPITATION
	Average minimum	Lowest recorded	Average maximum	Highest recorded	(inches)
April	46.1	36	74.1	91	1.88
May	50.5	38	86.1	100	0.02
June	51.2	39	83.8	102	T
July	60.2	49	99.4	107	T
August	57.7	50	98.2	105	0.00
September	56.1	45	93.3	106	0.16

Report of the National Park Service

Public Health

The State of California, Department of Public Health, has not made an investigation of this particular area. It believes that vector control problems will be similar to those encountered at Millerton Lake. It anticipates that the two most important vector mosquitoes that may be found in the area will be Anopheles freeborni, the malaria vector, and Culex tarsalis, the vector of encephalitis if conditions favorable to their production are permitted to exist.

The Bureau of Vector Control advises complete clearing of the reservoir area to be inundated, the elimination of grazing within the areas acquired, drainage of all residual pools and borrow pits, and the elimination of vegetative growth from shallow water areas formed by draw-down. The Bureau of Vector Control desires to make an inspection of the area prior to reservoir construction and conduct periodic inspections and control operations in the area later if found advisable.

Scientific Values

An archeological investigation of the area is yet to be made. Indians through ages past had lived in the vicinity of the spring on Cottonwood Creek. Here came herds of antelope to drink and here stopped tribesmen traveling from the Coastal areas on long journeys inland.

Gabriel Moraga, termed the greatest pathfinder and Indian fighter of his day, set out from Mission San Juan Bautista on September 21, 1806, with 25 men and Father Pedro Munoz as chaplain and diarist, proceeding from Monterey Bay to the north and east, and entered the proposed reservoir area by way of San Luis Creek. After the party traveled 40 miles over a "parched and treeless plain" (the eastern portion of the now productive San Joaquin Valley), he discovered and named various streams. Among them was the Merced River which was called "El Rio de Nuestra Sonora de la Merced" (The River of our Lady of Mercy). Merced County, founded in 1857, derives its name from this river. In 1808, after an unsuccessful attempt to find suitable locations for a chain of inland missions, Moraga returned from the Merced River area, passing through the reservoir site. This time he is said to have traveled through Pacheco Pass.

Pacheco Pass was used later by numerous Spanish and Mexican officers from San Juan Bautista Mission in pursuit of deserting soldiers or runaway Mission Indians all using this route. In the 1850's it was known as the Pacheco Pass stage road and for many years was a toll road.

Overland stages stopped at the Rancho San Luis Gonzaga, later known as the San Luis Station. This historic landmark is located one-quarter mile west of the dam site, north of and adjacent to Highway 152. It will be inundated by the reservoir. Adobe buildings were erected here probably as early as 1835. One of them, in excellent condition, remains; loopholes through the walls indicate its use as protection from hostile Indians. In this building there resides one of the descendants of the Spanish-Mexican days. The Rancho San Luis

Gonzaga was granted to Jose Maria Mejia and Juan Perez Pacheco November 4, 1843. On May 3, 1931, the Native Sons of the Golden West placed a plaque on the remaining one-story adobe. San Luis Station has been a stopping place for over 100 years, by Indians, explorers, rancheros, stage coach drivers and motorists. In addition to archeological investigations, a historical study should be made of the area and the significance of the adobe building determined. Possibly some consideration should be given to its dismantling and re-erection at a suitable location above any future high water.

Ecological, botanical, zoological, and geological values are relatively unimportant in the area to be inundated. Consequently no recommendation is made for a natural history study.

Present Recreation Evaluation of Reservoir Site

In the early spring some of the upper slopes are colorful with wildflowers but the more intensively used agricultural bottom lands have negligible displays. Small mammals, such as pocket gophers, mice, ground squirrels, and cottontail rabbits are present. The western slopes have some coyote, skunk, and a few deer, but the land is posted against trespassing. The intermittent streams which will be inundated contain no fish. Views from the road descending into the area are rather comprehensive of the nearby desiccated hills and gullies, of the flat expanse of the San Joaquin Valley, and, on clear days, of the Sierra Crest 120 miles to the east.

Report of the National Park Service

There is no recreation use at present other than an occasional tourist stopping for refreshments and the limited shade available at the gas station near the adobe building; the primary aim of the traveler in the summer seems to be to get out of this hot region as soon as possible. No inducements are present along the highway to encourage a visitor to stop--on the contrary, signs are posted warning of the extreme fire hazard and grass fires that could sweep the country rapidly.

Types of Recreation Suitable to Area

A reservoir in this area will provide recreation opportunities primarily for the people in the smaller towns and those in the larger cities of the west-central San Joaquin Valley as well as for the large farm population. Topography is favorable to boater access at numerous locations despite drawdown. Expanses of bare shoreland during periods of recession have proved to be of little detriment to swimmers, picnickers, and boaters in other similar arid areas where more refreshing bodies of water are at remote distances. Sites above high water adjacent to the highway on the west side, where shade from oak trees may be had, are suitable for picnicking and for the few visitors who may desire to camp. Picnicking will be popular but comparatively few locations have any shade. The reservoir should provide a potential warm-water fishery. Climate and environment are very similar to Millerton Lake, where bass and bluegill have provided good fishing for a number of years.

FACTORS INFLUENCING RECREATION DEVELOPMENT

There is need for acquatic recreation throughout the west side of the San Joaquin Valley. San Luis Reservoir, despite its lack of shade-producing vegetation, and its heat, can meet this need in the spring and fall months. To some extent it will meet a need of the towns in closer proximity, during the hot summer months. It also will meet a need of travelers along Highway 152 who may desire a break in a long monotonous trip through the great valley--there are no wayside picnic areas even for those traveling from west of the Coast Range.

There will be no direct competition with the recreation potentialities that can be realized by the proposed San Luis Reservoir in this portion of the San Joaquin Valley. The location at the base of the Coast Range near the western extremity of Merced County is convenient to the inhabitants of the western half of that county and to the population in nearby counties. Merced County lies entirely in the lower part of the great valley and does not have comparable bodies of water. However, Yosemite Lake, 7 miles northeast of Merced, the county seat, has a number of day-use facilities administered by the municipality, and partially serves the needs of the people in this vicinity. Other competitive areas, proposed and existing lakes, such as Millerton Lake, and higher reservoirs, are east of U. S. Highway 99, and within short travel distance from the cities and towns along that highway.

To the west, beyond Pacheco Pass, is the cooler climate of the Santa Clara Valley, the Pacific Ocean beaches, and the northern portion of the Salinas Valley. Within an hour's travel distance from the San Luis Reservoir site are numerous cities and towns in intermediate fertile valleys of the Coast Range and along the coast where there are many varied attractions--state and municipal parks, beaches, drives, and resorts. Consequently, but very limited use of the reservoir may be expected from this tributary population.

Relocation of Highway 152, 5.7 miles of which will be inundated as well as crossed by the dam, probably will be made along the north side of the reservoir, according to Division of Highway officials. The route has not been surveyed. Some 10.5 miles of new construction will be necessary, this longer distance being mainly to circumvent the dam and the reservoir, and attain elevation to the west. Comparatively short spurs from the highway will make suitable recreation areas accessible for day use. There are no existing roads on the south side open to the public, primarily because of the fire hazard and since the present dirt roads are only for private access. A new road will be necessary to a junction with the dirt road southerly from the dam which leads to the Basalt Hill fire lookout and to the small Los Banos Valley. Side roads could be constructed to recreation areas along the south shore. The most suitable development area appears to be on the south side of the reservoir between the dam's south abutment and the promontory east of San Luis Creek in section 29. This area, 2.5 miles east to west, has a northerly exposure and several springs which probably could furnish sufficient water for domestic supply systems. Irrigation for necessary planting could be pumped from the lake.

State Highway 152, the main arterial highway from the coastal regions to the interior for over 80 air miles both north and south, carries a considerable volume of travel throughout the year. Traffic counts taken immediately west of the road junction in Los Banos averaged 5,600 vehicles daily in 1952. State officials estimate 11,200 vehicles daily by 1972. To the east of this junction, state figures are 8,900 vehicles daily for 1952 and the daily average estimate for 1972, 17,700 vehicles. During July, present Sunday traffic at Pacheco Pass approaches 8,000 vehicles. With a relocated highway skirting the north side of the lake, there will be a natural tendency to slow down and view the reservoir; some will seek turn-outs and spots to picnic.

The local county officials are tentatively considering the construction of a small campground in the vicinity of the highway where it will leave the lake on the west. In view of climatic conditions, and probable limited demand for such facility, a campground is not immediately recommended, but the area should be set aside for such future development if conditions warrant. Picnic facilities would be ideal here for the traveler.

Merced County's population has had an uninterrupted growth for nearly 90 years. Its 1950 population of 69,780 is estimated to increase to 100,000 by 1960. An impetus in this growth may be expected when the San Luis Reservoir, with its attendant features, is constructed. The county is a fertile agricultural area, principal production being in fruit and nut crops, field crops, dairy products, turkeys, beef, vegetables and chickens. Large areas have been devoted to cotton in the past several years on the west side of the San Joaquin River. Los Banos is the business center for an agricultural area of over 6,000 people. It has the largest milk powder factory in the world. Thirty-one and one-half percent of the county population is urban.

Although Fresno and Stanislaus Counties, adjacent to Merced County, as well as Santa Clara County, have substantially larger populations, they have a much smaller number of residents tributary to the proposed reservoir than Merced County.

A very important factor influencing development is probable enlargement of the reservoir after initial construction. The water surface would be raised 85 feet to an elevation of 535 feet. Certainly this will have an effect on location of permanent-type facilities. However, many of the day-use facilities which may be necessary below 535 feet could be designed with this consideration in mind. Excepting for utilities and roads, the expected life of recreation facilities is usually 25 years.

ESTIMATE OF RECREATION USE

Various factors discussed previously lead to the conclusion that day-use will be predominant. It is evident that the reservoir will meet a need in this western portion of the San Joaquin Valley where there are no water areas, in swimming, day and evening picnicking, boating, and fishing. Casual visitors may be expected from the through highway traffic. In the following estimate no overnight visitors are included. In time a small campground may be worthy of consideration. Unfavorable climatic conditions, aridity, lack of vegetative cover, and competing areas having more attractions would discourage campers, prospects of concessioner cabins, vacation cabin site requests, and any use by organized groups other than day use.

Within 25 miles travel distance on the eastern side of Pacheco Pass are 7,144 people (1950 census) residing in five towns of which Los Banos, 12 miles from the reservoir; has 3,883. The rural population in this zone is estimated as 3,200. Visitation is anticipated to be equivalent to at least four visits from each inhabitant yearly, or 40,600.

On the west side of Pacheco Pass, there is only one town within the 25-mile distance: Hollister, population 4,890. Rural population is light and is estimated as 600. Attendance from this area: 5,400 visits yearly.

In the area to the east of Pacheco Pass within 26- to 50-mile travel distance are 23 cities and towns having a population of 55,230. However, 9 of these urban centers are on U. S. Highway 99 and within zones of influence from competing lakes. Deducting this population, there will remain 12,800 people in 14 small towns, the largest of which is Livingston, with 900 population. Including an estimate for rural population there are about 17,000 people within 26 to 50 miles whose aquatic recreation needs will be met by the proposed reservoir. After the novelty of a new lake passes, it is estimated that 2,000 people from the excluded population will visit San Luis Reservoir each year from this zone, and that there will be 25,500 visits by the remainder, or a total of 27,500 visits.

Within the corresponding 26- to 50-mile zone on the west side of the pass is an estimated population of 30,000. Gilroy, 36 miles distant, has a population of 4,953. Watsonville, a few miles from the coast, has 11,516 (1950 census). Although there are no competing lakes in this area, other recreation attractions far surpass the proposed reservoir, consequently only 3,000 visits to it are estimated.

San Luis Reservoir is not expected to have any substantial influence in drawing people from areas beyond 50 miles travel distance. There are too many competitive areas. There are 109,000 people in towns and cities within the 50-75 mile distance on the east side of Pacheco Pass. Of these, and including some rural population, about 4,000 live on the west side of the San Joaquin River. On the east side of the pass, the urban population (51 to 75 miles) is 126,000. The estimate from both zones is 5,000 visits.

Any estimate of visits by those traveling along the arterial highway which will pass above the reservoir would be conjectural. A conservative estimate of the number of automobiles passing by the lake during the most attractive portion of the recreation season is 300,000.

Report of the National Park Service

Assuming that one in 300 might stop at nearby prepared picnic spots or to view and perhaps enjoy some form of recreation for more than a few minutes, then 3,400 visits may be expected.1/

Summary of Estimated Attendance

From population east of proposed reservoir:		
Travel distance 0-25 miles	40,600	
" " 26-50 "	27,500	
" " 51-75 "	5,000	
Subtotal		73,100
From population west of proposed reservoir:		
Travel distance 0-25 miles	5,400	
" " 26-50 "	3,000	
" " 51-75 "	5,000	
Subtotal		13,400
From arterial highway traffic		3,400
Total		89,900 (say 90,000)

Based upon forecasts of population for 1960, a conservative estimate of 126,000 is obtained. This does not include allowance for increase in population that will result from construction of the San Luis Reservoir and irrigation works.

LAND ACQUISITION

Location of the state highway above a future high-water level has not been made as yet. Present indications, according to state highway officials, are that it will be relocated along the reservoir on the north side. It is recommended that all land between the relocated highway and the future water level of 535 feet be acquired to protect recreation values. This area may be approximately 1,000 acres.

1/ Based on 3.4 persons per car.

A similar strip of land on the south side is recommended for acquisition from the dam's south abutment to and including the promontory extending from section 29, R. 8 E., T. 10 S. In this area, sufficient land should be secured to include the springs and install the minimum basic recreation facilities; possibly 800 acres are involved. It is assumed that the Bureau of Reclamation will acquire lands within 300 feet horizontally of the ultimate reservoir flow line and this would protect values along the remainder of the shoreline on the south and west sides.

ESTIMATED COST OF RECREATION DEVELOPMENT

The following judgment figures represent a reasonable and conservative evaluation of the recreation benefits accruing to the public as a result of this project. They are necessarily conjectural as they deal with many intangibles that are difficult to evaluate and involve an attempt to foresee conditions that may or may not materialize. Three small picnic grounds are contemplated on the north side: one near the north abutment; one centrally located; and another at the west end. A boat-launching ramp also is considered necessary on the north side. On the south side and westerly from the abutment is the area most suitable for more extensive picnicking facilities, bath house, and boat launching. It is probable that a trailer camp and concession development also will prove advantageous in this area.

It is reasonable to assume that the recreation construction program will be accomplished over a period of several years. Construction work should be authorized by stages and then only as need has been proved.

Report of the National Park Service

The following cost estimate, based on present conditions, will vary somewhat by standards and policies established by the administering agency. For example, a concessioner might provide some of the listed facilities in addition to refectories, structures for boat and fishing tackle rental, etc.

A total estimated recreation development cost of $464,500 is derived as follows:

Estimate of Federal Development Costs
for Initial Minimum Basic Recreation Facilities
for Day Use Only 2/

1.	Access Roads - 20 feet, shoulder to shoulder including grading, gravel and drainage structures	$32,000
2.	Parking Areas - Including grading, gravel, drainage and curbs	2,500
3.	Water - 1 Well, pump and drain 1 Gravity supply and tank	10,000
4.	Sanitation - Pit toilets	2,000
5.	Boat Launching Ramp - Grading, concrete or steel mat	5,000
6.	Day Use Picnic Areas - Including tables, stoves, refuse cans and grading	4,500
7.	Conservation Landscaping - Including grading, planting trees, shrubs, grass, water supply for same and fencing	7,500
8.	Beach Development	5,000
9.	Portable Change Rooms 3/	5,000
10.	Trails and Paths	3,500
11.	Signs and Markers	1,000
12.	Supervision, Inspection and Contingencies, 15%	11,700
	Total	$89,700 (say $90,000)

2/ A master plan for the entire project area including all proposed Federal and nonFederal developments should be prepared in advance of any construction. Such a plan could be produced by the National Park Service at an estimated cost of $20,000, if funds could be made available to the Service by the Bureau of Reclamation.

3/ This item considered basically essential due to lack of any suitable natural cover, strong likelihood of use of reservoir for swimming, and undesirable aspects of indiscriminate use of cars for changing.

Estimate of NonFederal Recreation Development Costs

The following estimate of additional development costs, include facilities to complete the major recreation development on the south side, and construct additional facilities to be located in the Pacheco Pass entrance area at the west end, Cottonwood Creek area, as well as facilities westerly of the dam on the north side. These developments may be constructed, as need occurs, over a period of several years, the cost of which must be borne by the local administering agency.

1.	Access Roads - Additional roads, widening and hard topping of roads provided under initial Federal development	$40,000
2.	Parking Areas - Providing additional parking, and hard topping areas provided in initial Federal development	28,800
3.	Water - Providing water systems and piping to various facilities	40,000
4.	Sanitation - Adequate sewage disposal systems including modern comfort stations and additional pit toilets	28,000
5.	Boat Launching Ramps - Additional	10,000
6.	Boat Docks	10,000
7.	Beach - Swimming areas, rafts, markers and towers	20,000
8.	Bath House	20,000
9.	Picnic Areas - Additional	14,000
10.	Minor campgrounds and trailer camp development	20,000
11.	Trails	4,000
12.	Utilities - Electric	8,000
13.	Utility Building	8,000
14.	Administration Building	12,000
15.	Conservation Landscaping (continued)	35,000
16.	Miscellaneous Equipment - Including truck, patrol boat, tools, etc.	20,000
17.	Planning and contingencies	56,700
	Total	$374,500
	Grand Total - Estimated Recreation Development Costs	$464,500
	Estimated annual operation and maintenance costs	$ 30,000

ESTIMATED RECREATION BENEFITS

It is estimated that the monetary value of the recreation benefits resulting from the joint use of the reservoir will be $2,021,000 and an equal amount arising specifically from the development of recreation facilities. These figures represent a reasonable and conservative evaluation of the recreation benefits accruing to the public in the judgment of the National Park Service as a result of the construction of the reservoir. They are necessarily conjectural as they deal with many intangibles that are difficult to evaluate and involve an attempt to foresee conditions that may or may not materialize. Following is a breakdown of the method used in this estimate:

Development costs	$464,500
Annual O&M costs	30,000

Annual development cost--$464,500 amortized for 25 yrs. at 2-1/2% (.0543)	$ 25,200
Annual operation & maintenance cost	30,000
Total annual cost	$ 55,200
Capital, or present, value of total annual cost--$55,200 capitalized for 100 yrs. at 2-1/2% (36.614)	$2,021,000
Existing recreation values destroyed	0
Net benefits arising specifically from development of facilities	$2,021,000
Benefits resulting from joint use of reservoir	2,021,000
Total recreation benefits	$4,042,000

RECOMMENDED AGENCY FOR ADMINISTRATION, OPERATION, AND MAINTENANCE

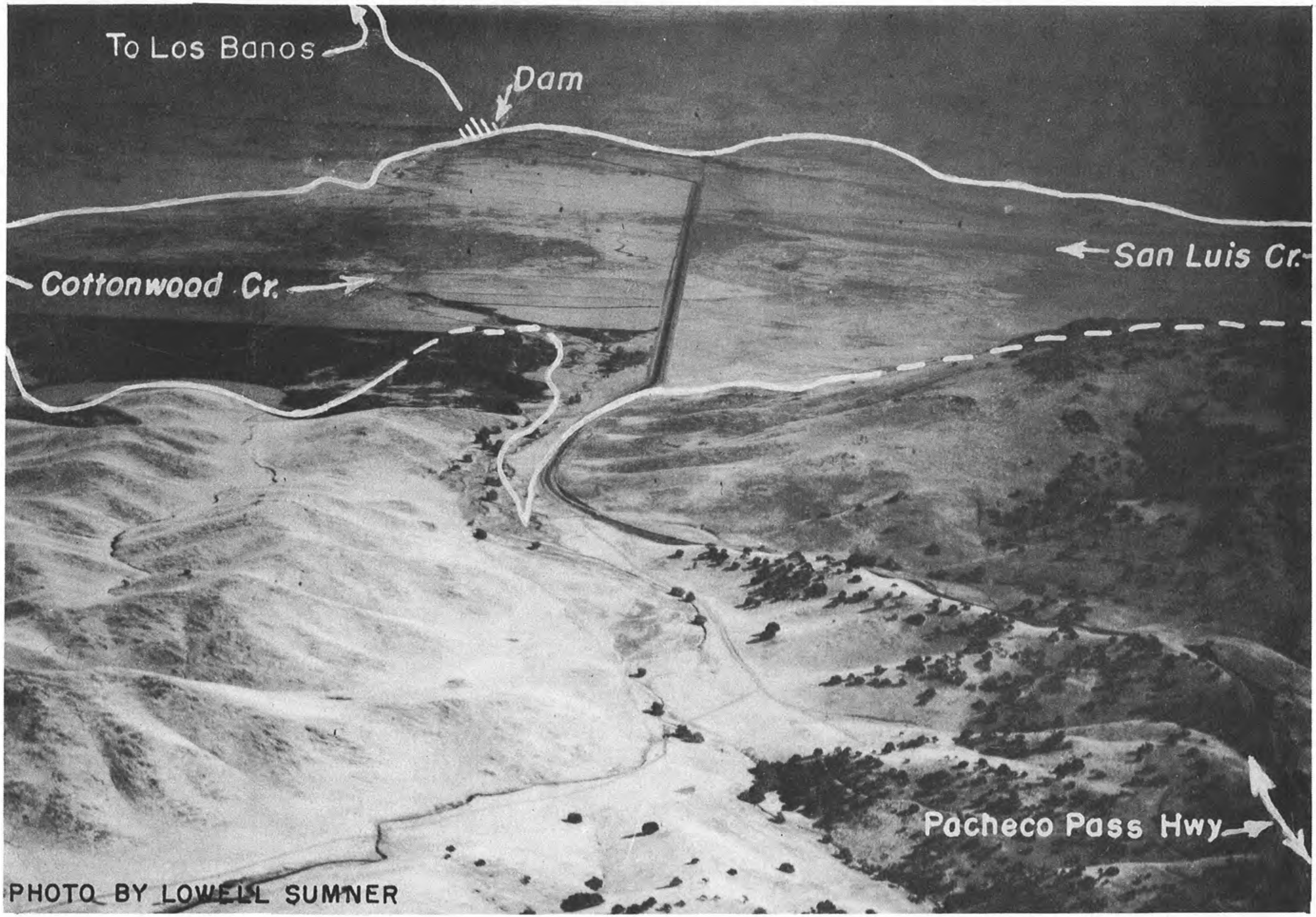
The area is of less than national significance. A county or state agency appears to be the most logical political unit to administer the recreation use of the reservoir and to maintain the facilities and features of the developed areas.

During conferences with members of the Merced County Planning Commission considerable interest was shown in the possibility of Merced County administering the recreation facilities at this reservoir. It is therefore recommended that Merced County be given first preference to be the administering agency.

FURTHER STUDY AND PLANNING

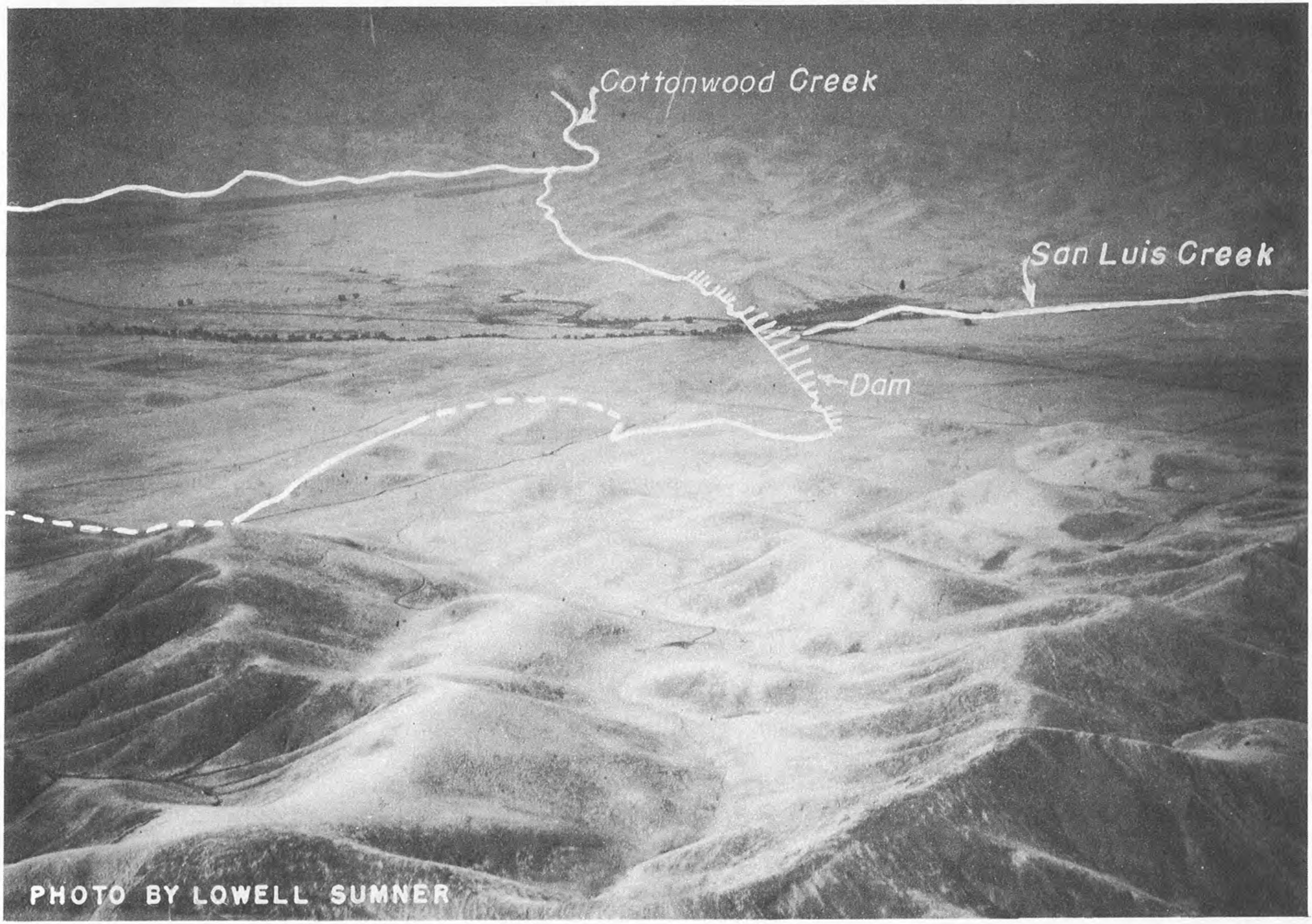
Further study and planning are necessary with all interested parties. This is of particular importance in regard to the location of the highway on the north side of the reservoir. Preparation of recreation use plans in advance of both dam and highway construction would permit integration of recreation developments and might permit economies in such developments. It is recommended that the County Planning Commission give consideration to adequate zoning along highways and neighboring properties to protect the area from incompatible and unsightly developments.

Borrow material for either the dam or the road should be obtained from locations where there will be no detrimental effect on the landscape or the recreation potentials. There are many details of planning and management that can be resolved by meetings with various agencies, by additional surveys, by determination of the most suitable development sites, and their final incorporation in a Master Recreation, Land Use, and Management Plan.



AERIAL VIEW TO THE EAST FROM VICINITY OF PACHECO PASS

GPO 968842



AERIAL VIEW NORTHWEST OVER SAN LUIS DAM SITE

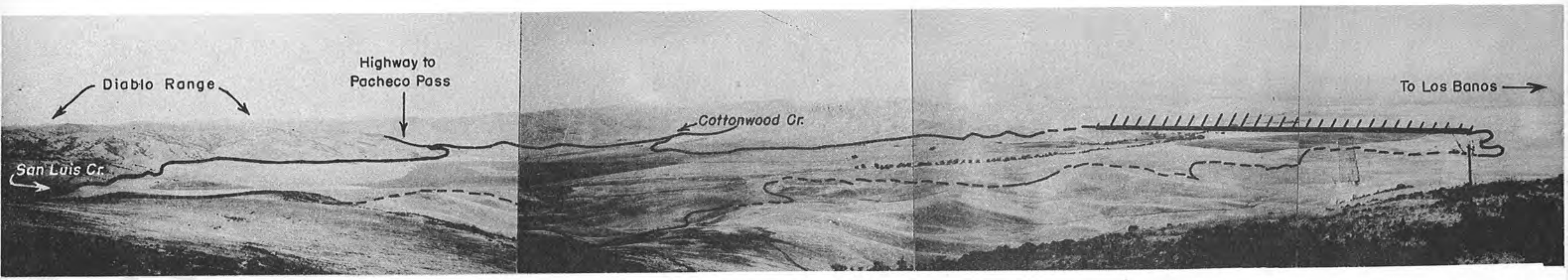
WESTERLY VIEW FROM PACHECO PASS HIGHWAY NEAR MAXIMUM HIGH WATER LEVEL. OTHER AREAS AROUND RESERVOIR ARE MORE VOID OF VEGETATION

EASTERLY VIEW NEAR PACHECO PASS HIGHWAY ABOVE WESTERN END OF RESERVOIR. NOTE TYPICAL UNDULATING, HEAVILY GRAZED HILLS

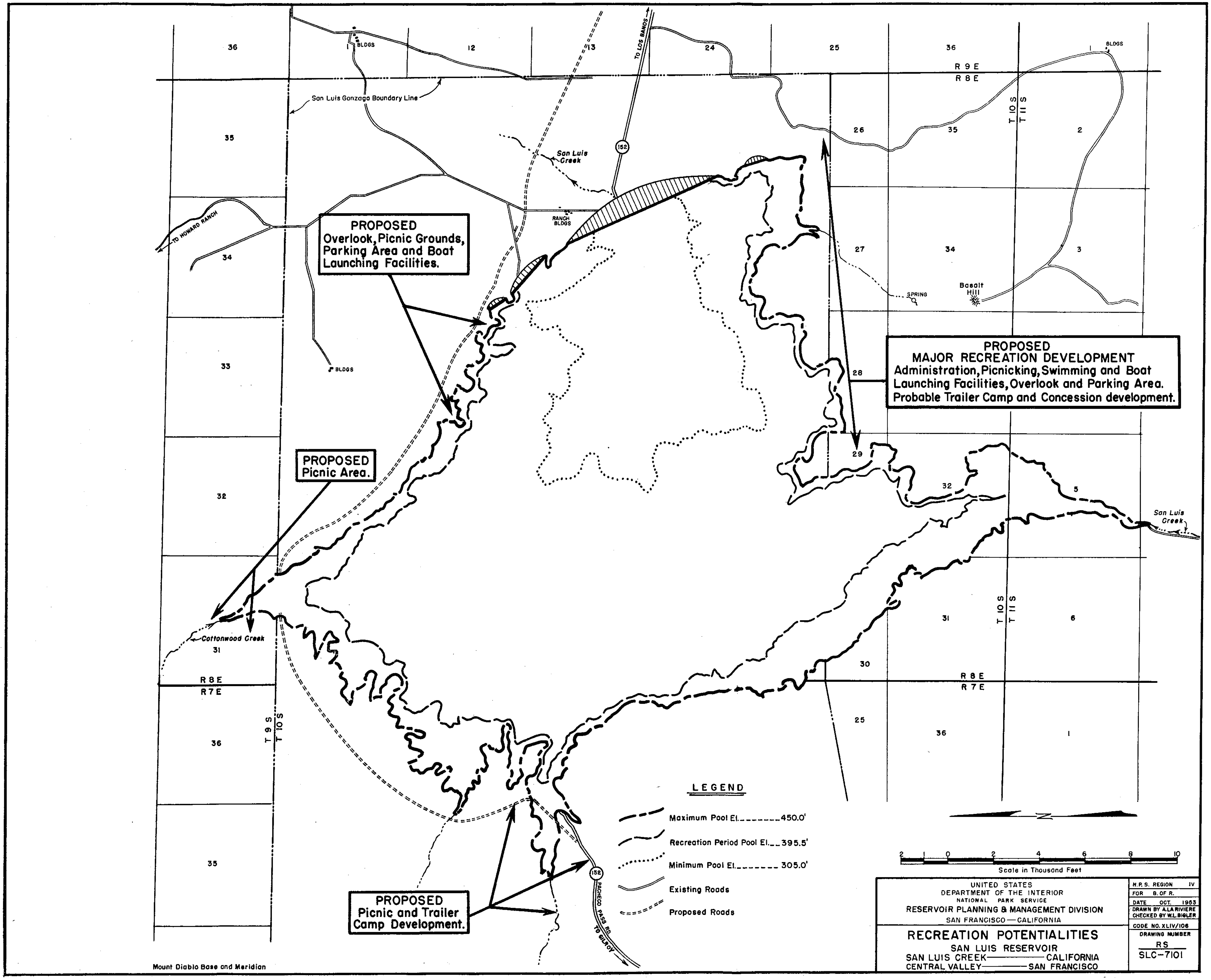
GPO 968842

LAND-302

PANORAMA NORTHERLY FROM PACHECO PASS HIGHWAY SHOWING OLD SAN LUIS RANCH ADOBE AT LEFT.
DAM SITE AT EXTREME RIGHT. AREA WILL BE INUNDATED.



PANORAMA OF SAN LUIS RESERVOIR SITE LOOKING NORTH FROM FIRE LOOKOUT ON BASALT HILL.



UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
RESERVOIR PLANNING & MANAGEMENT DIVISION
SAN FRANCISCO—CALIFORNIA

RECREATION POTENTIALITIES
SAN LUIS RESERVOIR
SAN LUIS CREEK——CALIFORNIA
CENTRAL VALLEY——SAN FRANCISCO

N.P.S. REGION IV
FOR B. OF R.
DATE OCT. 1953
DRAWN BY A.LARIVIERE
CHECKED BY W.L.BIGLER
CODE NO. XLIV/106
DRAWING NUMBER
RS
SLC-7101

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