# DON PEDRO HYDROELECTRIC PROJECT
# FERC NO. 2299

## FINAL LICENSE APPLICATION

## EXHIBIT H - PLANS AND ABILITY OF APPLICANTS TO OPERATE THE DON PEDRO HYDROELECTRIC PROJECT

## APPENDIX H-1
## FOURTH AGREEMENT

# FOURTH AGREEMENT

Between

THE CITY AND COUNTY OF SAN FRANCISCO

and

THE TURLOCK IRRIGATION DISTRICT AND THE MODESTO IRRIGATION DISTRICT

JUNE, 1966

(FULLY EXECUTED COPY)

## FOURTH AGREEMENT

## TABLE OF CONTENTS


| Art. No. | Title | Page No. |
|---|---|---|
| | Recitals | 1 |
| 1. | Scope of Agreement | 4 |
| 2. | Rights of Parties | 4 |
| 3. | The Board of Review | 4 |
| 4. | Fiscal Protection and Hold Harmless Clauses | 5 |
| 5. | Reservoir Storage Capacity | 6 |
| 6. | Flood Control Operations | 6 |
| 7. | Water Accounting | 7 |
| 8. | Water Releases; Apportionments | 10 |
| 9. | Determination of Costs and Cost Accounting | 11 |
| 10. | Responsibilities as to Project Costs | 12 |
| 11. | Disposition of Contributed Funds | 15 |
| 12. | License Conditions | 15 |
| 13. | Bonds and Insurance | 16 |
| 14. | Project Design Engineering | 16 |
| 15. | Construction Contract Bids | 16 |
| 16. | State Highway Relocation | 17 |
| 17. | County Highway Relocation | 17 |
| 18. | Recreation Plan | 17 |
| 19. | Evaluation of Bids | 17 |
| 20. | Reservations | 18 |
| | Signatures | 19 |

# F O U R T H  A G R E E M E N T

Between

THE CITY AND COUNTY OF SAN FRANCISCO

and

THE TURLOCK IRRIGATION DISTRICT AND THE MODESTO IRRIGATION DISTRICT

THIS AGREEMENT, made by and between the CITY AND COUNTY OF SAN FRANCISCO, a municipal corporation, acting by and through its Public Utilities Commission, hereinafter called "City," and the TURLOCK IRRIGATION DISTRICT and the MODESTO IRRIGATION DISTRICT, organized pursuant to the Irrigation District Law of the State of California, acting by and through their respective Boards of Directors, hereinafter called "Districts,"

WITNESSETH THAT:

1. WHEREAS, Districts and City own and operate certain water conservation facilities on the Tuolumne River for the purposes of domestic, municipal and industrial water supply, irrigation, flood control and the generation of electric power, and have operated said facilities effectively and harmoniously for many years; and

2. WHEREAS, in that certain agreement dated February 29, 1940, known as the "First Agreement," Districts and City did formally agree to continue to cooperate in a program of conservation of the waters of the Tuolumne River for their mutual benefit, and to recognize the provisions of the Act of Congress of December 19, 1913, known as the Raker Act (38 Stat. 242), as applying to Districts and City without waiving any of their rights; and,

3. WHEREAS, in that certain agreement dated November 22, 1943, known as the "Second Agreement," Districts and City did formally agree to continue the development of the Tuolumne River by cooperating in the building of the Cherry



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River Project and New Don Pedro Project and all appurtenant projects involving the use of Tuolumne River water; and,

4. WHEREAS, in that certain agreement dated June 30, 1949, known as the "Third Agreement," Districts and City did formally agree that the Districts have existing prior rights to the waters of the Tuolumne River and its tributaries, and agreed to provide for the storage, management and control of the waters of the Tuolumne River and its tributaries in such a manner as to assure, insofar as feasible, the availability of sufficient water to meet the requirements of Districts and City; and that toward this end City would first construct the Cherry Valley Project, after which the New Don Pedro Project, to be owned by Districts, would be constructed as provided by supplemental agreement; and did further agree upon their respective flood control responsibilities under a proposed contract with the United States through its Corps of Engineers, U. S. Army; and

5. WHEREAS, the United States of America, pursuant to the Flood Control Act of December 22, 1944, has entered into a contract with Districts and City dated August 29, 1949, and certified by the Federal Government on September 26, 1949, as supplemented by Supplemental Agreement No. 1, dated June 4, 1956, hereinafter called "Federal Contract," under which, in consideration for certain financial contributions to be made by the Federal Government, Districts and City agreed to provide for Tuolumne River flood control by making certain modifications in their then existing facilities and operations and by constructing the Cherry Valley Reservoir and the New Don Pedro Reservoir with New Don Pedro to provide not less than 340,000 acre feet for flood control; and

6. WHEREAS, the Cherry Valley Reservoir has been successfully completed by the City; and



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7. WHEREAS, the Legislature of the State of California has, pursuant to Chapter 282, Statutes of 1965, authorized a Davis-Grunsky Act grant of up to Seven Million Dollars ($7,000,000) for recreational functions and enhancement of fish and wildlife in connection with the construction of the New Don Pedro Reservoir; the above amount to be further increased by an estimated amount of Five Hundred Thousand Dollars ($500,000) for the provision of initial water supply and sanitary facilities under the provisions of said Davis-Grunsky Act; thereby making a grant of approximately Seven Million Five Hundred Thousand Dollars ($7,500,000) available from the State of California; and

8. WHEREAS, studies indicate that further conservation of Tuolumne River flows to provide for the needs of the Districts and the City can be accomplished by building the New Don Pedro Reservoir to its maximum capacity of approximately 2,030,000 acre feet; and

9. WHEREAS, the electors of the Districts and of the City have authorized the issuance of bonds to secure the estimated funds necessary to construct the New Don Pedro Project; and

10. WHEREAS, following application by the Districts and a hearing, the Federal Power Commission has ordered the issuance of a license to the Districts for the New Don Pedro Project (Turlock Irrigation District and Modesto Irrigation District Project No. 2299, 31 FPC510, 1128 (1964), containing certain conditions, including the filing of an agreement between Districts and City for Commission approval relating to the allocation of the total cost of the project and the acquisition of storage space in the reservoir, which proceedings have been affirmed by the United States Court of Appeals for the Ninth Circuit (California, et al. v. FPC 345 F2d 917 (1965); and

11. WHEREAS, it is now necessary to set forth the respective responsibilities of the Districts and the City in the New Don Pedro Project;

NOW, THEREFORE, the parties hereto do mutually agree as follows:

ARTICLE 1. SCOPE OF AGREEMENT

This agreement is intended to supplement and, to the extent of any inconsistency therewith, amend the provisions contained in the aforementioned First, Second and Third Agreements between Districts and City, to the end that the New Don Pedro Project, hereinafter called Project, may be constructed for the purpose of conserving water for the irrigation, domestic, municipal and industrial use requirements of the parties hereto; for flood control; for the generation of hydroelectric power; and for recreation, fish and wildlife. This Agreement shall continue in force until modified or canceled by mutual consent of the parties hereto.

ARTICLE 2. RIGHTS OF PARTIES

This Agreement does not, nor is it intended to, affect, alter, or impair in any manner the rights of the respective parties hereto in or to the waters or the use of waters of the Tuolumne River or its watershed acquired or existing under the laws of the State of California. Districts and City agree to recognize and abide by the provisions of the Raker Act as applying to Districts and City.

ARTICLE 3. THE BOARD OF REVIEW

Districts and City agree to cooperate fully to expedite the early completion of the Project, the planning and construction of which shall be under the general supervision and control of Districts. In order to keep the parties hereto fully advised regarding design progress and construction a Board of Review is hereby created. The Board shall be composed of three persons, one to be appointed by each of the parties hereto. The Board shall establish its own operating procedures. At least once each month the Board shall meet with Districts' project representatives and review progress and scheduling of the construction work, the expenditure and availability of funds, proposed contract modifications, and the matters falling within paragraphs I A, I D, and II of Appendix A of this Agreement. The Board shall arrange to have minutes kept for each of its meetings, and shall report the results of each of such meetings to the parties. The Board shall also



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make such recommendations to the parties as it sees fit to the end that a high level of cooperation is maintained among the parties and each is kept fully informed.

ARTICLE 4. FISCAL PROTECTION AND HOLD HARMLESS CLAUSES

Districts shall not award any construction contracts prior to the execution of this Agreement and its certification pursuant to Section 86 of City's Charter, nor prior to City's review and approval of the plans and specifications of such construction contracts, which approval shall not be unreasonably withheld. Districts shall proceed with planning and construction expeditiously and diligently until completion thereof, and City shall cooperate with Districts at all times to that end.

It is mutually understood and agreed that the program and conditions of this Agreement are subject on the part of City and Districts to such action as may be required by law or as required by applicable fiscal budgetary provisions of law governing City and Districts or by the necessity of bond issues, and further subject to execution of the supplemental agreement to the Federal Contract provided in Article 3b therein.

Districts agree to assume any City obligations under the Federal Contract for the construction of the New Don Pedro Project and further agree to assume all of City's obligations under the Federal Contract for flood control operation when the New Don Pedro Project is completed, provided City has made its contribution to the cost of the Project as set forth herein. Districts shall hold and save harmless City, its officers, agents, and employees, from liability of any nature or kind for and on account of any claim for damages arising as a result of the work performed or failure to meet the terms of the Federal Contract respecting the New Don Pedro Project. The New Don Pedro Project shall be owned solely by Districts, and Districts agree to maintain and operate it at their own expense, all in accordance with the terms and conditions herein.

The Districts shall have no liability for damages and shall be relieved of any obligations under this Agreement, if such damage is caused, or the performance of such obligations is prevented, by war, strikes, inability to obtain required materials, acts of God, or other causes beyond their control.

ARTICLE 5. RESERVOIR STORAGE CAPACITY

The New Don Pedro Reservoir shall be constructed to a capacity of approximately 2,030,000 acre feet; which capacity shall include 1,120,000 acre feet of Districts' storage, of which 309,000 acre feet is below minimum power pool; 570,000 acre feet storage space for use by City; and 340,000 acre feet for flood control storage space. Such portion of the 340,000 acre feet flood control storage space as is not reserved for flood control at any time shall be available 50% to Districts and 50% to City for conservation storage, thereby entitling City to a maximum of 740,000 acre feet of storage space, hereinafter called "exchange storage space."

ARTICLE 6. FLOOD CONTROL OPERATIONS

(a) Until the Project is constructed and in operation, both Districts and City agree to operate their existing reservoirs for purposes of flood control, in addition to conservation, in accordance with the provisions of the Federal Contract. City shall have the right to intercept and store water due Districts under the Raker Act and shall endeavor to maintain, insofar as feasible, sufficient storage in its reservoirs to protect Districts from loss of both irrigation and power water by reason of Districts' flood control operations. Upon demand of Districts, City agrees to release from City's reservoirs, through its powerhouses or otherwise, any or all water due Districts under the Raker Act: provided that all storage credits shall be terminated at such times as existing Don Pedro Reservoir spills or on October 31 of each year, at which time City shall own all water stored in its reservoirs.

(b) Upon completion of the New Don Pedro Reservoir, all obligations of the City and the Districts to operate any of their other reservoirs for flood control shall be terminated, and the entire flood control operation shall be transferred to the New Don Pedro Reservoir.

(c) Districts shall operate New Don Pedro Reservoir for flood control in accordance with the requirements of the Federal Contract and the applicable and valid regulations and orders of the Corps of Engineers of the United States Army. The maximum amount of space in the reservoir to be reserved for such flood control purposes is 340,000 acre feet.

ARTICLE 7. WATER ACCOUNTING

It is agreed that a principal benefit to be derived by City in return for its payment of a substantial part of the cost of the project shall be the right of City to release water to Districts when it can be stored in New Don Pedro Reservoir in advance of the time when a release thereof is required under the Raker Act and the right of City subsequently to intercept or divert equivalent quantities of water which would otherwise be required to be released to Districts, the City's advance releases being stored by Districts in New Don Pedro Reservoir and withdrawn therefrom by Districts for use in place of natural flow subsequently intercepted by City. The following provisions shall take effect upon the completion of New Don Pedro Reservoir and shall continue in effect thereafter throughout the term of this Agreement:

(a) A "Water Bank Account" shall be established and maintained by the parties in a manner to be approved by them from time to time. The Water Bank Account shall contain a detailed record of all advance releases credited to City and all debits charged to City as hereinafter provided, together with the net balance, if any, remaining to the credit of the City at all times. The Water Bank Account shall be maintained on a daily basis or such other basis as the parties may agree upon from time to time.

(b) Whenever the inflow to the New Don Pedro Reservoir from all sources exceeds whichever of the following is the smaller:

(1) The computed daily natural flow of the Tuolumne River at LaGrange Dam (as defined in the Raker Act), or

(2) The entitlement of the Districts under the Raker Act plus sixty-six (66) cubic feet per second,

then the excess shall be deemed to be natural flow of the Tuolumne River released by City to Districts in advance of the time when the release thereof is required under the Raker Act, and such excess shall be credited to City as "advance releases" and shall be treated as hereinafter provided.

(c) Whenever and to the extent that City has a credit balance in its Water Bank Account City may intercept and divert waters of the Tuolumne River above New Don Pedro Reservoir in quantities which will reduce the inflow into New Don Pedro Reservoir to less than the smaller of the two quantities hereinabove defined in paragraph (b) hereof, and the amount by which such inflow is so reduced below the smaller of said two quantities shall be charged to City in its Water Bank Account.

(d) The losses of water in storage in New Don Pedro Reservoir through evaporation and seepage shall be computed on a daily basis, and on each day when the City has a net credit balance in its Water Bank Account there shall be deducted from such balance that proportion of the day's evaporation and seepage losses which is equal to the proportion that the City's net credit balance in the Water Bank Account at the beginning of the day bears to the total volume of water then in storage in New Don Pedro Reservoir.

(e) Except with the prior consent of Districts, City shall never be entitled to have a debit balance in its Water Bank Account. With the Districts' prior approval City may create debit balances in its Water Bank Account on a temporary basis for the purpose of securing water which is necessary to maintain City's operations, but such debit balances shall be restored by City through advance releases as soon as practicable, and City shall compensate Districts in a manner to be mutually agreed upon for any damages or losses which may be suffered or incurred by Districts as a result of such action by City.

(f) The net credit balance of the City in its Water Bank Account shall never be permitted to exceed at any one time 570,000 acre feet plus one-half of the permitted encroachment in the flood control space. Whenever the City's net credit in its Water Bank Account shall equal or exceed the above, then, and so long as that condition continues, there shall be no credit to the City for advance releases pursuant to paragraph (b) hereof.

(g) Districts shall own and have exclusive control and use of all water released by City to Districts in advance pursuant to paragraph (b) hereof, may store such water in and withdraw such water from New Don Pedro Reservoir at such times and in such amounts as Districts shall see fit from time to time.

(h) For the purposes of computation, the daily natural flow of the Tuolumne River shall be deemed to be that flow which would have occurred at LaGrange Dam had no facilities of City and Districts been constructed on the Tuolumne River watershed.

(i) All computations, schedules, records and formulae used in measuring advance releases and establishing the net balance in the City's Water Bank Account from time to time shall be subject to examination and review by

authorized representatives of the parties hereto at all reasonable times. Monthly reports shall be made to the parties showing the results of all such computations and the status of the Water Bank Account on a daily basis. The correctness of each such monthly report shall be deemed to be conclusively established as between the parties in the absence of objection by any party within ninety (90) days after the delivery of such report. In the event of any objection within said period the parties shall endeavor to resolve the objection by mutual agreement, but if they are unable to do so within a reasonable time then upon request of any party the matter shall be referred to a panel of three qualified arbitrators, one appointed by City, one by Districts, and the third by the two so chosen, and the decision of a majority of the arbitrators shall be final and binding upon all parties.

ARTICLE 8. WATER RELEASES; APPORTIONMENTS.

The Districts and City recognize that Districts, as licensees under the Federal Power Commission license for the New Don Pedro Project, have certain responsibilities regarding the water release conditions contained in said license, and that such responsibilities may be changed pursuant to further proceedings before the Federal Power Commission. As to these responsibilities, as they exist under the terms of the proposed license or as they may be changed pursuant to further proceedings before the Federal Power Commission, Districts and City agree:

(a) That any burdens or changes in conditions imposed on account of benefits accruing to City shall be borne by City.

(b) That at any time Districts demonstrate that their water entitlements, as they are presently recognized by the parties, are being adversely affected by making water releases that are made to comply with Federal Power Commission license requirements, and that the Federal Power Commission has not relieved

them of such burdens, City and Districts agree that there will be a re-allocation of storage credits so as to apportion such burdens on the following basis: 51.7121% to City and 48.2879% to Districts.

In the event City and Districts cannot agree that there has been such an adverse effect and the extent thereof, these issues shall be determined by arbitration as provided in Article 7 (i) above.

(c) That in the event of such adverse effects on Districts' water entitlements, and the consequent necessity for distribution of burden therefor as provided in the foregoing subparagraph b, Districts shall forthwith seek modification by the Federal Power Commission of the water release conditions of said license.

ARTICLE 9. DETERMINATION OF COSTS AND COST ACCOUNTING

(a) Estimated Costs. Estimated Project costs made in March 1966 form the basis for the allocations of costs to the parties as made herein. The parties, however, recognize and agree that the costs to be defrayed in accordance with the allocations made shall be the actual costs of construction of the Project.

(b) Actual Costs. Actual costs of construction shall be those expenditures required in order to build the Project. In addition to the actual costs of all physical facilities, including lands, together with any relocations or replacements of facilities which Project construction may require, actual costs shall include but not be restricted to, the costs of administration, preliminary investigation, engineering, legal services and construction management.

(c) Accounting and Procedures. The Districts shall set up an accounting procedure for the Project satisfactory to the City, which shall be in accordance with the uniform system of accounts of the Federal Power Commission. Prior to awarding of any contracts for construction of the New Don Pedro Project the Districts shall select a bank or banks in which to establish accounts for all funds received and paid out in connection with the Project. Such funds shall be kept in bank accounts

separated from all other funds of the Districts. Funds covering the cost of the Project shall be deposited in these accounts by the Districts and City prior to awarding of contracts. Any interest accruing shall be credited to the City and Districts as their pro rata share of deposits earned. All payments for the Project shall be disbursed from these funds and any unused amounts at the completion of the Project shall be returned to the City and Districts as their credits indicate. The Districts shall render monthly statements to the City showing the distribution of all funds and the City's share of same. In addition, the Controller of the City shall have the right to make any investigation, inspection or audit which he may deem necessary. For the purpose of simplification, contracts awarded for construction work shall be itemized so far as practical, to separate items for City participation from items in which City does not participate.

(d) Reporting. Each party agrees that at any time, upon written request by any of the other parties, it will report the amount of funds it has available for disbursement under the terms of this Agreement. Districts agree that at any time upon written request they will furnish to City up-to-date Project cost estimates, certified statements as to Project costs actually incurred, and information as to their budgetary programs for the New Don Pedro Project.

ARTICLE 10. RESPONSIBILITIES AS TO PROJECT COSTS.

(a) Separable Costs. Of the total Project costs, Districts shall pay the costs of acquiring the site for the New Don Pedro Dam and all lands and interests in lands to be occupied by the New Don Pedro Reservoir. Districts shall also pay all costs of the Project facilities installed for the purpose of generating hydroelectric power and for operation and maintenance activity at the New Don Pedro Dam.

The costs of any modification to City's structures at Red Mountain Bar which may be necessary as a result of the construction of the New Don Pedro Project shall be borne by City. Estimates of these costs are set forth in Section I, Groups B, C and E of Appendix A incorporated herein by this reference. Each agency shall bear its own cost of interest charges during construction.

(b) Common Costs. All Project costs other than those set forth in Article 10a above shall be considered "Common Costs" to be shared by Districts and City as agreed upon herein. For purposes of cost sharing determination, common costs shall be in three general categories as follows:

(1) Construction Costs Allocated by Third Agreement - which shall include costs of: construction of a dam and appurtenances to impound a reservoir, including site clearing, of approximately 2,030,000 acre feet of capacity; including all access roads.

(2) Construction and Related Costs of Additions to Project Not Anticipated at Time of Third Agreement - which shall include costs of the relocation and reconnection, to include right of way acquisition, of all State and County highways and roads; the relocation, including right of way acquisition, or removal of any power and telephone lines or other facilities public or private; fishery studies; utilizing or acquiring, or gaining access to public lands; a recreational use plan together with facilities provided thereunder as approved by the Federal Power Commission; and any reconstruction which may be required by State or Federal authority at some future time.

(3) Other Costs - which shall include but not be restricted to costs of: preliminary engineering, legal and administrative activity; insurance, construction bonds; taxes; permits and inspections; accounting; public relations;

and administration, engineering, legal and management of construction. Estimates of common costs, insofar as these items have been identified or are available, are set forth in Sections IA, ID and II of Appendix A.

(c) Sharing of Common Costs. The sharing of Common Costs, as defined in Article 10b, shall be as follows with regard to both "construction" and "other" costs:

(1) Construction Costs Allocated by Third Agreement - shall be shared in the ratio of the estimated cost of constructing a 1,200,000 acre foot dam and reservoir to a 2,030,000 acre foot dam and reservoir, which on the basis of past studies and cost estimates yields percentages of 82.1582% for the City and 17.8418% for the Districts.

(2) Construction and Related Costs of Additions to Project Not Anticipated at Time of Third Agreement - shall be shared in the ratio of City's additional storage achieved to Districts' additional storage achieved after deductions for original Don Pedro Reservoir and minimum power pool, which yields percentages of 51.7121% for the City and 48.2879% for the Districts. Any continuing costs to the Project which might result from the Districts' deficit operation of recreational facilities required to be constructed under terms of the Federal Power Commission license will be shared by the City and Districts in the ratio established under this section.

(3) Other Costs - shall be shared in the ratio of the estimated cost of building the Project without hydroelectric power facilities to building it with such facilities, yielding percentages of 62.0201% for the City and 37.9799% for the Districts; except that items

applicable to separable costs listed in this article, section (a) above, shall be borne separately by the individual agencies.

(d) Sharing of Project Costs. The sharing of presently estimated Project costs under sections a, b, and c of this Article 10 is anticipated by the parties to be approximately as shown in Appendix A, incorporated herein by this reference.

ARTICLE 11. DISPOSITION OF CONTRIBUTED FUNDS

The Federal payments for the 340,000 acre-feet of flood control storage space in the New Don Pedro Reservoir, as provided for under Article 3b of the Federal Contract, shall be made to City. Any payments by the State or Federal Government for acquiring lands or interests in lands, or for the demolition, abandonment, relocation, or removal of buildings, and other structures, shall be made to Districts. Any payment by the State or Federal Government for recreation and fish and wildlife benefits shall be credited to the parties in the same percentages utilized for common construction costs under Article 10c2 hereof; provided, however, that the use of any money disbursed by the State of California to Districts pursuant to the portions of the Davis-Grunsky Act which provide for grants to public agencies shall be subject to the provisions of the grant contract to be executed between Districts and the State of California under that Act which regulates the use of the grant money. Any other Federal or State payments which may be made available for the New Don Pedro Project shall be allocated to Districts and City by supplemental agreement when and if they become available.

ARTICLE 12. LICENSE CONDITIONS

As a consequence of Districts' responsibilities as licensees for the New Don Pedro Project, as such responsibilities exist or may be changed pursuant to any further proceedings, City and Districts agree:

(a) To share as provided in Article 10c2 in the costs of such studies relating to the fishery of the Tuolumne River as may be required; in any

proceedings resulting therefrom; and in the costs of any facilities or program instituted as a consequence of such fishery studies or proceedings.

(b) To share as provided in Article 10c 1, 10c2, or 10c3, as appropriate, other costs arising out of Districts' responsibilities as licensees of the New Don Pedro Project.

ARTICLE 13. BONDS AND INSURANCE

Districts agree that City will be named as an additional obligee, as its interests may appear, on all labor, material, and performance bonds obtained in construction of the subject Project, as an additional insured on liability policies in force during and after construction and as an additional insured as its interests may appear on any casualty policy covering the New Don Pedro Dam and its appurtenances.

ARTICLE 14. PROJECT DESIGN ENGINEERING

As soon as practicable, following the execution of this Agreement, the Districts shall direct Bechtel Corporation to proceed with project design engineering, and preparation of plans and specifications for (a) a single construction contract with unit prices, and (b) separate supply contracts for turbines and valves, generators and busses, transformers and circuit breakers, gantry crane and gate hoist, gates and penstock and liner, and allied work necessary for the calling for bids for the construction of the New Don Pedro Project. The estimated cost of this work by Bechtel Corporation is $500,000.00. The City shall pay to the Districts, 82.1582% of the cost of the work contemplated by this paragraph relating to the construction of those items specified in Paragraph I A, of Appendix hereto. Such payment shall be made on demand of the Districts. The Districts shall pay 100% of the cost of the work contemplated by this paragraph relating to those items specified in Paragraph I B of said Appendix.

ARTICLE 15. CONSTRUCTION CONTRACTS, BIDS

Upon completion of the work contemplated by Article 14 hereof,

the Districts shall call for bids for the construction under a single construction contract with unit prices and separate supply contracts for the New Don Pedro Project.

ARTICLE 16. STATE HIGHWAY RELOCATION

The Districts shall enter into an agreement with the State of California, acting through the Division of Highways of the Department of Public Works, calling for a portion of the engineering and design work necessary for the State to proceed with the State highway relocations at a cost not to exceed $160,000.00 for the first year. The City shall pay 51.7121% of the cost thereof to the Districts at the time required by the Districts pursuant to said agreement.

ARTICLE 17. COUNTY HIGHWAY RELOCATION

The Districts shall take whatever action they may deem desirable in order to more accurately estimate the cost of relocating county highways. Provided the Districts have the prior written approval of the City for any expenditures in this regard, the City agrees to reimburse the Districts on demand 51.7121% of such expenditures.

ARTICLE 18. RECREATION PLAN

The Districts shall proceed with reasonable diligence to prepare the recreation plan required by the Federal Power Commission License and to prepare a feasibility report in support of an application for construction and facilities grants under the provisions of the Davis-Grunsky Act and to make an application for such grants. The City shall reimburse the Districts upon demand for the cost of such plan, feasibility report and application to the extent of 51.7121%, provided the cost thereof does not exceed $100,000.00.

ARTICLE 19. EVALUATION OF BIDS

Upon the receipt of bids for the construction of the New Don Pedro Project, each party shall make an estimate of the cost of the Project to it in accordance with the allocation of costs as provided herein.

In the event that (a) the estimated costs of the New Don Pedro Project to the Turlock Irrigation District, based on all factors known at that time, exceeds $28,216,904.00, the Turlock Irrigation District, at its option, may declare that the cost of the project exceeds the benefits; (b) the estimated costs of the New Don Pedro Project to the Modesto Irrigation District, based on all factors known at that time, exceeds $15,881,658.00, the Modesto Irrigation District, at its option, may declare that the cost of the project exceeds the benefits; (c) the estimated costs of the New Don Pedro Project to the City, based on all factors known at that time, exceeds $48,423,538.00, the City, at its option, may declare that the cost of the project exceeds the benefits; and upon any such declaration the parties hereto agree that no party shall be bound by this agreement except as to the provisions of Articles 14 to 19 inclusive.

ARTICLE 20. RESERVATIONS

Except with respect to Articles 14 to 19 inclusive, this Agreement is subject to (a) the approval of the Federal Power Commission, (b) the approval of the California District Securities Commission, and (c) the Districts' ability with reasonable efforts to make satisfactory arrangements for necessary county highway abandonment and relocation.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed by their respective officers thereunto duly authorized this 23rd day of May, 1966.

| TURLOCK IRRIGATION DISTRICT | MODESTO IRRIGATION DISTRICT |
|---|---|
| President | President |
| Secretary | Secretary |
| APPROVED AS TO FORM: | APPROVED AS TO FORM: |
| Chief Engineer | Chief Engineer |
| Attorney | Attorney |

CITY AND COUNTY OF SAN FRANCISCO

APPROVED AS TO FORM:

THOMAS M. O'CONNOR, City Attorney

By _____
Public Utilities Counsel

General Manager
of Public Utilities

APPROVED _____
ACTING Accounts Bureau Director

Authorized by Resolution No. 359 66
of the Board of Supervisors of the
City and County of San Francisco

Authorized by Resolution No. 66-0378
of the Public Utilities Commission
of the City and County of
San Francisco

Attest _____
Secretary and Assistant
General Manager, Administrative,
Public Utilities

NEW DON PEDRO ESTIMATE

APPENDIX A

| I. PER THIRD AGREEMENT | TOTAL COSTS | DISTRIBUTION OF COSTS CITY | MODESTO | TURLOCK |
|---|---|---|---|---|
| **A. Construction Items Allocated by Third Agreement** | | | | |
| 1. Reservoir | $ 1,420,000 | | | |
| 2. Dam | 32,639,000 | | | |
| 3. Dikes | 401,000 | | | |
| 4. Controlled Spillway | 1,540,000 | | | |
| 5. Emergency Spillway | 840,000 | | | |
| 6. Spillway Discharge Channel | 117,000 | | | |
| 7. Structure Power and Lighting | 162,000 | | | |
| 8. Diversions-Outlet Tunnel & Appurtenances | 6,000,000 | | | |
| 9. Access Roads | 780,000 | | | |
| 10. Visitors and Dam Headquarters | 250,000 | | | |
| 11. Direct Costs for City and Districts | 44,149,000 | | | |
| 12. Omissions and Contingencies | 4,690,000 | | | |
| 13. Escalations | 4,720,000 | | | |
| 14. Total | $ 53,559,000 | $ 44,003,110 | $ 3,013,926 | $ 6,541,964 |
| **B. Construction Items for Districts Only - Power Facilities** | | | | |
| 15. Power Plant Structures and Improvements | $ 2,100,000 | | | |
| 16. Power Tunnel, Penstock and Appurtenances | 5,170,000 | | | |
| 17. Tailrace | 41,000 | | | |
| 18. Turbines and Generators | 4,549,000 | | | |
| 19. Accessory Electrical Equipment | 1,133,000 | | | |
| 20. Miscellaneous Power Plant Equipment | 616,000 | | | |
| 21. Switchyard Structures | 160,000 | | | |
| 22. Switchyard Equipment | 1,416,000 | | | |
| 23. Communications | 80,000 | | | |
| 24. Direct Costs for Districts Only | 15,265,000 | | | |
| 25. Omissions and Contingencies | 1,270,000 | | | |
| 26. Escalation | 1,560,000 | | | |
| 27. Total | $ 18,095,000 | | $ 5,707,163 | $12,387,837 |

NEW DON PEDRO ESTIMATE (Cont'd.)

| | TOTAL COSTS | DISTRIBUTION OF COSTS: CITY | MODESTO | TURLOCK |
|---|---|---|---|---|
| C. Construction Items for City Only | | | | |
| 28. Modification of Red Mountain Bar Siphon--- $ | 1,000,000 | | | |
| 29. Omissions and Contingencies---------- | 100,000 | | | |
| 30. Escalation---------- | 50,000 | | | |
| 31. Total---------- | 1,150,000 | $ 1,150,000 | | |
| 32. Total Construction Cost of Dam, Reservoir and Power Facilities and Red Mountain Bar Modification $ | 72,804,000 | $45,153,110 | $ 8,721,089 | $ 18,929,801 |
| D. Administrative Items Applicable to Construction Costs Allocated by Third Agreement | | | | |
| 33. Administration, Legal, Taxes & General Expense | 1,000,000 | | | |
| 34. Engineering & Management of Construction---- | | | | |
| 35. On Specific Construction Costs---------- | 5,370,000 | | | |
| 36. From Project Delay---------- | 550,000 | | | |
| 37. Total---------- | 6,920,000 | 4,291,791 | 828,940 | 1,799,269 |
| 38. Total Construction & Related Costs to City and Districts $ | 79,724,000 | | | |
| E. Other Districts' Costs | | | | |
| 39. Reservoir Lands----------$ | 3,406,000 | | | |
| 40. Omissions, Contingencies, Engineering & Administration---------- | 340,600 | | 1,181,678 | 2,564,922 |
| 41. Transmission Lines (Incl. O&C, Escal., Eng. Administration)---------- | 4,337,000 | | 3,215,000 | 1,122,000 |
| 42. Buildings & Grounds for Project Operation & Maintenance---------- | 250,000 | | 78,850 | 171,150 |
| 43. Total Other Districts' Costs---------- $ | 8,333,600 | | $ 4,475,528 | $ 3,858,072 |
| II. ADDITIONS TO PROJECT COSTS NOT ANTICIPATED AT TIME OF THIRD AGREEMENT | | | | |
| 44. Relocation of State and County Roads $ | 8,200,000 | | | |
| 45. Omissions, Contingencies, Eng. & Admin. | 820,000 | | | |
| 46. Recreation---------- | 1,250,000 | | | |
| 47. Omissions, Contingencies, Eng. & Admin. | 100,000 | | | |
| 48. Total----------$ | 10,370,000 | $ 5,362,545 | $ 1,579,351 | $ 3,428,104 |
| 49. Net Project Estimate----------$ | 98,427,600 | $54,807,446 | $15,604,908 | $28,015,246 |

NEW DON PEDRO ESTIMATE (Cont'd.)

| | | TOTAL COSTS | DISTRIBUTION OF COSTS | | |
|---|---|---|---|---|---|
| | | | CITY | MODESTO | TURLOCK |
| III. | FINANCING COSTS | | | | |
| 50. | City's Interest During Construction (3%) | $ 2,958,500 | $ 2,958,500 | | |
| 51. | Districts' Interest During Construction (3-3/4%) | 4,100,000 | | $ 1,419,000 | $ 2,681,000 |
| 52. | Total Financing Cost | 7,058,500 | 2,958,500 | 1,419,000 | 2,681,000 |
| 53. | Gross Project Estimate---------- | $ 105,486,100 | 57,765,946 | 17,023,908 | 30,696,246 |
| 54. | Flood Control---------- | | - 5,464,000 | | |
| 55. | Devis-Grunsky---------- | | - 3,878,408 | - 1,142,250 | - 2,479,342 |
| 56. | Net---------- | | $ 48,423,538 | $ 15,881,658 | $ 28,216,904 |

NOTES:

1. The ratio of 0.821582 for City participation is taken from the comparison of the 1959 Bechtel estimate of a 1,200,000 acre feet reservoir to a 2,030,000 acre feet reservoir as estimated on September 28, 1962 for the FPC hearing. ($35,853,000 ÷ $43,639,000 = 0.821582).

2. The ratio of 0.620201 for City participation in the administrative items applicable to construction costs allocated by Third Agreement is determined by comparison of City's participation in the construction of the dam, reservoir, power facilities and Red Mountain Bar Siphon modification to the Districts' participation in these costs. ($45,153,110 ÷ $72,804,000 = 0.620201).

3. The ratio of 0.517121 for City participation in Additions to Project Costs Not Anticipated At Time of Third Agreement is determined by comparison of City's additional storage achieved to Districts' additional storage achieved after deductions for original Don Pedro Reservoir, and minimum power pool. (740,000 ÷ 1,431,000 = 0.517121). (691,000 ÷ 1,431,000 = 0.482879).

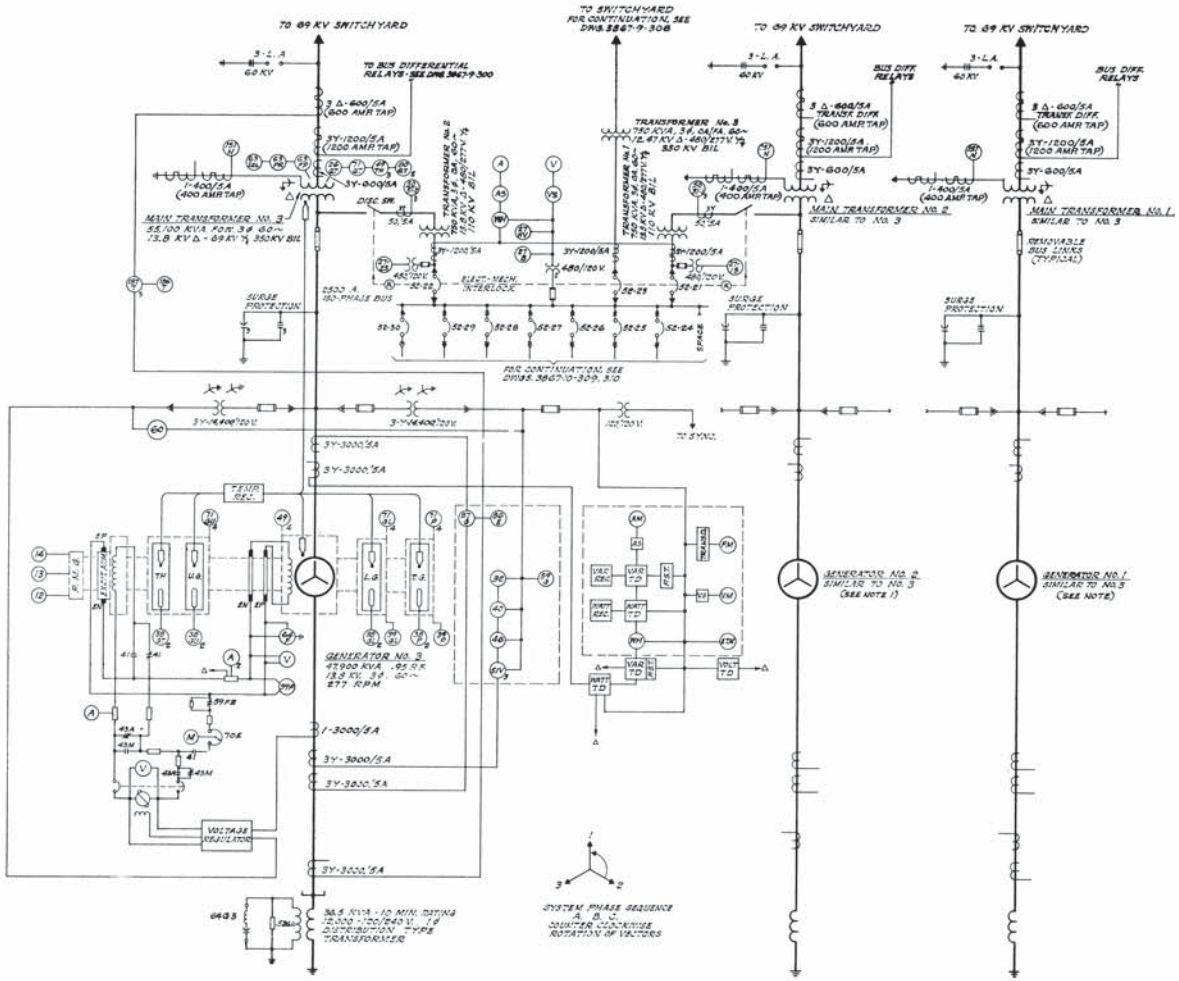
4. The Legislature has authorized a Davis-Grunsky grant of up to $7,500,000 which will accrue as a contribution to the Project. This amount will be distributed to the City and Districts in proportion to the amounts of additional storage achieved. (See Note 3 for ratios.)

# DON PEDRO HYDROELECTRIC PROJECT
# FERC NO. 2299

## FINAL LICENSE APPLICATION

## EXHIBIT H - PLANS AND ABILITY OF APPLICANTS TO OPERATE THE DON PEDRO HYDROELECTRIC PROJECT

## APPENDIX H-2
## SINGLE LINE DIAGRAM




This Drawing is a revision of an Exhibit previously approved as a part of the License for Project No. 2299, submitted by the undersigned in accordance with Article 2 of said License this 5th day of August 1974.

Turlock Irrigation District — President, Board of Directors

Modesto Irrigation District — President, Board of Directors

EXHIBIT L SHEET 11

PROJECT NO. 2299 CALIFORNIA

TURLOCK IRRIGATION DISTRICT
MODESTO IRRIGATION DISTRICT

# DON PEDRO PROJECT

TUOLUMNE RIVER

## ELECTRICAL

POWERHOUSE MAIN SINGLE LINE DIAGRAM

2299 - 128

# DON PEDRO HYDROELECTRIC PROJECT
# FERC NO. 2299

## FINAL LICENSE APPLICATION

## EXHIBIT H - PLANS AND ABILITY OF APPLICANTS TO OPERATE THE DON PEDRO HYDROELECTRIC PROJECT

## APPENDIX H-3
## 1972 ARMY CORPS OF ENGINEERS FLOOD CONTROL MANUAL

# DON PEDRO LAKE

## Tuolumne River, California

# RESERVOIR REGULATION FOR FLOOD CONTROL

AUGUST 1972

DEPARTMENT OF THE ARMY

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

# DON PEDRO DAM AND LAKE

## PERSONNEL CONCERNED WITH THE PROJECT OPERATION

| LOCATION | OFFICE PHONE(S) | NAME | HOME PHONE(S) |
|---|---|---|---|
| **PROJECT OWNERS/OPERATORS** | | | |
| **TURLOCK IRRIGATION DISTRICT** | | | |
| 333 East Canal Drive<br>Turlock CA 95381-0949 | Ofc (209) 883-8210<br>Ofc2 (209) 883-8211 | Chris L. Kiriakou<br>Interim General Mgr. | Hm (209) 634-3294 |
| | Ofc (209) 883-8325<br>Ofc2 (209) 883-8431 | Robert Hondeville<br>Energy Resources Admin. | |
| | Ofc (209) 883-8431 | Ron Butcher<br>Operations | Hm (209) 667-2438 |
| | Ofc (209) 883-8214 | Robert Nees<br>Administrator | Hm (209) 632-7321 |
| | Ofc (209) 883-8478 | Tim Gormley<br>tmgormley@tid.org | |
| | Ofc (209) 883-8321<br>Fax (209) 656-2147 | Wes Monier<br>Utility Analyst<br>fwmonier@tid.org | Hm (209) 357-3143<br>Pgr (209) 341-1307<br>Cell (209) 602-2463 |
| Control Center<br>901 N. Broadway Street<br>Turlock CA 95380-3012 | Ofc (209) 883-8480 | Staffed 24 Hours | |
| **U.S. ARMY CORPS OF ENGINEERS** | | | |
| Sacramento District<br>1325 J Street<br>Sacramento CA 95814-2922 | Ofc (916) 557-7490* | Col. Michael J. Walsh<br>District Engineer<br>mwalsh@spk.usace.army.mil | |
| Water Management Section | Ofc (916) 557-7101*<br>Fax (916) 557-7863 | Paul E. Pugner<br>Chief<br>ppugner@spk.usace.army.mil | Hm (916) 965-6669 |

| U.S. ARMY CORPS OF ENGINEERS | | | |
|---|---|---|---|
| Water Management Section | Ofc (916) 557-7105*<br>Fax (916) 557-7863 | Tom Patton<br>Water Manager<br>tpatton@spk.usace.army.mil | Hm (916) 454-0449 |
| | Ofc (916) 557-7110*<br>Fax (916) 557-7863<br>Ofc2 (916) 557-7120 | Ralph H. Johonnot<br>Hydrologic Data<br>rjohonnot@spk.usace.army.mil | Hm (916) 723-7252 |
| * For Emergencies During Non-Duty Hours Call: | Emer (916) 452-1535 | EMERGENCY NUMBER | |

| ADDITIONAL POINTS OF CONTACT | | | |
|---|---|---|---|
| **CALIFORNIA/NEVADA RIVER FORECAST CENTER** | | | |
| 3310 El Camino Ave. Ste 227<br>Sacramento CA 95821- | Ofc (916) 979-3056<br>Fax (916) 979-3067 | Rob Hartman | Hm (916) 786-4697 |
| **NATIONAL WEATHER SERVICE** | | | |
| 3310 El Camino Ave. Ste 228<br>Sacramento CA 95821- | Ofc (916) 979-3051<br>Fax (916) 979-3067<br>Emer (916) 979-3049 | | |
| **OFFICE OF EMERGENCY SERVICES** | | | |
| 1100 H Street<br>Modesto CA 95354- | Ofc (209) 525-4650<br>Fax (209) 525-5008 | Russ Richards<br>For Stanislaus County | |
| **SACRAMENTO FLOOD CENTER** | | | |
| California DWR<br>P. O. Box 219000<br>Sacramento CA 95821-9000 | Emer (800) 952-5530 | Eric Butler<br>Chief | |

Revised 10-Dec-99

DON PEDRO DAM AND SPILLWAY

Furnished by Modesto and Turlock Irrigation Districts.

# DON PEDRO LAKE

# TUOLUMNE RIVER, CALIFORNIA

## PERTINENT DATA

### GENERAL

**Drainage Areas (sq. mi.)**

| | |
|---|---|
| Tuolumne River at Don Pedro Dam | 1,533 |
| Eleanor Creek at Lake Eleanor | 78 |
| Cherry Creek at Cherry Valley Dam | 117 |
| Tuolumne River at Hetch Hetchy Dam | 455 |
| Tuolumne River at LaGrange Dam | 1,537 |
| Tuolumne River at mouth | 1,958 |

**Flow at Don Pedro Dam**

| | |
|---|---|
| Mean annual runoff (1896-1969) | 1,851,000 ac-ft |
| Average flow (1896-1969) | 2,555 c.f.s. |
| Minimum of record (27 Dec. 1922) | 2.1 c.f.s. |
| Maximum of record (18 Dec. 1950) | 61,000 c.f.s. |
| Maximum natural during record (23 Dec. 1955) | 160,000 c.f.s. |
| Standard project peak inflow (snowmelt) | 28,400 c.f.s. |
| Standard project peak inflow (rainflood) | 260,000 c.f.s. |
| Spillway design peak inflow | 602,000 c.f.s. |

### DON PEDRO DAM AND LAKE

**Main Dam (Earth and Rockfill)**

| | |
|---|---|
| Crest elevation | 855 ft |
| Crest width | 40 ft |
| Crest length | 1,900 ft |
| Maximum height above foundation (approx.) | 585 ft |
| Freeboard above spillway design flood pool | 5 ft |
| Volume of fill (approx.) | 16,750,000 cu yd |

**Spillways**

| | |
|---|---|
| **Gated, ogee section** | |
| Crest length | 135 ft |
| Crest elevation | 800 ft |
| Gates (Tainter) | 3 - 45'-0"x30'0" |
| Capacity (elev. 830') | 78,000 c.f.s. |
| Capacity (elev. 850') | 172,500 c.f.s. |
| **Ungated, ogee section** | |
| Crest length | 995 ft |
| Crest elevation | 830 ft |
| Capacity (elev. 850') | 300,000 c.f.s. |
| Total capacity (elev. 850') | 472,500 c.f.s. |

**Reservoir**

| | |
|---|---|
| **Elevation** | |
| Minimum power pool | 600.0 ft |
| Bottom of flood control pool | 802.0 ft |
| Gross pool | 830.0 ft |
| Spillway design flood pool | 850.0 ft |
| **Area** | |
| Minimum power pool | 3,520 ac |
| Bottom of flood control pool | 11,260 ac |
| Gross pool | 12,960 ac |
| Spillway design flood pool | 14,240 ac |
| **Storage capacity** | |
| Minimum power pool | 309,000 ac-ft |
| Bottom of flood control pool | 1,690,000 ac-ft |
| Gross pool | 2,030,000 ac-ft |
| Spillway design flood pool | 2,301,000 ac-ft |

### OUTLET WORKS

| | |
|---|---|
| Type | Lined tunnel controlled by slide gates |
| Tunnel length | 3,500 ft (approx.) |
| Tunnel diameter | 12 ft concrete lined enlarging to 30 ft |
| Upstream inlet invert elev. | 342 ft |
| Downstream ℄ elev. of outlet | 310 ft |
| Outlet controls | 3 parallel outlets, each with two 4'x5' slide gates in tandem |
| Capacity (at elev. 830') | 7,370 c.f.s. |

### POWER CONDUIT

| | |
|---|---|
| Length along ℄ | 2,960 ft |
| Tunnel diameter | 18'6" concrete-lined<br>16'6" and 16'0" steel-lined |
| Inlet invert elev. | 525 ft |
| Outlet portal ℄ elev. | 299 ft |
| Bulkhead gate | 22'0" high x 14'0" wide hydraulically operated |
| Emergency closure gate | 21'0" high x 12'0" wide hydraulically operated fixed wheel gate |

### POWERHOUSE

| | |
|---|---|
| Number of units | 3 |
| Turbines | 70,000 HP at 450' NEH (Francis-type) |
| Generators | 47,900 KVA at .95 p.f. |
| Elevation of ℄ of distributor | 299.0 ft |
| Maximum static head (830-299) | 531.0 ft |
| Full gate discharge | 1,500 c.f.s./gate |
| Maximum discharge through turbines | 4,500 c.f.s. |
| Turbine shut-off valve | 115" horiz. shaft (Butterfly-type) |
| Pressure regulator valve | 50" fixed-cone dispersion type |
| Flood control valve | 72" hollow-jet type |
| Maximum discharge through F.C. valve | 3,140 c.f.s. |

DON PEDRO DAM AND LAKE
TUOLUMNE RIVER, CALIFORNIA

# REPORT ON RESERVOIR REGULATION FOR FLOOD CONTROL

APPENDIX IV
TO
MASTER MANUAL OF RESERVOIR REGULATION
SAN JOAQUIN RIVER BASIN, CALIFORNIA

AUGUST 1972

Department of the Army
Sacramento District, Corps of Engineers
Sacramento, California



Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G

REPORT ON RESERVOIR REGULATION
FOR FLOOD CONTROL

DON PEDRO DAM AND LAKE
TUOLUMNE RIVER, CALIFORNIA

TABLE OF CONTENTS


| Paragraph | Subject | Page |
|---|---|---|
| | Pertinent Data | Inside Cover |
| | Photo - Don Pedro Dam and Spillway | |
| | Personnel | Frontispiece |
| | CHAPTER I - GENERAL INFORMATION | |
| 1. | Authority and Scope | 1 |
| 2. | Authorization for Flood Control Allocation | 1 |
| | CHAPTER II - BASIN DESCRIPTION | |
| 3. | Description of the Area | 3 |
| 4. | Climate | 4 |
| 5. | Runoff Characteristics | 6 |
| 6. | Flood Characteristics | 7 |
| 7. | Areas Subject to Flooding | 9 |
| | CHAPTER III - FLOOD POTENTIAL | |
| 8. | Rain-Flood Potential | 10 |
| 9. | Snowmelt Flood Potential | 10 |
| 10. | Seasonal Variation of Rain-Flood Potential | 10 |
| | CHAPTER IV - FLOOD CONTROL DESIGN REQUIREMENTS | |
| 11. | Reservoir Design Rain Flood | 11 |
| 12. | Rain-Flood Space Requirements | 11 |
| 13. | Reservoir Design Snowmelt Flood | 12 |
| 14. | Snowmelt Flood Space Requirements | 13 |
| 15. | Multiple Use of Reservoir Space | 13 |
| 16. | Flood Control Diagram | 14 |
| 17. | Credit for Upstream Storage Space | 15 |
| 18. | Monthly Space Requirements Under Historical Conditions | 16 |
| | CHAPTER V - PROJECT FEATURES | |
| 19. | Description of Project | 17 |
| 20. | Recreation Facilities | 19 |
| 21. | Construction History | 19 |

## TABLE OF CONTENTS (Cont'd)


| Paragraph | Subject | Page |
|---|---|---|
| | CHAPTER VI - GENERAL PROJECT OPERATION | |
| 22. | Responsibility for Operation | 21 |
| 23. | Upstream Regulation | 21 |
| 24. | Downstream Regulation | 21 |
| 25. | Downstream Channel Capacities | 21 |
| 26. | Flood Damages | 22 |
| 27. | Conservation Operation | 23 |
| 28. | Power Releases | 23 |
| 29. | Relation to Other Projects | 23 |
| | CHAPTER VII - OPERATIONAL CONTROLS | |
| 30. | Hydrologic Facilities | 24 |
| 31. | Forecasts of Inflow | 24 |
| 32. | Coordination with Other Agencies | 26 |
| | CHAPTER VIII - PROJECT ACCOMPLISHMENTS | |
| 33. | Examples of Operation | 27 |
| 34. | Operation Record | 27 |
| | CHAPTER IX - STUDIES IN PROGRESS OR PLANNED | |
| 35. | Current Studies | 28 |


## LIST OF CHARTS


| Chart No. | |
|---|---|
| 1 | General Map |
| 2 | Topography and Stream Gaging Stations |
| 3 | Tuolumne River Stream Profile |
| 4 | Normal Annual Precipitation, Climatological Stations and Snow Courses |
| 5 | Computed Natural Flow, Tuolumne River near La Grange |
| 6 | Mean Monthly Natural Flows for Period of Record Through 1969 |
| 7 | Pertinent Runoff Data, Tuolumne River Basin |
| 8 | Standard Project Rain-Flood Series |
| 9 | Rain-Flood Frequency Curves, Tuolumne River near La Grange |
| 10 | Rain-Flood Frequency Curves, Dry Creek near Modesto |
| 11 | Standard Project Snowmelt Flood |
| 12 | Snowmelt-Flood Frequency Curves, Tuolumne River near La Grange |
| 13 | Routing of Reservoir Design Flood (64% of SPF) |
| 14 | Seasonal Flood Control Space Requirements |
| 15 | Routing of Standard Project Flood (Rain-Flood Series) |
| 16 | Routing of Historical Rain Floods |
| 17 | Routing of Hypothetical Snowmelt Floods |
| 18 | Routing of Historical Snowmelt Floods |

TABLE OF CONTENTS (Cont'd)

LIST OF CHARTS (Cont'd)


| Chart No. | |
|---|---|
| 19 | Snowmelt Runoff versus Required Space |
| 20 | Monthly Required Flood Control Reservation |
| 21 | Plan and Section of Dam (2 sheets) |
| 22 | Spillway, General Arangement |
| 23 | Spillway, Plan and Sections (2 Sheets) |
| 24 | Outlet Works, General Arrangements |
| 25 | Power Tunnel, General Arrangements |
| 26 | Location of Recreation Areas |
| 27 | Area and Capacity Curves, Hetch Hetchy Reservoir |
| 28 | Area and Capacity Curves, Cherry Valley Reservoir |
| 29 | Capacity Curve, Lake Eleanor |
| 30 | Flow-Damage Curves, Rain Floods (2 sheets) |
| 31 | Flow-Damage Curves, Snowmelt Floods |
| 32 | Forecast Verification Data, Natural April-July Flows |
| 33 | Snowmelt Forecast Criteria (2 sheets) |
| 34 | Rain-Flood Forecasting Criteria |
| 35 | Routing of Probable Maximum Flood |
| 36 | Stage-Duration Curves |
| 37 | Stage Frequency Curve |
| 38 | Seasonal Variation of Reservoir Storage Frequency |
| 39 | Peak Rain-Flood Frequency Curves below La Grange Dam |
| 40 | Peak Rain-Flood Frequency Curves at Modesto |
| 41 | Relation of Rain Floods at Modesto and La Grange |
| 42 | Maximum Mean Daily Snowmelt Flood Frequency Curves, Tuolumne River below La Grange Dam |
| 43 | Operation Record (Don Pedro, Cherry Valley, and Hetch Hetchy Reservoirs - Step 2 Operation 1949-1970) |
| 44 | Operation Record, Don Pedro Lake (October 1970- ) |
| 45 | Monthly Reservoir Operation, Don Pedro Lake (Form) |




USCE000227



Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G

REPORT ON RESERVOIR REGULATION
FOR FLOOD CONTROL
DON PEDRO DAM AND LAKE
TUOLUMNE RIVER, CALIFORNIA

# CHAPTER I - GENERAL INFORMATION

## 1. AUTHORITY AND SCOPE

This report on reservoir regulation for flood control, Don Pedro Dam and Lake, is an appendix to the Master Manual of Reservoir Regulation, San Joaquin River Basin, California, and is prepared in accordance with instructions contained in ER 1110-2-240, EM 1110-2-3600, and EC 1110-2-67, which pertain to requirements for reports on reservoir regulation for flood control for projects subject to provisions of Section 7 of the Flood Control Act of 1944 (58 Stat. 890). The pertinent portion of that act reads as follows:

> "Hereafter it shall be the duty of the Secretary of War to prescribe regulations for the use of storage allocated for flood control or navigation at all reservoirs constructed wholly or in part with Federal funds provided on the basis of such purposes, and the operation of any such project shall be in accordance with such regulations . . . . . ."

This report contains detailed descriptive information about the project, the method of operation, and a draft of proposed regulations for flood control operation. A portion of the material used in the preparation of this report was supplied by the Modesto and Turlock Irrigation Districts, and some of the charts showing technical features of the project were furnished by Bechtel Corporation, consulting engineers for the design and construction of Don Pedro Dam and appurtenances, for the Modesto and Turlock Irrigation Districts. Detailed hydrologic data and analysis for the Tuolumne River are contained in Appendix A, and detailed flood-control data and criteria for the Tuolumne River are incorporated as Appendix B to "Report on Cost Allocation for Flood Control, Tuolumne River Reservoirs, Tuolumne River, California" dated 10 October 1961 (Revised 1 June 1962). These appendices are referred to herein as the Hydrology Report and the Flood-Control Reservoir Operation Report, respectively.

A description of the overall San Joaquin River Basin plan of flood control is given in the Master Manual of Reservoir Regulation, San Joaquin River Basin, California.

## 2. AUTHORIZATION FOR FLOOD CONTROL ALLOCATION

a. The Tuolumne River Project was authorized by the Flood Control Act of 22 December 1944. The plan of improvement authorized for Tuolumne River

was specified as that plan recommended by the Chief of Engineers in Committee Document No. 2, Committee on Flood Control, House of Representatives, 78th Congress, 2d Session, which states in part as follows:

> . . . "That in lieu of the construction of the proposed Jacksonville Reservoir an expenditure, to the extent justified by proportinate benefits for flood control, estimated at $5,800,000 for the equivalent of 320,000 acre-feet in Jacksonville Reservoir, be authorized toward the first cost of the proposed New Don Pedro Reservoir or other suitable reservoirs in Tuolumne Basin, provided that local interests construct, maintain, and operate the dams and reservoirs, allocate storage for flood control, and agree to operate such storage in accordance with rules and regulations prescribed by the Secretary of War . . . ."

b. The terms of the agreement between the Irrigation Districts, the City and County of San Francisco, and the Federal Government for joint construction and use of reservoir storage in the Tuolumne River Basin are set forth in Contract No. DA-04-167-eng-38, dated 29 August 1949, as amended by Supplemental Agreement No. 1 dated 12 June 1967; the flood control accomplishments of the project being achieved in three steps as follows:

Step 1. During the period of December 1949 to March 1956, the Modesto and Turlock Irrigation Districts operated up to 100,000 acre-feet of storage space in Don Pedro Reservoir for flood control in accordance with rules specified by the Corps of Engineers.

Step 2. During the period of March 1956 to October 1970, the City and County of San Francisco operated Cherry Valley and Hetch Hetchy Reservoirs, and the Irrigation Districts operated Don Pedro Reservoir for flood control in accordance with regulations mutually agreed upon by the Corps of Engineers and the operating agencies, and published in the Federal Register.

Step 3. Since October 1970, with completion of Don Pedro Lake (to a capacity of 2,030,000 acre-feet) by local interests, the Irrigation Districts have been operating a maximum of 340,000 acre-feet of flood control reservation in Don Pedro Lake as described herein. This manual, specifically prepared for Step 3 operation, will supersede the "Reservoir Regulation Manual for Flood Control, Tuolumne River Project, California, Don Pedro, Hetch Hetchy, and Cherry Valley Reservoirs, revised July 1959."

3. DESCRIPTION OF THE AREA

a. Tuolumne River drains an area of about 1,958 square miles located in central California between the Stanislaus River Basin on the north and the Merced River Basin on the south. A map of the area is shown on chart 1. The Tuolumne River originates in the extensive snow fields of the upper Sierra Nevada, which rise to elevations in excess of 13,000 feet m.s.l. at the higher peaks including Mt. Lyell (13,090 ft.) and Mt. Dana. It flows westward through upland meadows and then through a deep canyon nearly 80 miles long cut in solid granite. The lower end of this canyon is Hetch Hetchy Valley, which is occupied by Hetch Hetchy Reservoir. Below Hetch Hetchy Reservoir the river passes through a relatively steep canyon and flows into Don Pedro Lake. Below Don Pedro Lake the river flows westward across the valley floor and joins the San Joaquin River, about 10 miles west of the city of Modesto.

b. The area above Don Pedro Dam consists of 1,533 square miles of steep and rugged mountainous terrain. Elevations range from about 500 feet at the dam to over 13,000 feet near the crest of the Sierra Nevada, with about 60 percent of the total area above 5,000 feet. Topography of Tuolumne River Basin is shown on chart 2. The drainage system includes the main stream and numerous tributaries, the most important of which are Clavey River, Cherry and Eleanor Creeks, and the North, Middle, and South Forks of Tuolumne River. The slope of the stream above the dam averages 125 feet per mile, ranging from about 50 feet per mile in the lower reaches to more than 800 feet per mile on some of the upper tributaries. Stream profiles are shown on chart 3. Tuolumne River at Don Pedro Dam has a mean annual natural runoff (measured at the gage near La Grange) of 1,850,000 acre-feet. This represents a basin average of 22.7 inches, which is 51 percent of the normal annual precipitation of 44.5 inches.

c. The drainage area between Don Pedro Dam and the mouth of Tuolumne River includes about 167 square miles of undeveloped, hilly pasture land and about 180 square miles of valley floor land. The latter includes one of the most highly developed diversified agricultural areas in the State of California, and food processing is the main industrial activity of the area. The area below Don Pedro Dam contributing to Tuolumne River flows consists of 295 square miles, entirely upstream from the city of Modesto. Local runoff from the 52 square miles located below Modesto is considered to be inconsequential for reservoir regulation purposes. The principal foothill stream contributing to Tuolumne River below Don Pedro Lake is Dry Creek, which has an area of 196 square miles, and enters Tuolumne River from the north at the city of Modesto. The valley floor area slopes from an elevation of about 200 feet at the foothill line to an elevation of about 40 feet at San Joaquin River. This area is traversed by an extensive network of canals, which distribute Tuolumne River water to the service areas of the Modesto Irrigation District on the north and the Turlock Irrigation District on the south of Tuolumne River. The area is serviced by the main lines of the Southern Pacific and Santa Fe Railroads, by U.S. Highway No. 99, and by numerous State and County highways.

d. The vegetative cover of the basin consists of scattered sub-alpine conifers in the upper elevations, light and heavy coniferous forest in the intermediate elevations, and a light cover of deciduous trees, chaparral, and grassland in the lower elevations. The following tabulation gives a distribution of the various types of vegetation with respect to elevation.

| Description | Range of elevation (feet) | Percent of basin area |
|---|---|---|
| Grass lands (scattered timber) | 500 - 2,000 | 7 |
| Brushlands (chaparral, etc.) | 1,500 - 3,500 | 14 |
| Deciduous forest | 1,000 - 4,000 | 12 |
| Light coniferous | 4,000 - 10,000 | 30 |
| Heavy coniferous | 6,000 - 8,500 | 20 |
| Sub-alpine forest | 9,000 - 10,000 | 11 |
| Bare rock | 11,000 - 13,000 | 6 |

4. CLIMATE

The climate of the Tuolumne River Basin is characterized by moderate winters and hot summers in the valley area, wet cold winters and hot dry summers in the higher watershed areas, and severe winters with cool summers at the higher elevations. The winter storms affecting the area are caused by cyclonic wave disturbances along the polar front which usually originate in the vicinity of the Aleutian Islands. Most of the precipitation associated with these storms over Tuolumne River Basin, is concentrated by orographic effect on the western slope of the Sierra Nevada, with marked differences in precipitation amounts within short distances. The normal annual precipitation varies from about 10 inches on the valley floor to 19 inches at Don Pedro Dam, about 70 inches in the upper reaches of the watershed, and the basin mean above Don Pedro Dam is about 44.5 inches. About 88 percent of the annual precipitation occurs during the period of November through April. Isohyets of normal annual precipitation, and the location of climatological stations within and adjacent to the basin are shown on chart 4. The monthly distribution of normal annual precipitation in inches for three stations located within the basin is shown below.

Average Monthly Precipitation

| Month | Modesto (elev 91 ft) | | Sonora RS (elev 1750 ft) | | Hetch Hetchy (elev 3870 ft) | |
|---|---|---|---|---|---|---|
| | in | % | in | % | in | % |
| Jul | 0.02 | 0.2 | 0.03 | 0.2 | 0.11 | 0.3 |
| Aug | 0.01 | 0.1 | 0.02 | 0.1 | 0.08 | 0.2 |
| Sep | 0.19 | 1.5 | 0.35 | 1.1 | 0.52 | 1.5 |
| Oct | 0.58 | 4.8 | 1.61 | 5.0 | 1.97 | 5.6 |
| Nov | 0.94 | 7.7 | 2.98 | 9.3 | 3.47 | 9.9 |
| Dec | 2.41 | 19.8 | 5.61 | 17.5 | 6.40 | 18.2 |
| Jan | 2.27 | 18.7 | 6.01 | 18.8 | 5.91 | 16.8 |
| Feb | 2.11 | 17.3 | 5.97 | 18.6 | 5.85 | 16.6 |
| Mar | 1.82 | 15.0 | 5.06 | 15.8 | 5.02 | 14.3 |
| Apr | 1.26 | 10.3 | 2.83 | 8.8 | 3.09 | 8.8 |
| May | 0.49 | 4.0 | 1.27 | 4.0 | 2.01 | 5.7 |
| Jun | 0.07 | 0.6 | 0.27 | 0.8 | 0.75 | 2.1 |
| Annual | 12.17 | 100.0 | 32.01 | 100.0 | 35.18 | 100.0 |

Precipitation usually occurs as rain at elevations below 4,000 feet and as snow at higher elevations, although snow has occurred in the valley and rain may occur at elevations above 10,000 feet. Snow cover below 5,000 feet is generally transient, and may accumulate and melt several times during a winter season. Normally the snow accumulates at higher elevations until about the 1st of April, when the melt rate exceeds snowfall. Basin 1 April snowpack data for a wet year (1969), a dry year (1961), and normal (1931-1970 average) at selected representative snow courses are given in the following tabulation.

1 April Snow Survey Data

| Snow Course No. | Name | Elev. in feet | Depth in inches 1969 | Depth in inches 1961 | Water equivalent Inches 1969 | Water equivalent Inches 1961 | Water equivalent Inches Normal | % normal 1969 | % normal 1961 |
|---|---|---|---|---|---|---|---|---|---|
| 159 | Bond Pass | 9,300 | 193.0 | 62.0 | 85.3 | 20.2 | 43.5 | 196 | 46 |
| 161 | Tuolumne Mdws | 8,600 | 125.6 | 44.3 | 50.5 | 12.4 | 22.6 | 223 | 55 |
| 167 | Paradise | 7,700 | 163.8 | 69.0 | 85.6 | 22.4 | 40.2 | 213 | 56 |
| 172 | Bell Meadow | 6,500 | 104.9 | 7.4 | 42.2 | 3.2 | 18.1 | 233 | 18 |

A complete list of snow courses representative of Tuolumne River Basin, and their respective locations, is given on chart 4.

Temperatures in the mountains decrease generally with increasing elevation. Observed temperature extremes at Modesto in the valley are 15°F. and 111°F., while those at Hetch Hetchy (elev. 3,870 ft.) are -1°F. and 104°F. The monthly distribution of mean temperature is illustrated by key stations as follows:

Monthly Mean Temperatures (°F.)

| Month | Modesto (elev. 91 ft.) | Sonora RS (elev. 1,750 ft.) | Hetch Hetchy (elev. 3,870 ft.) |
|---|---|---|---|
| Jan | 45.0 | 43.9 | 37.3 |
| Feb | 49.3 | 47.0 | 40.0 |
| Mar | 53.9 | 50.6 | 44.3 |
| Apr | 59.6 | 56.6 | 50.7 |
| May | 65.5 | 62.9 | 56.5 |
| Jun | 71.2 | 69.9 | 63.1 |
| Jul | 76.3 | 77.8 | 71.6 |
| Aug | 74.0 | 76.2 | 70.7 |
| Sep | 70.8 | 71.6 | 66.2 |
| Oct | 62.6 | 62.0 | 56.7 |
| Nov | 52.3 | 52.0 | 46.6 |
| Dec | 46.0 | 46.0 | 40.1 |
| Mean | 60.5 | 59.7 | 53.7 |

## 5. RUNOFF CHARACTERISTICS

Runoff on Tuolumne River varies considerably over the watershed. In the lower portion of the watershed, runoff is mostly the result of rain and is subject to considerable fluctuation during the winter season. Low flows occur from late spring through the summer and fall season, when rainfall is very light. About 75 percent of the runoff occurs during December through March. In the middle portion of the watershed, runoff is produced by either rain or snow or a combination of the two. About 40 percent of the runoff occurs during December through March. Runoff from the upper portion of the watershed is produced mainly from snow, about 20 percent occurring during the months of December through March and about 75 percent during the months of April through July. Occasionally in the early winter a heavy storm of warm rain may remove the snow cover over the entire area and produce heavy runoff. Chart 5 gives computed natural runoff (1895-1970) on monthly and annual bases, for Tuolumne River near La Grange. Charts 6 and 7 give various pertinent natural runoff data for a number of representative locations within the Tuolumne River Basin.

6. FLOOD CHARACTERISTICS

a. Flood flows on both Tuolumne and lower San Joaquin Rivers are of two types, winter rain floods and spring snowmelt floods. Winter rain floods, which occur during the period of November through March, are caused by heavy rains and are sometimes augmented by the melting of snow at intermediate elevations. Winter floods have sharp, high peak flows and are usually of short duration and comparatively small volume. Winter storms, which account for about 80 percent of the annual precipitation of the Tuolumne region, originate over the Pacific Ocean and are associated with large volumes of moist air moving inland against the mountain barriers. Usually rainfall occurs over the Coast Ranges and below 5,000 feet elevation on the Sierra Nevada, with snowfall at higher elevations. Rainfall intensities are usually moderate, but rainfall generally continues for 3 or 4 days. Up to 50 percent of the normal annual precipitation may fall in a single storm period. Above 5,000 feet elevation on the Sierra Nevada, the snow usually accumulates into a deep snow pack which does not melt until the next summer. Occasionally, the incoming moist air is sufficiently warm to cause rainfall at the higher elevations, which may melt some of the accumulated snow pack and augment the rain flood runoff. Snowmelt floods, which occur from April through July, are the result of general melting of snow in the high mountains. Although these floods have comparatively low peaks, they have large volumes and are of long duration.

b. The largest rain flood of record on Tuolumne River was that of December 1955. The series of meteorological events which culminated in this great flood began with a moderately heavy, warm type storm on 5-9 December, which deposited several inches of rain along the Sierra Nevada, melted back the abnormally low snowline which had existed before the storm, and compacted the snow at high elevations. After a storm-free period of about 5 days, a stationary-cold front developed which extended from the vicinity of the Hawaiian Islands northeastward to the northern California coast, between a massive high pressure cell off Southern California and a strong low pressure cell in the Gulf of Alaska. That system directed a persistent, fast-moving stream of air inland across the west coast. By 15 December, the snowline was at about 4,500 feet elevation, and there was about 50 inches of snow at 10,000 feet elevation. During the first cold phase of the storm, from 16 to 20 December, about 3.5 inches of precipitation fell as rain below about 6,000 feet elevation and as snow above. The snowline retreated about 500 feet in elevation, but snow depths at 10,000 feet increased to over 100 inches. Ground conditions at low elevations became moderately wet. After the 21st, temperatures and wind velocities increased greatly, and the rainfall extended almost to the highest point in the basin. During the 3-day period from 21 to 24 December, about 16.5 inches of rain fell on the basin. The snowline retreated about 800 feet in elevation, and snow depths increased about 18 inches at all elevations. On the last day of the storm, temperatures again decreased, snow fell as low as 3,500 feet elevation, and previous snow depths were generally restored. The peak inflow of 22 December



Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G

into Don Pedro Reservoir (controlled by Hetch Hetchy, Cherry Valley, and Eleanor Reservoirs) was about 100,000 c.f.s. and the outflow at La Grange was 41,700 c.f.s. The natural inflow peak would have been about 160,000 c.f.s., and the 3-day inflow volume was 420,000 acre-feet.

c. The previously recorded maximum inflow was 86,000 c.f.s. on 19 November 1950, while corresponding outflow at La Grange was 28,900 c.f.s. Maximum outflow at La Grange was 61,000 c.f.s. on 8 December 1950, only slightly less than the inflow at that time. The storm series responsible for the 1950 flood runoff began with a cool storm of moderate intensity on 13-15 November, which left a shallow blanket of snow down to about 6,000 feet elevation over the Tuolumne Basin. The entire region was then invaded by a storm of near record-breaking magnitude which brought extremely warm air inland against the entire range of the Sierra Nevada and caused intense rainfall to extremely high elevations. By 18 November the mountain watershed was very wet and had been stripped of its protective pack of snow. During the 8-day storm period 14-21 November, rainfall totaled 14.62 inches at Hetch Hetchy with a maximum 24-hour rainfall of 7.95 inches. At Lake Eleanor the total for the period was 18.32 inches, and the maximum 24-hour rainfall was estimated at 9 inches. A second storm followed on 3-4 December during which period the stations recorded 6.05 inches and 7.06 inches, respectively. After a 2-day let-up the rains came again on 7-8 December, the stations recorded 3.09 inches and 4.33 inches, respectively. This latter rainfall brought additional runoff to an almost full reservoir with the result that peak inflow on 8 December was reduced only slightly to a peak outflow of 61,000 c.f.s. on that date.

d. The largest snowmelt flood of record on Tuolumne River was that of 1906, which had a peak discharge of about 20,000 c.f.s. and an April through July runoff volume of 2,680,000 acre-feet at La Grange. This record flood volume was almost equaled by the 1969 snowmelt flood which had a computed natural April through July runoff volume of about 2,400,000 acre-feet at La Grange. The 1969 flood had a higher peak (22,000 c.f.s.) and an earlier runoff distribution, thus providing a more critical test of project accomplishments.

e. Other important flood runoff has occurred from the Tuolumne River watershed. In the pre-record period 1850 to 1896, three major floods are known to have occurred. These were the rain floods of January 1862 and December 1867, and the snowmelt flood of 1890. The peak flow of the 1862 flood has been estimated at 130,000 c.f.s. near La Grange. The 26 December 1867 stage has been reported as slightly higher than the 1862 peak. The snowmelt runoff of 1890 has been estimated as about 2,500,000 acre-feet during May, June and July.

## 7. AREAS SUBJECT TO FLOODING

The present valley flood plain of Tuolumne River, subject to damaging flows from both rain floods and snowmelt floods, is estimated at about 16,000 acres of highly developed agricultural land extending from the town of Waterford to the confluence with San Joaquin River. A small part of the metropolitan area of Modesto (population 100,000) also lies within this flood plain. Although an extensive levee system gives a considerable degree of protection to the Modesto urban and suburban areas, large rain floods on Tuolumne River are a significant threat to these areas. Any flood flow in excess of 40,000 c.f.s. at Modesto could cause extensive damage to residential, industrial, and commercial development.

## CHAPTER III - FLOOD POTENTIAL

### 8. RAIN-FLOOD POTENTIAL

a. Rain-flood potential is affected by antecedent ground conditions and by the extent and condition of the snowpack over the basin. An unusually wet watershed, or a shallow initial snowpack in the basin may significantly augment the amount of flood runoff. On the other hand, a deep persistent snowpack in the basin may be capable of retaining substantial amounts of rainfall on the basin for extended periods of time.

b. The more damaging flows on Tuolumne River are caused by intense rain floods of short duration similar to that of December 1955, described in paragraph 6b. The standard project rainflood series is developed and presented in the Hydrology Report. Inflow to Don Pedro Lake and runoff from the uncontrolled area downstream, are shown on chart 8. This flood series has a peak flow of 260,000 c.f.s., a 7-day volume of 947,000 acre-feet, and a 35-day volume of 1,530,000 acre-feet at Don Pedro Lake. Frequency curves of rain-flood volumes, for Don Pedro Lake inflows under natural conditions, and similar curves of rain-floods originating in the Dry Creek area below Don Pedro Dam are shown on charts 9 and 10, respectively.

### 9. SNOWMELT FLOOD POTENTIAL

Snowmelt runoff in the Tuolumne River Basin begins about 1 April each year and continues into July. The April-July runoff volume averages 1,253,000 acre-feet for the period 1896 through 1970 and ranged from 382,000 acre-feet in 1924 to 2,680,000 acre-feet in 1906. The standard project snowmelt flood inflow to Don Pedro Lake, presented in the Hydrology Report, is shown on chart 11. This flood has a maximum daily flow of 28,400 c.f.s. and an April-July runoff volume of 2,880,000 acre-feet. Frequency curves of snowmelt flood volumes for Don Pedro Lake inflows under natural conditions are shown on chart 12.

### 10. SEASONAL VARIATION OF RAIN-FLOOD POTENTIAL

Large rain floods in the Tuolumne River Basin occur most frequently in the months of November through March, and are not known to occur in the months of June through August. For a specified ground condition, the seasonal variation of rain-flood potential is dependent on the seasonal variation of storm potential, which has been related to latitude and 10-year storm precipitation. This seasonal variation of storm potential is defined by criteria contained in office report, "Reservoir Operation Criteria for Flood Control," dated October 1959.

11. RESERVOIR DESIGN RAIN FLOOD

a. Provision of 340,000 acre-feet of flood control space in Don Pedro Lake is in accordance with Contract No. DA-04-167-eng-38, entered into on 29 August 1949, as amended by Supplemental Agreement No. 1 dated 12 June 1967; between the United States of America, the City and County of San Francisco, and Turlock and Modesto Irrigation Districts as referred to in paragraph 2b. This flood control space requirement was derived on the basis of experienced rain floods in the Tuolumne River Basin. More recent experience during the large rain floods of November-December 1950 and December 1955 indicates that the flood control space of 340,000 acre-feet in Don Pedro Lake (with no space in upstream reservoirs) would not be adequate to control these large floods to nondamaging flows downstream. However, based on historical record of upstream reservoir operation, about 220,000 acre-feet of incidental empty space will exist (on the average) 80 percent of the time during the rain flood season.

b. Routing studies using hypothetical rain floods patterned after the standard project rain flood series, indicate that the 340,000 acre-feet of flood control space would control about 64 percent of the standard project rain flood to nondamaging outflows if 220,000 acre-feet of incidental empty space was assumed to exist in upstream reservoirs. Such a flood, (64% SPF) is used in this report as a reservoir design flood. It was constructed to conform with the following runoff volumes obtained from the rain flood volume frequency data given on chart 9.

| Duration (days) | Reservoir Design rain flood (acre-feet) |
|---|---|
| 1 | 234,000 |
| 5 | 487,000 |
| 10 | 612,000 |
| 20 | 796,000 |
| 30 | 938,000 |
| 35 | 984,000 |

A reservoir design rain flood series has been obtained by reducing the ordinates of the standard project rain flood series so that volume from the various durations equal those in the above tabulation. The hydrograph thus obtained is shown on chart 13.

12. RAIN-FLOOD SPACE REQUIREMENTS

a. Provision of 340,000 acre-feet of flood control space during the rain flood season would provide control of the reservoir design flood described in paragraph 11. In order to maximize the overall project accomplishments, it is desirable to allocate only as much space to flood control

as actually needed and to carefully define seasonal allocation requirements in order that space may be allocated for other project uses when there is no flood control requirement.

b. In order to determine the reservoir design rain flood potential at the beginning and end of the rain flood season, criteria relative to the seasonal variation of rainstorm potential referenced in paragraph 10 were used. Since the reservoir design flood was derived from percentages of the standard project flood and not developed as a result of a specific reservoir design storm, floods that would result from various percentages of the "reservoir design storm", on both wet and dry ground conditions, were obtained indirectly by approximate procedures described in the Flood Control Reservoir Operation Report.

c. The seasonal variation of maximum flood space requirement is based in part on the seasonal variation of ground wetness potential. Values of maximum required space, interpolated between space required for dry and wet ground conditions are indicated by the large circles on chart 14.

d. As stated in paragraph 11a, a minimum of about 220,000 acre-feet of incidental empty space in upstream reservoirs can be expected to exist 80 percent of the time in the rain flood season. A routing of the standard project flood series based on the assumed availability of 220,000 acre-feet of space in upstream reservoirs and 340,000 acre-feet of space in Don Pedro Lake is shown on chart 15. This routing is made using the emergency spillway operation criteria discussed in paragraph 5 of Appendix A and shown on chart A-9. Routings of four large rain floods through Don Pedro Lake are shown on chart 16.

13. RESERVOIR DESIGN SNOWMELT FLOOD

a. Routings of the maximum recorded snowmelt floods of 1906, 1907 and 1969 indicate that use of a maximum of 340,000 acre-feet of space at Don Pedro Lake is adequate to control these floods to channel capacity through the critical downstream Tuolumne River reach. About 260,000 acre-feet would be required to control the 1906 snowmelt flood, and about 308,000 acre-feet would be required to control the 1969 snowmelt flood if empty space does not exist in upstream reservoirs. It will be noted that in the 1906 and 1907 snowmelt flood routings, snowmelt runoff was preceded by rain floods requiring flood control space in March. It was further assumed that both 1906 and 1907 rain floods occurred under present-day conditions, and therefore, they were partially controlled by upstream reservoirs.

b. Routing of a hypothetical snowmelt flood obtained from snowmelt volume frequency data on chart 12, and patterned after the standard project snowmelt flood series indicates that use of 340,000 acre-feet of flood control space will control about 77 percent of the standard project snowmelt

flood to channel capacity below Don Pedro Lake, if such a flood is preceded by the March 1907 rain flood, the most severe of record obtained from the frequency curves on chart 12. A reservoir design snowmelt flood has been obtained by assigning ordinate values equal to 77% of the ordinates of the standard project snowmelt flood series with resulting volumes for the various durations as follows:

| Duration (days) | Reservoir design snowmelt flood (acre-feet) |
|---|---|
| 15 | 531,000 |
| 35 | 1,096,000 |
| 60 | 1,695,000 |
| 90 | 2,045,000 |
| 122 | 2,210,000 |

The routings of both the standard project snowmelt flood and the reservoir design snowmelt flood are shown on chart 17, and routings of the 1906, 1907 and 1969 snowmelt floods are shown on chart 18.

14. SNOWMELT FLOOD SPACE REQUIREMENTS

a. While space for snowmelt floods will be required only on a forecast basis, limits should be defined for the maximum anticipated snowmelt flood space requirement on any specified day of the year. The limiting space requirements have been based on the control of the reservoir design and recorded snowmelt floods. The maximum required space was determined by routing the reservoir design snowmelt flood using a full channel capacity release of 9,000 c.f.s. plus irrigation and aqueduct diversions.

b. The snowmelt space limits at the end of the snowmelt season were determined from back routings of the reservoir design, 1906 and 1969 snowmelt floods under the criteria referred to in paragraph 14a. The 1906 flood was the most critical on record insofar as late season snowmelt is concerned. Space requirements determined from those back routings are summarized on chart 14.

15. MULTIPLE USE OF RESERVOIR SPACE

The allocation of a portion of project costs to flood control at Don Pedro Lake is based on optimum use of reservoir space for all project purposes with space reserved for flood control use on a priority basis when needed, as defined in approved flood control regulations. Since the rainflood and the snowmelt flood potential vary seasonally, it is possible to obtain optimum usage of that portion of the reservoir space required for flood control during flood seasons by carefully defining seasonal limits and space

requirements for flood control, thus releasing the reservoir space for other uses outside the flood seasons. Furthermore, since snowmelt flood volumes can be forecast well in advance, additional space can be used for conservation purposes during the snowmelt season when forecasts indicate that a lesser amount of flood control space is required. Rain floods, however, cannot yet be adequately forecasted far enough in advance for operational purposes and rain flood space requirements cannot be decreased on the basis of a forecast.

16. FLOOD CONTROL DIAGRAM

a. The flood control diagram which provides a maximum flood control reservation of 340,000 acre-feet is shown on chart A-8.

b. Conditional use of space within the maximum snowmelt flood reservation is provided by the snowmelt parameters. These parameters were based on computed relationships between remaining runoff and required space, shown on chart 19, with a contingency allowance equal to twice the standard error of estimate, the derivation of which is explained below. With such allowance, the space provided should be adequate, on the average, an estimated 97 percent of the time.

c. The relationships of required space to remaining runoff at the beginning of each month (chart 19) were derived by back-routing snowmelt flows for each year when flood control space would have been needed. These back-routings were based on the assumption that operating contingencies will limit efficiency of operation to about 80%, and the resulting outflows are approximated by using an average assumed release of 7200 c.f.s. (80% of objective) plus the following irrigation, power and municipal demands.

| Month | Irrigation and power (acre-feet) | Municipal (San Francisco) (acre-feet) |
|---|---|---|
| Feb | 29,000 | 11,200 |
| Mar | 29,000 | 12,400 |
| Apr | 160,000 | 12,000 |
| May | 160,000 | 12,400 |
| Jun | 160,000 | 12,000 |
| Jul | 160,000 | 12,400 |

17. CREDIT FOR UPSTREAM STORAGE SPACE

a. After 1 May of each year, when the natural forecasted April-July snowmelt runoff of Tuolumne River at La Grange indicates a runoff volume of 1,450,000 acre-feet (or less) is anticipated, the required space, indicated by the snowmelt parameters (chart A-8), may be reduced when empty space is available in the upstream reservoirs. Such a reduction of flood control space requirements in Don Pedro Lake could be made only to the extent that such upstream space would be sure to be filled by the time that Don Pedro Lake fills.

b. Examination of runoff data in connection with empty space in upstream reservoirs usable for flood control indicates that credit for 80 percent of the space available for the storage of snowmelt floodwaters in reservoirs upstream of Don Pedro Lake can safely be allowed subject to conditions stated in paragraph 17a above. Because of variation of snowmelt flood potentials in the Tuolumne River Basin, and absence of close operational coordination between Don Pedro Lake and the upstream reservoirs, credit for available empty space in Cherry Valley and Hetch Hetchy Reservoirs will be subject to the following restrictions (see note 4 on chart A-8).

(1) Not more than 70 percent of the creditable portion of the requirement may be allowed for empty space in Hetch Hetchy Reservoir.

(2) Not more than 30 percent of the creditable portion of the requirement may be allowed for empty space in Cherry Valley Reservoir.

(3) No reduction of the rain flood reservation value will be permitted below 50,000 acre-feet.

Criteria established herein, for allowing credit for available empty space in Cherry Valley and Hetch Hetchy Reservoirs, are illustrated by the following examples: (After 1 June, these criteria could be further modified as per note 5 of Flood Control Diagram, chart A-8.)

| Date | Forecast | Total required storage space based on forecast | Total combined empty space in upstream reservoirs | Total credit for empty space in upstream reservoirs | Maximum credit for empty space in Hetch Hetchy Res | Maximum credit for empty space in Cherry Valley Res | Adjusted required empty space in Don Pedro Reservoir |
|---|---|---|---|---|---|---|---|
| | | | (ALL VALUES IN ACRE-FEET) | | | | |
| 1 May | 1,800,000 | 610,000 | 250,000 | 200,000 | 140,000 | 60,000 | 340,000 |
| 5 May | 1,600,000 | 505,000 | 200,000 | 160,000 | 112,000 | 48,000 | 340,000 |
| 10 May | 1,400,000 | 405,000 | 160,000 | 128,000 | 89,600 | 38,400 | 277,000 |
| 15 May | 1,200,000 | 310,000 | 130,000 | 104,000 | 72,800 | 31,200 | 206,000 |
| 30 May | 1,000,000 | 300,000 | 100,000 | 80,000 | 56,000 | 24,000 | 220,000 |
| 15 Jun | 600,000 | 120,000 | 30,000 | 24,000 | 16,800 | 72,000 | 96,000 |
| 1 Jul | 300,000 | 35,000 | 20,000 | 16,000 | 11,200 | 4,800 | 35,000 |

18. MONTHLY SPACE REQUIREMENTS UNDER HISTORICAL CONDITIONS

Using the flood control diagram shown on chart A-8, the monthly storage space requirements based on forecasts from observed precipitation data (see paragraph 31) by use of chart 23 of Flood Control Reservoir Operation Report were determined for the period 1896 through 1958. For the period 1959 through 1970, the monthly storage space requirements are based on actual runoff forecasts made by the State of California. Computed values of the monthly space requirements are tabulated on chart 20.

## CHAPTER V - PROJECT FEATURES

### 19. DESCRIPTION OF PROJECT

a. The Don Pedro Project, located on the Tuolumne River about 35 miles east of Modesto, includes the following major features: the dam and reservoir, gated and ungated spillway sections, outlet works, and power plant. The general layout of the project including the main units, power and diversion tunnels, access roads and other permanent features is shown on chart 1.

b. The Don Pedro Dam is located in Section 3, T3S, R14E, 1½ miles downstream from the old concrete-arch structure which since 1956, in cooperation with Cherry Valley and Hetch Hetchy Reservoirs, has provided a fair degree of flood protection to the downstream areas under step 2 of the flood control agreement. All gates have been removed from the old dam and interference with flow is now minor. The Don Pedro Dam is a combination rock and earthfill structure with maximum height of 585 feet above foundation and a length of 1,900 feet. The elevation of the top of the dam is 855 feet, providing a 5-foot freeboard above the spillway design flood pool at elevation 850 feet. Plan and section of the dam are shown on chart 21.

c. Don Pedro Lake gross pool capacity at 830.0 foot elevation is 2,030,000 acre-feet, of which 340,000 acre-feet are allocated during flood seasons for flood control storage. The minimum power pool of 309,000 acre-feet corresponds to elevation 600.0 feet. Maximum storage corresponding to the spillway design (probable maximum) flood is 2,301,000 acre-feet at elevation 850.0 feet. The water surface area at gross pool is 12,960 acres and the length of shoreline is approximately 159 miles. The maximum reservoir depth at gross pool elevation is about 550 feet. The area-capacity curves for Don Pedro Lake are shown on chart A-1, and an area-capacity table is given on chart A-2.

d. The spillway located on the abutment ridge west of the dam, as shown on chart 21, consists of two sections:

(1) A gated spillway with a 135-foot long concrete ogee section, crest at elevation 800 feet, controlled by three 45-foot long by 30-foot high radial type, hoist operated, steel gates, provides control for all normal operations of the reservoir.

(2) An ungated emergency spillway with a 995-foot long concrete ogee section, crest at elevation 830 feet, located adjacent and to the right of the controlled spillway, provides additional safety precaution for the passage of very large and infrequent flood flows.

(3) The total combined discharge capacity of the gated and emergency spillways is 472,500 c.f.s. at the maximum water surface elevation of 850 feet, with 5 feet of freeboard remaining. Plans and elevations of the spillways are shown on charts 22 and 23. Spillway discharge rating curves are given on chart A-5 (full gate opening), and on chart A-6 (partial gate opening).

e. A concrete-lined 3,500-foot long 30 feet diameter tunnel, located through the left abutment, initially constructed for diverting the river around the project during construction, is used as the outlet works for all normal reservoir release purposes. The inlet works are located near and to the left of the upstream portal of the diversion tunnel at elevation 343 feet and may be closed for inspection and maintenance by a 22-foot by 11-foot wheeled buckhead gate. Flow passes through a 12-foot diameter concrete-lined tunnel, enters the diversion tunnel through an elbow plug and continues on to a 60-foot long head reducing section before entering the outlet works. The outlet works is located in a concrete plug about 135 feet long, centered approximately on the axis of the dam. Three separate parallel outlets are provided, each controlled by two 4-foot by 5-foot high-pressure slide gates in tandem. The combined capacity of the three outlets at elevation 830 feet is 7,370 c.f.s. Plans and sections of the outlet works are shown on chart 24. Discharge rating curves for the outlet works are shown on chart A-3.

f. A 2,950-foot long power tunnel passes through the left abutment about 225 feet above present riverbed level. The intake and trashrack structure incorporates a remote controlled hydraulically operated bulkhead gate to allow unwatering of the tunnel for inspection and maintenance. From the intake the tunnel is 18'-6" in diameter and concrete-lined for about 1,615 feet including an 86-foot long transition section at the 321 foot high shaft for the 12-foot by 21-foot fixed wheel control gate. The next portion of the tunnel is 16'-6" in diameter and steel-lined for about 880 feet. The remaining 455 feet of the power conduit is 16'-0" steel-lined to the outlet portal at elevation 299 feet and is connected to the turbine branch lines by means of a steel reducing manifold encased in concrete. A hollow-jet flood control valve, located in the power house, is connected to the power conduit at the manifold and is used in conjunction with the outlet works for making reservoir releases. Plans and sections through the power tunnel works are shown on chart 25. Discharge rating curves for the flood control valve and turbines are shown on chart A-4. Chart A-7 shows stage-discharge curves for several pertinent stream gaging stations located downstream from Don Pedro Dam.

g. The power house is an outdoor type with three Francis type turbines, each rated at 70,000 HP at 450 feet net head, which drive three 47,900 KVA, 3-phase, 0.95 p.f., 60-cycle generators. The three main transformers are rated at 55,100 KVA, 13.8/69 KV, 3-phase, 60-cycle.

20. RECREATION FACILITIES

a. The Modesto and Turlock Irrigation Districts have agreed through a contract with the State of California under terms and conditions provided by the Davis-Grunsky Act to develop and maintain recreational facilities at Don Pedro Lake. The Districts have acquired multipurpose lands, needed for project operational purposes, to a distance of at least 100 feet back from the contour line defining elevation 830 feet. The total area of lands to be developed for recreation under the Davis-Grunsky grant, including multipurpose project lands to be used for recreation, is 558 acres, with 259 acres to be used exclusively for recreational purposes under the Davis-Grunsky program. In addition, lands below elevation 830 feet are seasonally available as the water level recedes. Several locations have been found suitable for recreational development. Of these locations, three, shown on chart 26, have been selected for development under the Davis-Grunsky program as follows:

(1) Fleming Meadows Recreation Area, on the south shore, will have 130 picnic units, 125 tent camping units, 87 recreation vehicle hookup units, a 7-lane boat launching ramp, a swimming lagoon, and two concession complexes.

(2) Right Abutment Recreation Area will provide 183 camping units and an observation area overlooking the dam and reservoir.

(3) Moccasin Point Recreation Area, at the upper end of the reservoir, will include 20 picnic units, 62 tent camping units, 13 recreation vehicle hookup units, and a 2-lane boat launching ramp.

Highway 49-120 and a new county road will provide good access to the three recreation areas plus a 500-acre location set aside for hunting.

b. Besides fishing, Don Pedro Lake is expected to be widely used for picnicking, boating, camping, swimming, and water skiing. The overall recreation plan calls for the development of permanent recreation facilities at all the selected sites listed above.

c. Don Pedro recreational facilities are expected to serve as many as 390,000 visitors during the first year of operation with progressive increase to 500,000 visitors by 1980. The reservoir area and the locations of the proposed recreational developments are shown on chart 26.

21. CONSTRUCTION HISTORY

a. Public access roads, and reservoir and site clearing began in August 1967. Excavation for the diversion tunnel began in September 1967, was completed in September 1968 and the tunnel was plugged in October 1970 after the outlet works were completed in July 1970. Excavation work for both the

controlled and emergency spillways started in September 1967 and the spillways were completed in November 1970. Foundation excavation for the main dam began in December 1967 and the embankment was completed in May 1970. Construction of the new power plant began in August 1968 and was completed in March 1971.

b. Dedication ceremonies were held on 29 May 1970 when the final load of fill officially completed the construction of the dam. All facilities required for the control of Tuolumne River flows were completed by October 1970 and the river outlets in the old dam were opened on 15 November 1970 to allow transfer of storage and control to the Don Pedro Dam and Lake. All remaining work was completed in May 1971 and the project was dedicated on June 11, 1971.

## CHAPTER VI - GENERAL PROJECT OPERATION

### 22. RESPONSIBILITY FOR OPERATION

Don Pedro Lake is operated by Modesto and Turlock Irrigation Districts. Operation in the interest of flood control is in accordance with the rules and regulations prescribed by the Secretary of the Army pursuant to Section 7 of the Flood Control Act of 1944 (see Appendix A). The flood control diagram is shown on chart A-8, and the emergency spillway release diagram on chart A-9. Details concerning the responsibility for flood control operation are discussed in paragraph 7 of Appendix A.

### 23. UPSTREAM REGULATION

a. There are three reservoirs in the drainage basin above Don Pedro Lake. These are: Lake Eleanor (26,000 acre-feet), Hetch Hetchy (360,000 acre-feet), and Cherry Valley (Lake Lloyd 268,000 acre-feet). Although there is no longer any flood control space allocated in these reservoirs, their normal operation effectively controls small and moderate floods and has considerable influence in reducing large rain and snowmelt floods. Area and capacity curves for Hetch Hetchy and Cherry Valley (Lake Lloyd) reservoirs are shown on charts 27 an 28 respectively. A capacity curve for Lake Eleanor is shown on chart 29.

b. Although Tuolumne River runoff upstream from Don Pedro Lake is also under constant regulation by diversions leading to several power plants, the only diversion away from Tuolumne River Basin is the flow diverted into the Hetch Hetchy Aqueduct which leads to San Francisco. The capacity of this aqueduct is about 620 c.f.s. in the mountains and about 250 c.f.s. through the valley floor to San Francisco. The valley floor portion will be increased to the full 620 c.f.s. capacity when this greater supply is required.

### 24. DOWNSTREAM REGULATION

Water for irrigation is diverted at La Grange Dam, a masonry gravity diversion structure located about 2½ miles downstream from the Don Pedro Dam. Modesto Canal diverts into Dallas-Warner Reservoir (27,000 acre-feet) and thence into the Modesto Irrigation District canals. Turlock Canal diverts into Turlock Lake (49,000 acre-feet) and thence into the Turlock Irrigation District canals. The combined capacity of the Turlock and Modesto Canals is about 4,000 c.f.s. Since diversions for irrigations are upstream from the areas subject to flood damage, such diversions have considerable effect in reducing prolonged snowmelt floodflows. However, winter diversions are small and have practically no effect on large rain floods.

### 25. DOWNSTREAM CHANNEL CAPACITIES

a. Tuolumne River from Don Pedro Dam to San Joaquin River has a length of about 50 miles. The channel reach above the town of Waterford has a large capacity, and little damage results from floodflows. Below Waterford,

low intermittent levees along the stream give partial protection against flood overflow, but some agricultural damage occurs in low-lying unprotected areas when flows exceed 9,000 c.f.s., and significant damage begins when flows exceed 12,000 c.f.s. In the vininity of Modesto, flows in the order of 35,000 c.f.s. will endanger the Modesto sewage disposal plant and may damage homes in a few areas.

b. On the average, uncontrolled flows originating below Don Pedro Lake will exceed 9,000 c.f.s. once in 25 years and will exceed 12,000 c.f.s. once in 60 years (77% SPF). Local floods of this magnitude are of short duration and the accompanying damages are minor.

26. FLOOD DAMAGES

a. Flood damages along Tuolumne River below Don Pedro Lake are caused by both rain and snowmelt floods. Rain floods, characterized by high peaks, small volumes, and short durations are damaging to both urban and agricultural areas, while snowmelt floods, characterized by low peaks, large volumes, and long durations are damaging to low-lying agricultural areas only. Damages caused by recent floods along Tuolumne River, based on prices and conditions at the time of the flood, are as follows:

| Floods | | Damages ($) |
|---|---|---|
| November-December | 1950 | 630,000 |
| December | 1955 | 550,000 |
| March-April | 1958 | 50,000 |
| January | 1969 | 1,440,000 |

In each flood, at least 50 percent of the total damages along Tuolumne River was to agricultural land and crops, and the remainder was to utilities, roads, bridges, canals, and to some commercial and residential establishments located in the suburban area of Modesto.

b. With 340,000 acre-feet of flood control space available in Don Pedro Lake there will be a higher degree of flood protection to the agricultural lands and to the suburban areas of Modesto than has existed before completion of the Don Pedro Dam. However, some damage may result from Tuolumne River rain floods and snowmelt floods under present conditions on the average once each 60 years as determined from charts 39 and 42, respectively. Charts 30 and 31 show the flow-damage curves for areas below Don Pedro Lake for rain floods and snowmelt floods, respectively.

27. CONSERVATION OPERATION

Operation for conservation will be as follows:

a. All inflows in excess of irrigation, municipal, and power demands will be stored to the extent that conservation space is available.

b. Releases will be in accordance with daily requirements as determined by the Modesto and Turlock Irrigation Districts.

c. Irrigation releases will be seasonally adjusted to greater or lesser amounts in accordance with forecasts of expected runoff and water in storage at the beginning of the irrigation season.

d. Releases to benefit downstream fishery will be in accordance with schedules worked out with the State Department of Fish and Game and the US Fish and Wildlife Service. Annually, these releases will vary from 123,210 acre-feet to 64,040 acre-feet depending on whether the amount of runoff in the prior water year into Don Pedro Lake exceeds or is less than 1,000,000 acre-feet.

28. POWER RELEASES

Power generation equipment at the Don Pedro Powerplant consists of three units, rated at 47,900 KVA at 0.95 p.f. This generated capacity is serving the electrical distribution system of the Modesto and Turlock Irrigation Districts. Releases of water for power generation is subordinated to releases required for irrigation and will be coordinated with the release requirements for flood control and fish life. Project releases will normally be restricted to a maximum discharge of 4,000 c.f.s. which is the contemplated combined capacity of the Districts' canal system.

29. RELATION TO OTHER PROJECTS

The flood control operation of Don Pedro Lake will be independent of the operation of all other Tuolumne River reservoirs except for credit allowed for incidental empty space in upstream reservoirs.

## 30. HYDROLOGIC FACILITIES

Hydrologic facilities available for operation of the project consist of the following:

a. Recording pool gages at Don Pedro Lake, Lake Eleanor, Hetch Hetchy, and Dallas-Warner reservoirs.

b. Non-recording pool gages (staff gages) at Lake Lloyd and Turlock Lake.

c. Eighteen recording stream gaging stations, of which twelve are above and six below Don Pedro Lake.

d. Twenty-eight precipitation stations in or adjacent to the basin. Of these stations, five are recording, fourteen are non-recording, and nine are seasonal storage gages.

e. Eight snow courses.

f. One aerial snow depth marker.

g. Fifteen snow courses with aerial snow depth markers.

The locations of the above facilities are shown on charts 2 and 4.

## 31. FORECASTS OF INFLOW

a. Of primary concern in the operation of Don Pedro Dam and Lake are forecasts of the volume of snowmelt inflow that occurs each year during the months of April through July. Under step 2 operation (1949-1970), forecasts of natural runoff for Tuolumne River at La Grange were made on the basis of precipitation data and by the use of forecasting criteria specifically designed and prepared for Tuolumne River Basin by US Army, Corps of Engineers (see chart 23 of Flood Control Reservoir Operation Report). While the selection of forecast procedure is a part of the operation responsibility of the operating agency, subject to approval of the Corps of Engineers, the generally accepted forecasts of snowmelt season runoff for Sierra Nevada streams are those prepared and published by the State of California, Department of Water Resources. These forecasts have been determined to be reliable and are used in operating all major San Joaquin River Basin reservoirs; therefore use of the official published State of California forecast for operation of Don Pedro Lake is recommended. The Department prepares and publishes forecasts of April through July runoff for the Tuolumne River, inflow to Don Pedro Lake, as of 1 February, 1 March, 1 April, and 1 May of each year. Forecasts are available in the reports titled Bulletin No. 120, "Water Conditions in California," which

are published on the 10th of each month of February, March, April, and May each year. Prior to 1953, snow survey data for 1 February and 1 March were collected and published by the State of California, but no forecasts of Tuolumne River inflow to Don Pedro were made on these dates. Beginning in February 1953, the State has been making and publishing preliminary forecasts of snowmelt runoff for 1 February and 1 March. Snow survey data for 1 April and 1 May have been collected and published by the State since 1932, and forecasts of snowmelt runoff have been made and published for these dates by the State since 1936 and in earlier years. Chart 32 shows the actual April through July runoff, the forecasts of runoff made by the State, and the errors in these forecasts.

b. The forecasting procedure currently in use by the State of California, Department of Water Resources for Tuolumne River inflow to Don Pedro, is illustrated, using 1967 data, on chart 33. Figure 1 is the diagram used to solve the forecast equation. The dashed line graphically illustrates the determination of the 1 April forecast of unimpaired April - July 1967 snowmelt runoff to Don Pedro Lake (1,500,000 acre-feet). Figures 2 and 3 are the forms used to compute indexes (1967 indexes shown) required in the forecast equation. Forecasts are based upon conditions as of the date of forecast, with median precipitation and snowpack increments assumed after the date of forecast.

c. The forecast range diagram shown on figure 3 (chart 33) is used to determine the probable range of forecast departure for any forecast date during the season. For example, for the forecast of 1,500,000 April - July runoff to Don Pedro Lake made on 1 April 1967, the Forecast Range Diagram indicates a 10 percent probability that the actual runoff will exceed 1,500,000 + 260,000, (with abnormal accretions) or 1,760,000 acre-feet, and a 90 percent probability that the runoff will exceed (or a 10 percent probability that the runoff will be less than) 1,500,000 - 140,000 (with subnormal accretions) or 1,360,000 acre-feet. The actual forecast and departure is summarized in tabular form in the lower left hand corner of figure 3, chart 33.

d. Forecasts made by the State may be modified for operating purposes as the snowmelt season progresses when such modification is indicated by information developed after the forecast was issued, and is approved by the District Engineer, Corps of Engineers. Modification of the published forecast for operating purposes may be based on new data developed by aerial reconnaissance flights, new storm conditions, or significantly different end-of season forecasts based on current rate of runoff and normal rate of runoff recession.

e. Because rain floods which normally occur during the November-March season are far more severe and more damaging than snowmelt floods over Tuolumne River Basin, it will also be necessary to make or procure frequent forecasts of rain flood inflow to Don Pedro Lake and of local inflow downstream from the reservoir.

f. Procedures for forecasting the approximate rain flood inflow hydrograph to Don Pedro Lake have been developed by the State Federal Forecasting Center as shown by the rain flood forecasting criteria on chart 34. Forecast prepared using these procedures, subject to modicication for known hydrologic deviations at the time, are considered acceptable for the flood control operation of Don Pedro Lake. Figure "b" of the criteria gives the rainfall-runoff relationship as computed by the State-Federal Forecasting Center for the area above Don Pedro Dam, and shows the total potential runoff resulting from total basin-mean-precipitation for any desired period. Figure "a" of the criteria shown on chart 34, adjusts the total potential runoff to immediate runoff caused by the rainfall during a specified period of precipitation. Thus adjustment is based mainly on the freezing level of the total contributing area above Don Pedro Dam (1,533 square miles). The approximate freezing level is usually reported during storm periods by the National Weather Service (NOAA). An average freezing level should be used whenever this level changes rapidly during a storm period.

g. The antecedent index (AI) used in the rain flood forecasts shown on chart 34 is an index of the loss potential of the basin, or an index of the relationship between rainfall and surface runoff for a selected storm period. The numerical value of this AI indicates the number of inches of rain that would be required to produce one inch of surface runoff. Antecedent indexes and freezing levels may be obtained from the State-Federal River Forecast Center. The estimated basin-mean adjusted runoff given on chart 34, along with the prestorm AI and the base flow, could be applied to the unit hydrograph ordinates and the basin AI-loss-rain relationship to determine an inflow hydrograph to Don Pedro Lake. Also, when desired, an approximate runoff volume for any specified duration can be directly computed by application of chart 34. However, in computing inflows into Don Pedro Lake allowance would be made for various degrees of regulation by empty space in the upstream reservoirs.

h. No flood forecasting procedures are available for Dry Creek drainage areas, and none are needed for snowmelt forecasting purposes from this low-lying area. During the rainflood season, when necessary peak flows and runoff volumes could be obtained from the State-Federal River Forest Center or of unit hydrograph techniques and precipitation data.

32. COORDINATION WITH OTHER AGENCIES

In order to insure that the flood control operation of Don Pedro Lake will be as effective and reasonable as possible, in controlling floods along Tuolumne River as well as along San Joaquin River below the mouth of the Tuolumne River, it is essential that the operating districts keep advised at all times of possible flood hazards, weather conditions, inflow into the reservoir, and flows in the Tuolumne River below Don Pedro Dam and in San Joaquin River. This requires close liaison with other agencies, including the National Weather Service (NOAA), the State of California Department of Water Resources, the Bureau of Reclamation, and the Corps of Engineers.

## 33. EXAMPLES OF OPERATION

Routings of four large historical rain floods through Don Pedro Lake are shown on chart 16. At the beginning of each routing, it was assumed that there was 340,000 acre-feet of empty space in Don Pedro Lake and that inflows into the reservoir were impaired by incidental regulation by upstream reservoirs. Routings of three large historical snowmelt floods (1906, 1907, and 1969) are shown on chart 18. It was assumed that at the beginning of each snowmelt flood routing, all upstream reservoirs were full and that there was 340,000 acre-feet of empty space in Don Pedro Lake. A hypothetical operation of Don Pedro Lake during the probable maximum flood (spillway design flood) is shown on chart 35. It was assumed that at the beginning of this routing all upstream reservoirs were full and there was 170,000 acre-feet of empty space in Don Pedro Lake. A maximum pool elevation of 850.0 feet (2,303,000 acre-feet) and a peak outflow of 470,000 c.f.s. were attained. Stage-duration curves are presented on chart 36, a stage frequency curve on chart 37, and a seasonal variation of reservoir storage frequency on chart 38. Peak rain-flood frequency curves under natural, preproject and project conditions for Tuolumne River below La Grange Dam are shown on chart 39. Similar frequency curves for Tuolumne River at Modesto, derived indirectly by use of the flow-relationship curve shown on chart 41, are shown on chart 40. Daily peak snowmelt-flood frequency curves for Tuolumne River below La Grange Dam, under natural, preproject and project conditions are shown on chart 42.

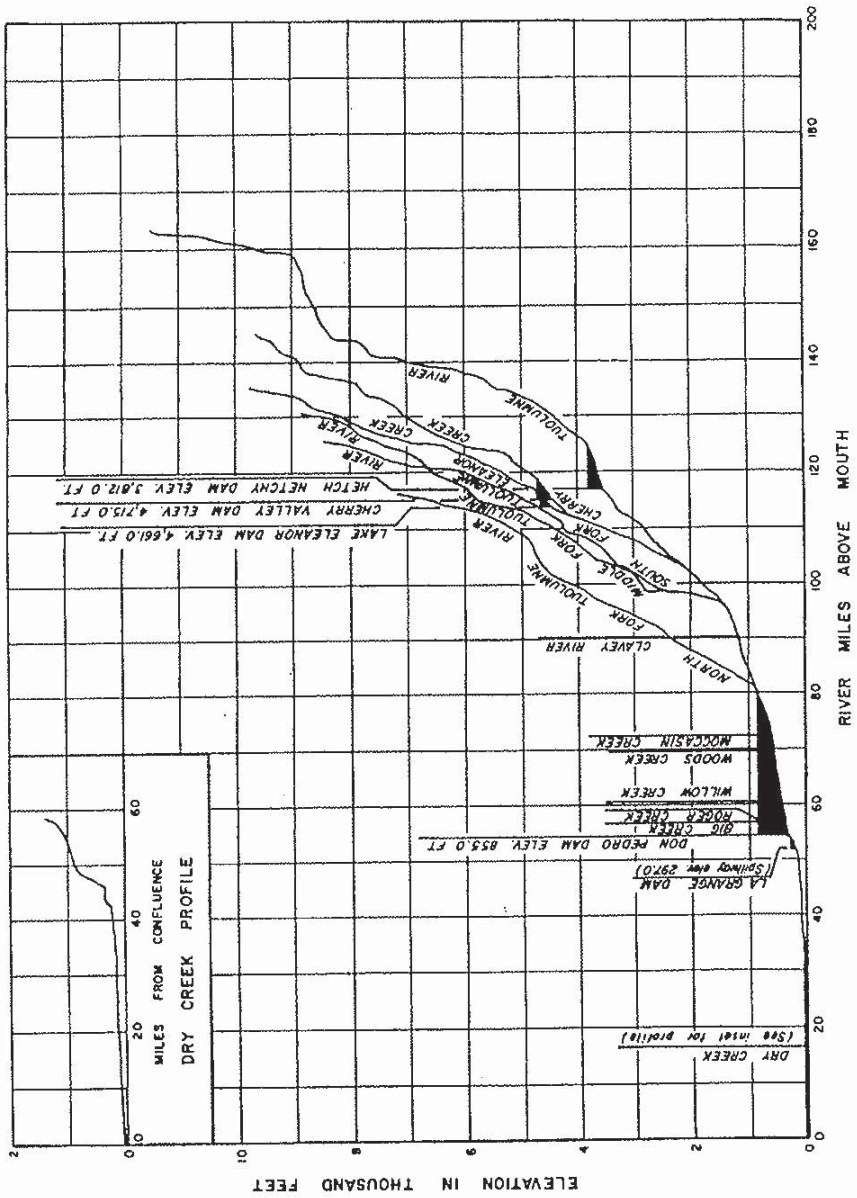
## 34. OPERATION RECORD

A record of storage at Don Pedro Lake and flows in Tuolumne River above La Grange Dam (corresponding to outflow from Don Pedro) is published in the Surface Water Records of the US Geological Supply. The historical record of operation for Don Pedro Lake, Hetch Hetchy, and Cherry Valley (Lake Lloyd) Reservoirs under step 2 flood control regulations (water years 1950-1970) is shown in graphical form on chart 43. The operation of Don Pedro Lake under step 3 flood control regulations began on 1 October 1970, and is shown on chart 44. A record of flood control requirements, and of storage and flow pertinent to the flood control operation is contained in the monthly reports submitted to the Chief of Engineers by the District Engineer, Corps of Engineers, Sacramento, California. A copy of this monthly report form is shown on chart 45.

## CHAPTER IX - STUDIES IN PROGRESS OR PLANNED

### 35. CURRENT STUDIES

No studies are currently in progress or planned for the immediate future in the Tuolumne River Basin. However, it is anticipated that the "Master Manual of Reservoir Regulation, San Joaquin River Basin, California" dated 5 September 1953 will be revised and up-dated in the near future. A practicable plan for coordinating flood control operation of all facilities in the San Joaquin River Basin, including storage structures on the tributary streams, bypass and diversion facilities, coordinated reporting and dissemination of hydrologic and operating data, and necessary inter-agency operating agreements is under study and will be discussed in the Master Manual.



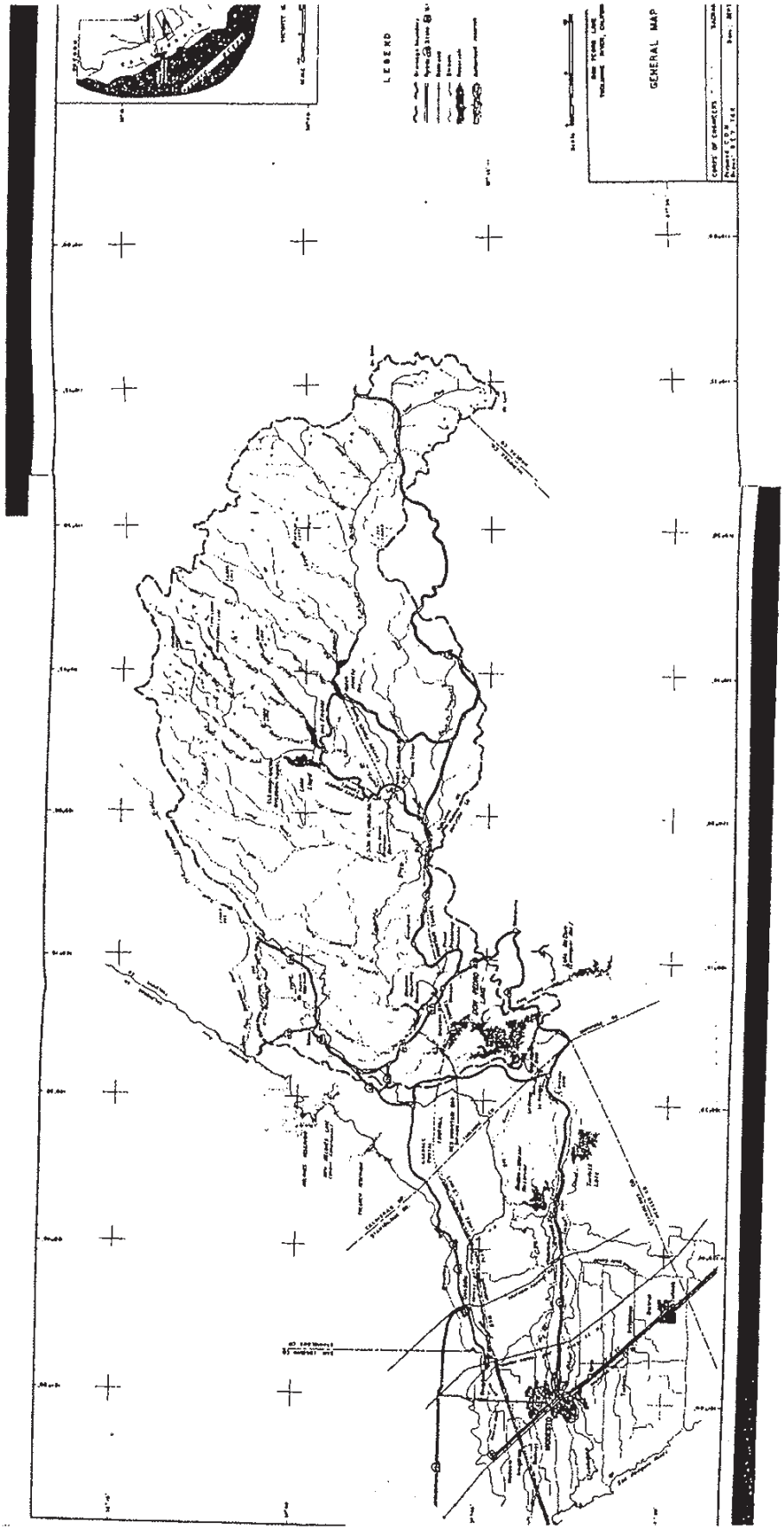

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

TUOLUMNE RIVER
STREAM PROFILE

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: C.D.M. Date: SEPTEMBER 1971
Drawn: T.G.K.

CHART 3

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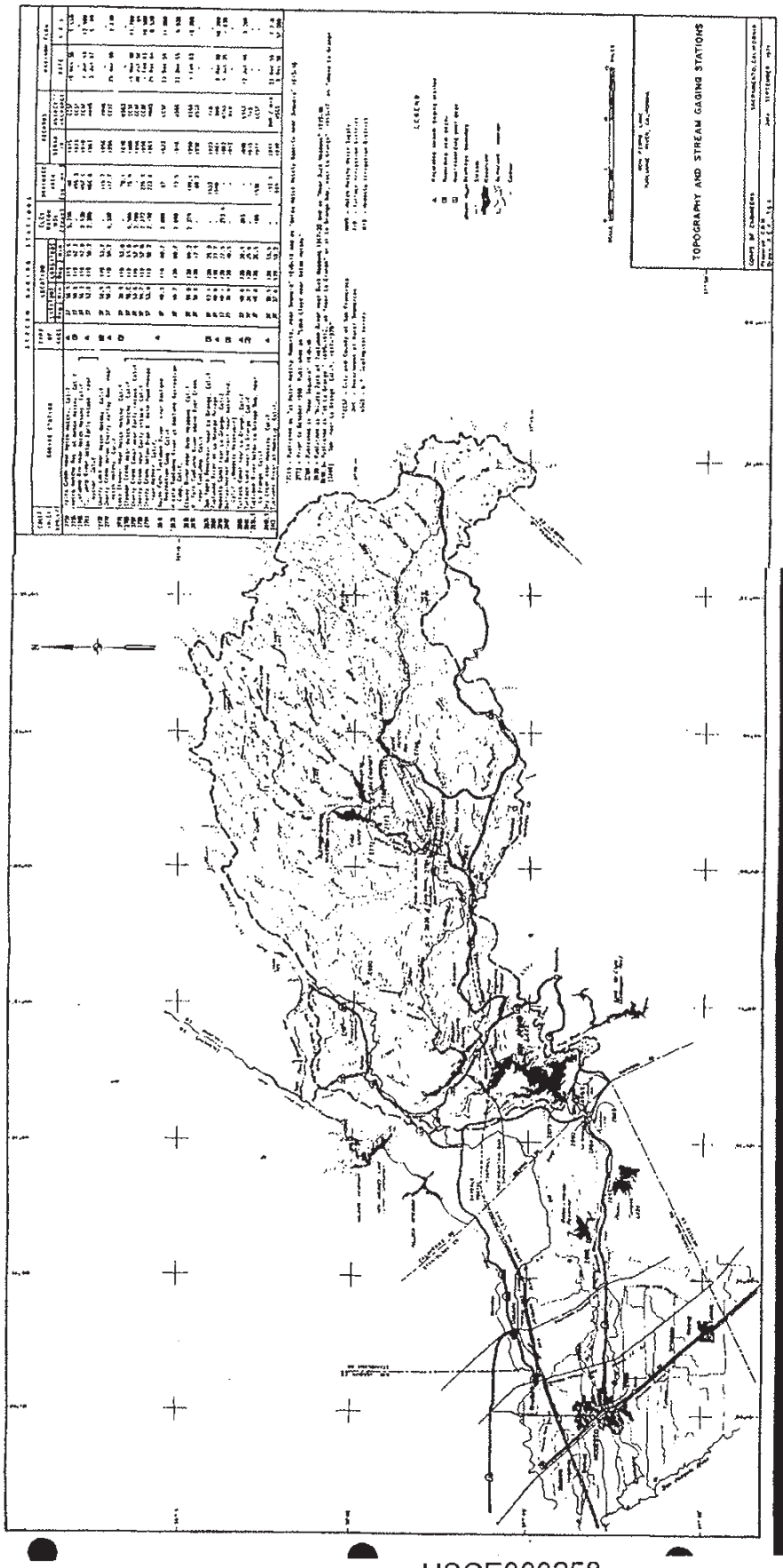


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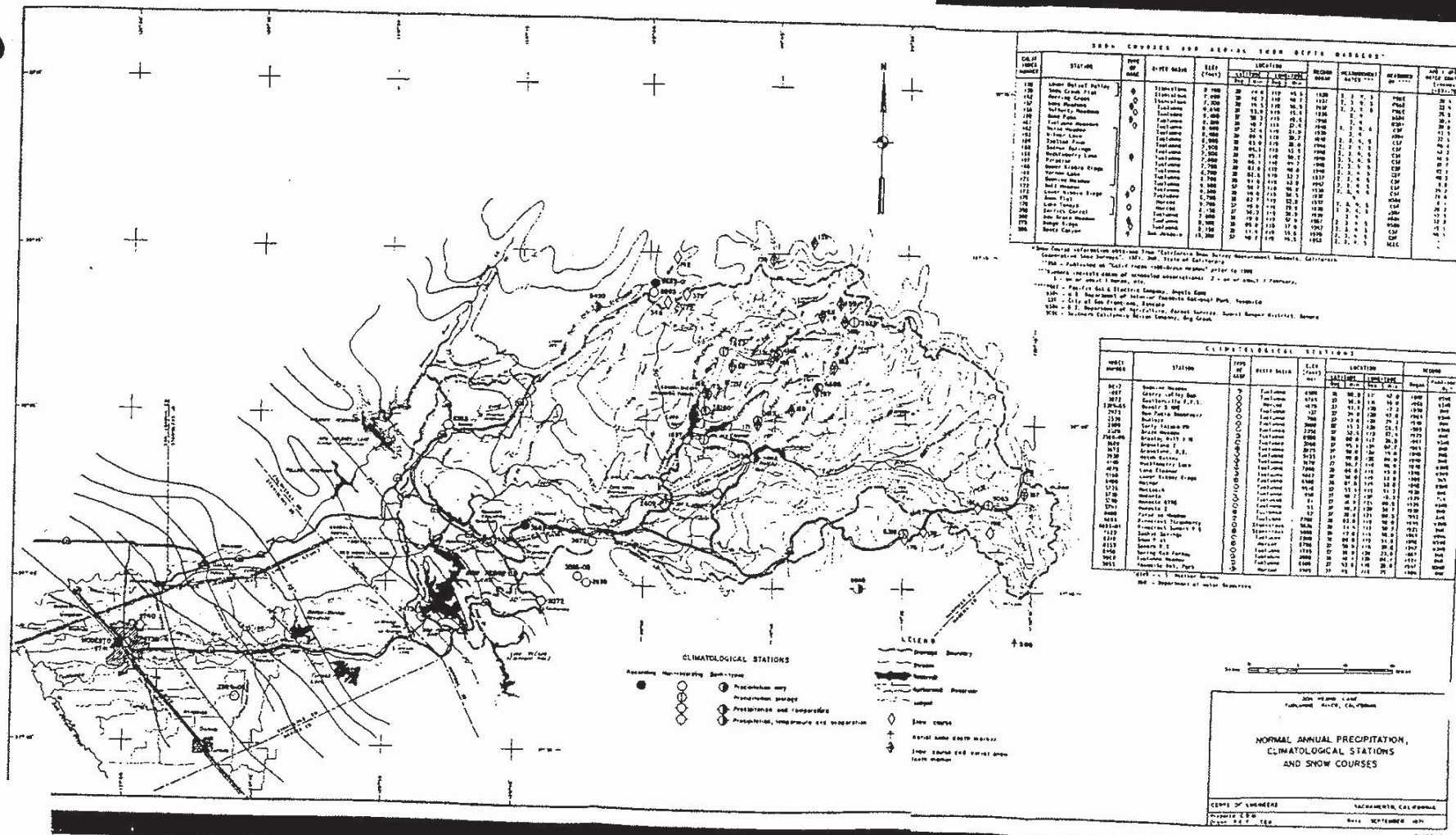

CLIMATOLOGICAL STATIONS
LEGEND
NORMAL ANNUAL PRECIPITATION,
CLIMATOLOGICAL STATIONS
AND SNOW COURSES

USCE000259

COMPUTED NATURAL FLOW, TUOLUMNE RIVER NEAR LA GRANGE
DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

| Water Year | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Runoff in thousands of acre-feet | | | | | | | |
| 1895-96 | 0.5 | 7.5 | 17.4 | 174.0 | 67.9 | 167.6 | 209.6 | 340.2 | 652.1 | 212.3 | 31.5 | 26.9 | 1,913.5 |
| 1896-97 | 9.3 | 73.8 | 68.2 | 71.3 | 273.8 | 224.1 | 455.7 | 771.4 | 117.9 | 120.9 | 18.4 | 8.9 | 2,413.7 |
| 1897-98 | 14.9 | 45.1 | 64.6 | 30.7 | 49.0 | 71.9 | 221.9 | 262.8 | 113.3 | 19.4 | 11.7 | 6.5 | 916.8 |
| 1898-99 | 11.1 | 6.9 | 15.9 | 12.7 | 43.1 | 242.3 | 321.4 | 294.5 | 376.7 | 65.3 | 12.9 | 5.4 | 1,432.3 |
| 1899-1900 | 32.6 | 154.1 | 177.2 | 154.4 | 58.2 | 156.3 | 157.9 | 445.2 | 332.4 | 51.2 | 7.3 | 4.3 | 1,751.5 |
| 1900-01 | 76.7 | 159.0 | 85.5 | 222.9 | 435.7 | 245.3 | 256.9 | 532.0 | 590.2 | 251.9 | 52.0 | 11.9 | 2,922.0 |
| 1901-02 | 13.7 | 35.9 | 56.7 | 32.5 | 83.8 | 138.8 | 291.7 | 397.5 | 461.3 | 84.0 | 27.0 | 6.1 | 1,589.0 |
| 1902-03 | 7.9 | 41.0 | 50.8 | 123.3 | 93.8 | 195.4 | 342.0 | 479.0 | 438.9 | 83.4 | 16.5 | 7.0 | 1,879.0 |
| 1903-04 | 5.4 | 59.3 | 26.6 | 26.1 | 217.4 | 334.1 | 350.6 | 654.9 | 516.9 | 164.1 | 46.6 | 37.0 | 2,439.5 |
| 1904-05 | 196.6 | 45.3 | 28.5 | 45.2 | 103.7 | 200.6 | 226.7 | 344.7 | 337.3 | 81.3 | 14.9 | 6.4 | 1,630.0 |
| 1905-06 | 4.9 | 6.0 | 6.3 | 179.6 | 120.6 | 453.5 | 400.4 | 697.1 | 851.9 | 731.0 | 133.3 | 27.9 | 3,014.7 |
| 1906-07 | 12.4 | 16.1 | 92.2 | 148.3 | 237.9 | 696.6 | 579.0 | 641.7 | 661.1 | 496.0 | 132.8 | 30.6 | 3,746.9 |
| 1907-08 | 12.9 | 18.6 | 38.6 | 59.3 | 47.6 | 112.2 | 207.0 | 251.1 | 181.6 | 62.6 | 23.9 | 5.4 | 1,027.4 |
| 1908-09 | 13.0 | 12.8 | 21.5 | 405.5 | 275.4 | 179.1 | 340.1 | 519.6 | 645.3 | 212.9 | 31.8 | 10.9 | 2,667.9 |
| 1909-10 | 13.8 | 154.0 | 237.0 | 197.0 | 108.0 | 241.0 | 419.0 | 465.0 | 207.0 | 51.4 | 16.8 | 16.0 | 2,121.6 |
| 1910-11 | 16.0 | 20.4 | 39.8 | 373.0 | 220.0 | 449.0 | 438.0 | 516.0 | 821.0 | 451.0 | 64.0 | 15.6 | 3,424.4 |
| 1911-12 | 15.4 | 14.3 | 15.9 | 27.7 | 27.7 | 60.6 | 101.0 | 333.0 | 381.2 | 67.0 | 12.4 | 7.1 | 1,061.3 |
| 1912-13 | 6.1 | 26.5 | 12.5 | 28.0 | 28.9 | 53.3 | 173.0 | 192.0 | 242.0 | 71.9 | 32.0 | 20.3 | 1,060.5 |
| 1913-14 | 6.8 | 13.5 | 15.3 | 416.0 | 195.0 | 235.0 | 313.0 | 508.0 | 541.0 | 259.0 | 52.4 | 11.0 | 2,626.6 |
| 1914-15 | 13.5 | 16.1 | 15.4 | 56.1 | 200.0 | 180.0 | 303.0 | 472.0 | 578.0 | 208.0 | 21.6 | 8.9 | 2,074.0 |
| 1915-16 | 9.2 | 8.9 | 11.1 | 221.0 | 183.0 | 387.0 | 403.0 | 459.0 | 469.0 | 181.0 | 33.6 | 13.9 | 2,359.7 |
| 1916-17 | 71.3 | 35.9 | 66.4 | 53.9 | 224.0 | 141.0 | 281.0 | 437.0 | 678.0 | 199.0 | 26.6 | 8.9 | 2,223.0 |
| 1917-18 | 4.5 | 5.9 | 11.1 | 12.2 | 54.5 | 266.8 | 280.2 | 347.3 | 415.0 | 45.1 | 5.0 | 13.3 | 1,461.5 |
| 1918-19 | 52.2 | 34.2 | 32.7 | 26.4 | 78.0 | 117.9 | 268.6 | 563.0 | 143.9 | 25.0 | 7.1 | 4.0 | 1,347.2 |
| 1919-20 | 5.9 | 4.2 | 24.7 | 24.8 | 29.0 | 161.6 | 231.0 | 478.6 | 315.0 | 48.3 | 12.4 | 6.5 | 1,342.1 |
| 1920-21 | 41.1 | 53.3 | 69.5 | 196.2 | 155.9 | 231.8 | 254.4 | 442.2 | 458.3 | 95.2 | 13.5 | 6.6 | 2,018.0 |
| 1921-22 | 6.2 | 5.9 | 57.3 | 71.7 | 189.5 | 181.3 | 260.3 | 717.5 | 751.9 | 194.0 | 27.2 | 10.4 | 2,473.8 |
| 1922-23 | 10.6 | 31.6 | 123.9 | 133.6 | 79.5 | 113.1 | 265.7 | 521.3 | 319.1 | 157.8 | 27.1 | 22.1 | 1,785.8 |
| 1923-24 | 28.5 | 13.6 | 13.8 | 25.3 | 41.6 | 37.9 | 138.9 | 209.4 | 16.8 | 16.8 | 0 | 0 | 542.6 |
| 1924-25 | 14.7 | 47.9 | 52.0 | 44.5 | 227.1 | 165.6 | 350.3 | 538.4 | 352.4 | 111.9 | 22.6 | 5.9 | 1,932.1 |
| 1925-26 | 15.1 | 16.2 | 32.8 | 19.0 | 100.0 | 127.4 | 362.3 | 303.8 | 59.2 | 18.9 | 3.3 | 1.4 | 1,110.0 |
| 1926-27 | 5.2 | 74.1 | 60.0 | 63.2 | 223.1 | 159.7 | 351.5 | 454.1 | 476.2 | 146.3 | 24.6 | 13.1 | 2,051.1 |
| 1927-28 | 15.3 | 87.0 | 44.1 | 51.3 | 82.2 | 343.4 | 263.3 | 447.8 | 152.7 | 27.6 | 7.3 | 2.0 | 1,525.1 |
| 1928-29 | 0 | 5.8 | 18.1 | 19.1 | 38.2 | 101.6 | 148.1 | 378.1 | 224.7 | 40.7 | 4.6 | 0 | 979.0 |
| 1929-30 | 2.0 | 0 | 24.7 | 39.0 | 70.1 | 146.6 | 245.9 | 274.8 | 266.2 | 48.8 | 10.0 | 0 | 1,148.1 |
| 1930-31 | 8.9 | 20.4 | 10.3 | 26.1 | 44.5 | 66.3 | 154.0 | 209.3 | 49.0 | 10.2 | 9.0 | 1.8 | 609.8 |
| 1931-32 | 1.7 | 6.0 | 93.7 | 79.4 | 240.2 | 171.6 | 245.0 | 524.2 | 532.7 | 175.2 | 32.0 | 12.0 | 2,114.3 |
| 1932-33 | 5.7 | 3.2 | 10.9 | 26.9 | 31.5 | 82.6 | 170.9 | 250.8 | 426.1 | 75.1 | 16.1 | 4.5 | 1,104.3 |
| 1933-34 | 0 | 8.0 | 40.8 | 64.9 | 90.0 | 150.2 | 186.4 | 149.0 | 95.1 | 12.1 | 6.1 | 4.6 | 807.2 |
| 1934-35 | 11.2 | 47.6 | 52.0 | 105.9 | 107.3 | 136.9 | 465.5 | 530.7 | 521.5 | 109.5 | 20.7 | 4.1 | 2,103.0 |
| 1935-36 | 11.6 | 19.6 | 18.2 | 104.2 | 352.0 | 207.5 | 392.9 | 520.2 | 390.2 | 120.4 | 17.0 | 2.9 | 2,160.1 |
| 1936-37 | 4.3 | 8.6 | 27.3 | 31.4 | 273.9 | 209.5 | 295.6 | 633.9 | 399.4 | 91.4 | 16.9 | 4.6 | 1,997.0 |
| 1937-38 | 9.2 | 18.8 | 312.6 | 101.9 | 322.7 | 424.8 | 422.4 | 720.2 | 711.6 | 305.2 | 55.5 | 19.5 | 3,424.4 |
| 1938-39 | 43.3 | 46.4 | 37.3 | 42.6 | 59.9 | 144.1 | 261.9 | 216.0 | 74.3 | 17.3 | 7.5 | 16.2 | 987.9 |
| 1939-40 | 44.9 | 16.6 | 20.2 | 226.5 | 250.0 | 344.1 | 324.9 | 571.1 | 341.6 | 54.2 | 10.8 | 2.0 | 2,206.9 |
| 1940-41 | 11.3 | 15.6 | 129.1 | 115.4 | 219.0 | 260.1 | 279.6 | 662.7 | 534.4 | 224.1 | 30.5 | 8.2 | 2,489.4 |
| 1941-42 | 7.0 | 37.6 | 161.5 | 164.8 | 142.4 | 148.7 | 337.0 | 472.0 | 597.6 | 253.4 | 30.2 | 3.3 | 2,355.5 |
| 1942-43 | 5.1 | 86.4 | 92.8 | 246.3 | 163.8 | 371.9 | 385.2 | 494.5 | 352.5 | 140.9 | 24.8 | 5.2 | 2,369.4 |
| 1943-44 | 11.6 | 15.6 | 20.9 | 42.7 | 80.4 | 135.2 | 164.6 | 455.8 | 267.2 | 37.0 | 11.2 | 2.4 | 1,295.2 |
| 1944-45 | 9.1 | 89.0 | 81.3 | 55.6 | 304.8 | 164.4 | 284.3 | 455.1 | 462.3 | 163.1 | 16.8 | 0 | 2,085.8 |
| 1945-46 | 60.3 | 98.3 | 207.7 | 118.9 | 69.9 | 155.8 | 347.8 | 488.5 | 242.7 | 52.5 | 7.9 | 3.4 | 1,873.7 |
| 1946-47 | 16.1 | 64.0 | 76.7 | 41.9 | 80.2 | 146.1 | 192.2 | 352.5 | 110.7 | 20.9 | 0 | 2.9 | 1,094.2 |
| 1947-48 | 38.2 | 28.1 | 17.2 | 39.7 | 25.9 | 73.0 | 220.7 | 436.2 | 433.8 | 87.7 | 5.2 | 2.5 | 1,408.2 |
| 1948-49 | 5.2 | 8.2 | 17.8 | 19.9 | 39.1 | 123.2 | 318.2 | 436.4 | 240.4 | 29.5 | 4.5 | 3.7 | 1,246.1 |
| 1949-50 | 3.9 | 14.2 | 13.4 | 77.5 | 124.3 | 128.3 | 329.1 | 467.4 | 319.4 | 62.2 | 6.5 | 0 | 1,546.2 |
| 1950-51 | 24.4 | 521.0 | 509.0 | 159.2 | 138.9 | 168.7 | 253.8 | 372.9 | 256.7 | 60.1 | 9.6 | 2.0 | 2,476.9 |
| 1951-52 | 9.0 | 30.8 | 121.4 | 218.7 | 147.8 | 239.8 | 466.4 | 791.3 | 594.2 | 291.9 | 54.1 | 16.9 | 2,982.3 |
| 1952-53 | 8.7 | 11.9 | 53.1 | 145.1 | 63.5 | 106.6 | 269.6 | 259.5 | 414.4 | 166.7 | 12.7 | 4.2 | 1,516.0 |
| 1953-54 | 6.0 | 16.5 | 25.7 | 43.5 | 101.0 | 213.7 | 344.8 | 450.2 | 185.3 | 37.7 | 2.1 | 1.9 | 1,428.4 |
| 1954-55 | 5.0 | 16.3 | 49.2 | 67.0 | 61.5 | 81.5 | 144.4 | 366.9 | 295.4 | 38.3 | 0 | 1.5 | 1,126.8 |
| 1955-56 | 5.7 | 11.1 | 671.4 | 435.8 | 168.7 | 197.8 | 301.0 | 592.5 | 618.2 | 247.8 | 29.4 | 9.5 | 3,288.9 |
| 1956-57 | 19.7 | 24.0 | 22.8 | 36.5 | 125.3 | 153.7 | 175.9 | 378.4 | 410.4 | 64.3 | 5.9 | 3.6 | 1,420.5 |
| 1957-58 | 14.9 | 20.8 | 43.9 | 63.2 | 180.5 | 251.6 | 403.4 | 718.3 | 555.7 | 230.1 | 57.6 | 21.6 | 2,561.6 |
| 1958-59 | 15.2 | 6.2 | 8.8 | 69.8 | 108.1 | 120.5 | 216.7 | 233.5 | 137.0 | 12.2 | 0 | 41.8 | 969.8 |
| 1959-60 | 11.3 | 6.6 | 8.5 | 23.5 | 120.7 | 148.4 | 238.1 | 293.3 | 156.6 | 6.3 | 0 | 0 | 1,013.3 |
| 1960-61 | 1.3 | 11.6 | 30.8 | 14.6 | 46.1 | 69.5 | 160.4 | 214.8 | 115.6 | 9.2 | 3.3 | 1.6 | 678.8 |
| 1961-62 | 3.9 | 9.5 | 25.3 | 25.3 | 235.0 | 139.2 | 381.9 | 356.5 | 446.0 | 112.4 | 8.8 | 0 | 1,750.8 |
| 1962-63 | 13.5 | 9.2 | 24.6 | 66.6 | 136.0 | 113.2 | 247.9 | 534.0 | 464.4 | 171.4 | 26.8 | 14.2 | 2,021.8 |
| 1963-64 | 16.8 | 105.4 | 50.8 | 60.4 | 53.7 | 71.1 | 167.1 | 118.8 | 222.4 | 34.6 | 6.3 | 1.7 | 1,109.1 |
| 1964-65 | 6.6 | 54.2 | 495.3 | 310.6 | 142.5 | 141.6 | 320.7 | 437.1 | 474.0 | 227.3 | 95.8 | 19.9 | 2,715.6 |
| 1965-66 | 2.3 | 128.4 | 86.1 | 81.9 | 77.2 | 143.6 | 295.2 | 353.2 | 82.9 | 18.0 | 7.0 | 8.7 | 1,284.5 |
| 1966-67 | 8.3 | 59.4 | 218.5 | 134.5 | 118.4 | 308.2 | 290.2 | 647.3 | 733.2 | 490.0 | 72.2 | 17.9 | 3,098.1 |
| 1967-68 | 9.1 | 12.3 | 30.9 | 44.6 | 132.8 | 121.5 | 184.1 | 287.1 | 143.0 | 18.3 | 8.0 | 4.2 | 996.5 |
| 1968-69 | 13.2 | 78.1 | 80.8 | 558.5 | 266.7 | 229.3 | 443.6 | 389.7 | 721.4 | 313.0 | 55.3 | 1.9 | 3,651.7 |
| 1969-70 | 42.6 | 41.7 | 103.2 | 388.6 | 135.7 | 185.3 | 160.6 | 395.1 | 341.0 | 90.7 | 13.9 | 16.3 | 1,914.7 |
| Mean | 17.7 | 42.4 | 78.4 | 112.6 | 139.3 | 188.5 | 286.4 | 451.6 | 384.2 | 131.1 | 23.7 | 9.1 | 1,865.6 |

CHART 5



Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G

MEAN MONTHLY NATURAL FLOWS FOR PERIOD OF RECORD THROUGH 1969

TUOLUMNE RIVER BASIN

| Station | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Acre-feet | | | | | | | | |
| Tuolumne River near Hetch Hetchy | 5,900 | 11,900 | 20,000 | 18,500 | 23,000 | 37,000 | 90,400 | 216,300 | 222,200 | 77,800 | 13,300 | 4,400 | 740,700 |
| Cherry Creek below Cherry Valley Dam, near Hetch Hetchy | 3,400 | 7,900 | 13,100 | 10,600 | 14,400 | 21,400 | 45,600 | 82,600 | 68,300 | 18,700 | 1,900 | 1,200 | 289,100 |
| Eleanor Creek near Hetch Hetchy | 1,200 | 4,400 | 7,700 | 7,500 | 9,100 | 14,800 | 26,900 | 39,800 | 25,600 | 6,500 | 800 | 500 | 144,800 |
| Middle Tuolumne River at Oakland Recreation Camp | 300 | 900 | 2,300 | 2,400 | 3,700 | 4,800 | 9,500 | 18,300 | 10,600 | 1,900 | 400 | 200 | 55,300 |
| South Fork Tuolumne River near Oakland Recreation Camp | 700 | 1,800 | 4,100 | 5,100 | 7,000 | 9,500 | 13,700 | 16,000 | 7,600 | 1,900 | 800 | 600 | 68,800 |
| Tuolumne River at La Grange | 17,400 | 42,400 | 78,000 | 108,900 | 139,300 | 188,600 | 288,500 | 452,600 | 384,800 | 131,700 | 23,800 | 9,000 | 1,865,000 |
| *Dry Creek near Modesto | 3,300 | 2,100 | 6,100 | 10,100 | 8,200 | 6,800 | 7,100 | 5,100 | 4,500 | 3,400 | 3,400 | 3,700 | 63,800 |
| *Tuolumne River at Tuolumne City | 50,400 | 68,800 | 102,100 | 114,700 | 128,500 | 137,600 | 134,100 | 151,300 | 153,600 | 50,400 | 25,200 | 29,800 | 1,146,500 |
| | | | | | Percent of Annual Runoff | | | | | | | | |
| Tuolumne River near Hetch Hetchy | 0.8 | 1.6 | 2.7 | 2.5 | 3.1 | 5.0 | 12.2 | 29.2 | 30.0 | 10.5 | 1.8 | 0.6 | 100.0 |
| Cherry Creek below Cherry Valley Dam, near Hetch Hetchy | 1.2 | 2.7 | 4.5 | 3.7 | 5.0 | 7.4 | 15.8 | 28.5 | 23.6 | 6.5 | 0.7 | 0.4 | 100.0 |
| Eleanor Creek near Hetch Hetchy | 0.8 | 3.1 | 5.3 | 5.2 | 6.3 | 10.2 | 18.6 | 27.5 | 17.7 | 4.5 | 0.5 | 0.3 | 100.0 |
| Middle Tuolumne River at Oakland Recreation Camp | 0.5 | 1.6 | 4.2 | 4.4 | 6.7 | 8.6 | 17.2 | 33.1 | 19.2 | 3.5 | 0.7 | 0.3 | 100.0 |
| South Fork Tuolumne River near Oakland Recreation Camp | 1.1 | 2.6 | 5.9 | 7.4 | 10.2 | 13.8 | 19.9 | 23.3 | 11.0 | 2.8 | 1.2 | 0.8 | 100.0 |
| Tuolumne River at La Grange | 0.9 | 2.3 | 4.2 | 5.8 | 7.5 | 10.1 | 15.5 | 24.3 | 20.6 | 7.0 | 1.3 | 0.5 | 100.0 |
| *Dry Creek near Modesto | 5.1 | 3.3 | 9.5 | 15.8 | 12.9 | 10.7 | 11.1 | 8.0 | 7.1 | 5.4 | 5.3 | 5.8 | 100.0 |
| *Tuolumne River at Tuolumne City | 4.4 | 6.0 | 8.9 | 10.0 | 11.2 | 12.0 | 11.7 | 13.2 | 13.4 | 4.4 | 2.2 | 2.6 | 100.0 |

* Flows affected by storage, diversion, and return flow.

CHART 6

PERTINENT RUNOFF DATA

TUOLUMNE RIVER BASIN

| Station | Source of data | Drainage area (sq miles) | Yrs. of record to 1969 | Yearly Average Natural Flow | | | | Maximum flow (Through 1969) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | April-July | | Annual | | | |
| | | | | inches | ac-ft | inches | ac-ft | cfs | cfsm |
| Tuolumne River near Hetch Hetchy | b | 457 | 59 | 24.9 | 606,700 | 30.4 | 740,700 | 12,900 | 28d |
| Cherry Creek below Cherry Valley Dam, near Hetch Hetchy | b | 118 | 59 | 36.3 | 215,200 | 48.8 | 289,100 | 18,100 | 153d |
| Eleanor Creek near Hetch Hetchy | b | 78.4 | 59 | 23.6 | 98,800 | 34.6 | 144,600 | 11,700 | 149d |
| Middle Tuolumne River at Oakland Recreation Camp | b | 73.5 | 44 | 10.3 | 40,300 | 14.1 | 55,300 | 4,920 | 67 |
| South Fork Tuolumne River near Oakland Recreation Camp | b | 87 | 46 | 8.5 | 39,200 | 14.8 | 68,800 | 11,900 | 137 |
| Tuolumne River at La Grange | a | 1,540 | 74 | 15.3 | 1,257,600 | 22.7 | 1,865,000 | 61,000 | 40d |
| Dry Creek near Modesto | c | 192.3 | 26 | 2.0 | 20,100d | 6.2 | 63,800d | 7,710 | 40d |
| Tuolumne River at Tuolumne City | c | 1,896 | 33 | 4.8 | 489,400d | 11.3 | 1,146,500d | 44,000 | 23e |

a City of San Francisco (computed natural flows)
b U.S.G.S.
c State of California
d Flows affected by storage and/or diversions
e Mean daily flows

CHART 7

STANDARD PROJECT RAIN-FLOOD SERIES
TUOLUMNE RIVER BASIN

6-hour average flows in thousand c.f.s.

| Period Ending | New Don Pedro Inflow | Down-stream Runoff | Period Ending | New Don Pedro Inflow | Down-stream Runoff | Period Ending | New Don Pedro Inflow | Down-stream Runoff | Period Ending | New Don Pedro Inflow | Down-stream Runoff |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-6 | 3.9 | .1 | 10-18 | 1.2 | .1 | 20-6 | 58.3 | 9.5 | 29-18 | 18.4 | 3.7 |
| 12 | 8.8 | .4 | 24 | 1.0 | .1 | 12 | 45.1 | 6.2 | 24 | 12.8 | 2.6 |
| 18 | 12.4 | 1.4 | 11-6 | 8.3 | .2 | 18 | 36.9 | 4.1 | 30-6 | 9.1 | 1.7 |
| 24 | 16.8 | 2.1 | 12 | 16.7 | 1.1 | 24 | 30.6 | 2.8 | 12 | 6.2 | 1.1 |
| 2-6 | 22.7 | 3.1 | 18 | 26.6 | 2.4 | 21-6 | 26.2 | 2.0 | 18 | 4.8 | .8 |
| 12 | 23.1 | 4.1 | 24 | 35.9 | 3.8 | 12 | 20.9 | 1.5 | 24 | 3.9 | .5 |
| 18 | 17.1 | 3.5 | 12-6 | 48.5 | 5.6 | 18 | 17.4 | 1.1 | 31-6 | 3.2 | .4 |
| 24 | 12.0 | 2.5 | 12 | 49.4 | 7.3 | 24 | 14.6 | .8 | 12 | 2.8 | .3 |
| 3-6 | 8.1 | 1.6 | 18 | 36.4 | 6.4 | 22-6 | 12.2 | .7 | 18 | 2.3 | .2 |
| 12 | 5.4 | 1.1 | 24 | 21.6 | 4.4 | 12 | 10.2 | .5 | 24 | 2.2 | .2 |
| 18 | 4.2 | .7 | 13-6 | 17.3 | 2.9 | 18 | 8.5 | .4 | 32-6 | 2.2 | .1 |
| 24 | 3.7 | .5 | 12 | 11.7 | 1.9 | 24 | 7.1 | .3 | 12 | 2.2 | .1 |
| 4-6 | 2.8 | .4 | 18 | 9.0 | 1.3 | 23-6 | 6.0 | .2 | 18 | 2.2 | .1 |
| 12 | 2.5 | .3 | 24 | 7.4 | .9 | 12 | 13.5 | .8 | 24 | 2.2 | .1 |
| 18 | 2.0 | .2 | 14-6 | 6.1 | .7 | 18 | 19.1 | 1.9 | 33-6 | 2.9 | .1 |
| 24 | 1.6 | .2 | 12 | 5.2 | .5 | 24 | 25.6 | 2.9 | 12 | 6.4 | .4 |
| 5-6 | 1.4 | .1 | 18 | 4.2 | .4 | 24-6 | 34.2 | 4.3 | 18 | 9.0 | 1.2 |
| 12 | 1.1 | .1 | 24 | 3.5 | .3 | 12 | 34.9 | 5.7 | 24 | 11.1 | 1.8 |
| 18 | 1.0 | .1 | 15-6 | 2.9 | .2 | 18 | 25.6 | 5.0 | 34-6 | 14.9 | 2.7 |
| 24 | .8 | .1 | 12 | 2.4 | .2 | 24 | 18.1 | 3.5 | 12 | 15.1 | 3.6 |
| 6-6 | 5.0 | .1 | 18 | 2.0 | .2 | 25-6 | 12.3 | 2.3 | 18 | 10.7 | 3.1 |
| 12 | 11.1 | .7 | 24 | 1.7 | .2 | 12 | 8.4 | 1.5 | 24 | 6.2 | 2.2 |
| 18 | 15.8 | 1.7 | 16-6 | 2.0 | .1 | 18 | 6.5 | 1.0 | 35-6 | 5.5 | 1.4 |
| 24 | 21.3 | 2.6 | 12 | 9.2 | .1 | 24 | 5.3 | .7 | 12 | 4.0 | .9 |
| 7-6 | 28.8 | 3.8 | 18 | 51.6 | .1 | 26-6 | 4.4 | .5 | 18 | 3.1 | .6 |
| 12 | 29.3 | 5.0 | 24 | 100.2 | .1 | 12 | 3.8 | .4 | 24 | 2.5 | .5 |
| 18 | 21.7 | 4.3 | 17-6 | 62.1 | .3 | 18 | 3.0 | .3 | 36-6 | 2.2 | .3 |
| 24 | 15.1 | 3.0 | 12 | 34.3 | 1.9 | 24 | 2.5 | .2 | 12 | 2.2 | .3 |
| 8-6 | 10.2 | 2.0 | 18 | 26.3 | 2.6 | 27-6 | 2.2 | .2 | 18 | 2.2 | .2 |
| 12 | 6.9 | 1.3 | 24 | 41.8 | 1.8 | 12 | 2.2 | .1 | 24 | 2.2 | .1 |
| 18 | 5.4 | .9 | 18-6 | 93.8 | 1.2 | 18 | 2.2 | .1 | 37-6 | 2.2 | .1 |
| 24 | 4.4 | .6 | 12 | 132.9 | 1.1 | 24 | 2.2 | .1 | 12 | 2.2 | .1 |
| 9-6 | 3.6 | .5 | 18 | 179.8 | 2.7 | 28-6 | 4.4 | .2 | 18 | 2.2 | .1 |
| 12 | 3.1 | .4 | 24 | 242.7 | 5.2 | 12 | 9.9 | .4 | 24 | 2.2 | .1 |
| 18 | 2.5 | .3 | 19-6 | 247.2 | 8.1 | 18 | 14.1 | 1.4 | | | |
| 24 | 2.1 | .2 | 12 | 182.5 | 12.0 | 24 | 18.7 | 2.2 | Total | 3082.0 | 263.1 |
| 10-6 | 1.7 | .2 | 18 | 127.7 | 15.6 | 29-6 | 24.6 | 3.3 | Thousand | | |
| 12 | 1.4 | .1 | 24 | 86.1 | 13.6 | 12 | 25.0 | 4.3 | ac-ft | 1531.0 | 130.3 |

NOTE:

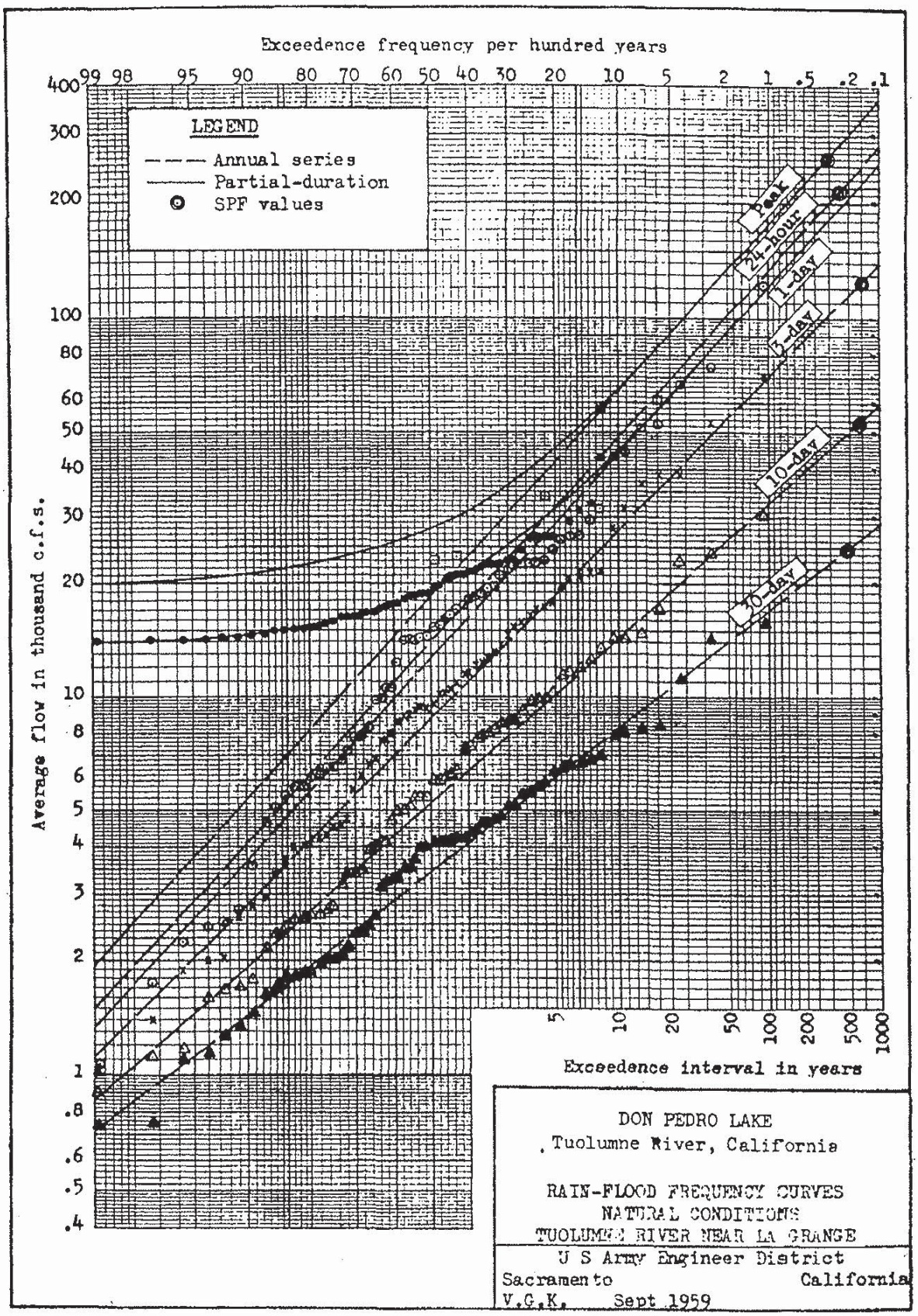
Downstream runoff includes that tributary between Don Pedro Dam site and the mouth of Tuolumne River. Quantities shown are reduced quantities that can coincide with full standard project flood quantities above Don Pedro Reservoir. For days 16-22, timing shown hereon has been corrected and flows for downstream runoff are 1 day later than shown in Table IV of Hydrology Report.

Tuolumne River Project, California March 1961 D.D.D. File: TT

CHART 8



Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G

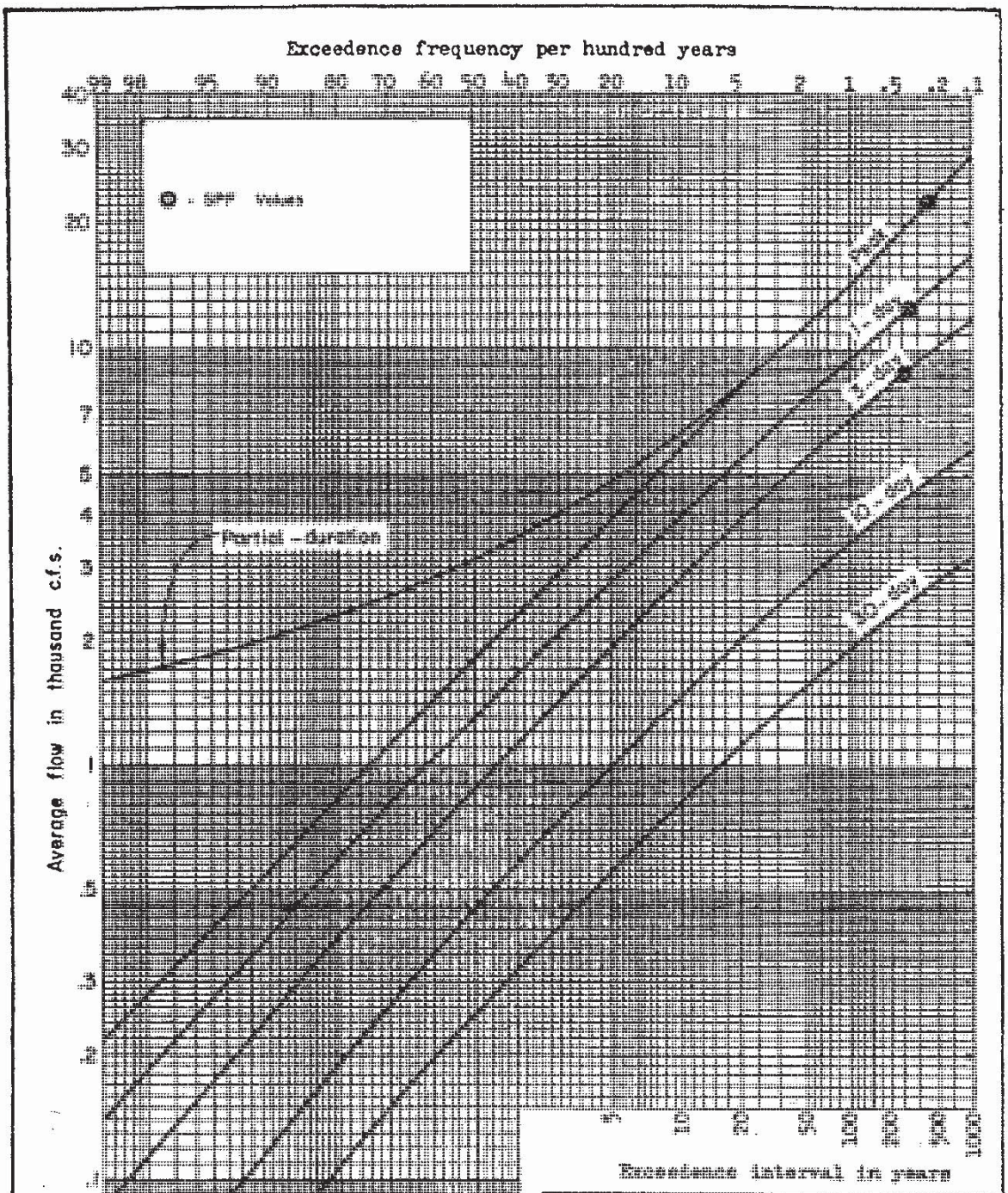



DON PEDRO LAKE
Tuolumne River, California

RAIN-FLOOD FREQUENCY CURVES
NATURAL CONDITIONS
TUOLUMNE RIVER NEAR LA GRANGE

U S Army Engineer District
Sacramento California
V.G.K. Sept 1959

CHART 9




DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

RAIN-FLOOD FREQUENCY CURVES
DRY CREEK NEAR MODESTO
(NATURAL CONDITIONS)

Corps of Engineers, Sacramento, Calif

Prepared: D.D.D. Date: September 1971

CHART 10



USCE000265

Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G

STANDARD PROJECT SNOWMELT FLOOD

TUOLUMNE RIVER AT DON PEDRO DAM

24-hour average flows in thousand c.f.s.

| April | Flow | May | Flow | June | Flow | July | Flow |
|---|---|---|---|---|---|---|---|
| 1 | 2.4 | 1 | 8.8 | 1 | 22.2 | 1 | 15.3 |
| 2 | 3.6 | 2 | 11.3 | 2 | 24.3 | 2 | 13.2 |
| 3 | 4.6 | 3 | 12.3 | 3 | 23.9 | 3 | 13.0 |
| 4 | 3.3 | 4 | 13.3 | 4 | 24.1 | 4 | 13.9 |
| 5 | 2.9 | 5 | 15.5 | 5 | 24.2 | 5 | 14.1 |
| 6 | 3.3 | 6 | 13.2 | 6 | 25.9 | 6 | 13.3 |
| 7 | 3.7 | 7 | 10.4 | 7 | 28.4 | 7 | 11.4 |
| 8 | 3.4 | 8 | 8.6 | 8 | 25.1 | 8 | 10.1 |
| 9 | 3.3 | 9 | 8.5 | 9 | 21.3 | 9 | 8.4 |
| 10 | 3.4 | 10 | 9.6 | 10 | 20.8 | 10 | 8.3 |
| 11 | 3.5 | 11 | 11.1 | 11 | 21.2 | 11 | 7.5 |
| 12 | 3.6 | 12 | 12.8 | 12 | 21.4 | 12 | 7.0 |
| 13 | 3.5 | 13 | 17.9 | 13 | 20.9 | 13 | 7.1 |
| 14 | 3.5 | 14 | 18.4 | 14 | 19.2 | 14 | 6.5 |
| 15 | 4.2 | 15 | 16.5 | 15 | 17.3 | 15 | 6.3 |
| 16 | 4.8 | 16 | 17.0 | 16 | 15.9 | 16 | 5.8 |
| 17 | 4.0 | 17 | 19.5 | 17 | 16.0 | 17 | 5.6 |
| 18 | 4.5 | 18 | 22.4 | 18 | 17.2 | 18 | 5.0 |
| 19 | 4.9 | 19 | 23.3 | 19 | 18.3 | 19 | 4.3 |
| 20 | 3.7 | 20 | 23.0 | 20 | 16.9 | 20 | 3.9 |
| 21 | 4.1 | 21 | 20.6 | 21 | 17.5 | 21 | 3.6 |
| 22 | 4.6 | 22 | 19.2 | 22 | 17.8 | 22 | 3.5 |
| 23 | 5.9 | 23 | 18.3 | 23 | 18.8 | 23 | 3.3 |
| 24 | 5.7 | 24 | 16.0 | 24 | 20.4 | 24 | 3.1 |
| 25 | 5.5 | 25 | 11.9 | 25 | 20.3 | 25 | 2.8 |
| 26 | 5.1 | 26 | 11.6 | 26 | 19.9 | 26 | 2.6 |
| 27 | 4.9 | 27 | 13.1 | 27 | 21.2 | 27 | 2.5 |
| 28 | 5.5 | 28 | 17.0 | 28 | 21.6 | 28 | 2.4 |
| 29 | 7.0 | 29 | 18.6 | 29 | 21.6 | 29 | 2.3 |
| 30 | 7.9 | 30 | 21.4 | 30 | 19.4 | 30 | 2.2 |
| | | 31 | 22.2 | | | 31 | 2.1 |
| Total | 130.3 | | 483.3 | | 623.0 | | 210.4 |

Tuolumne River Project, California, March 1961 D.D.D.

CHART 11



Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G

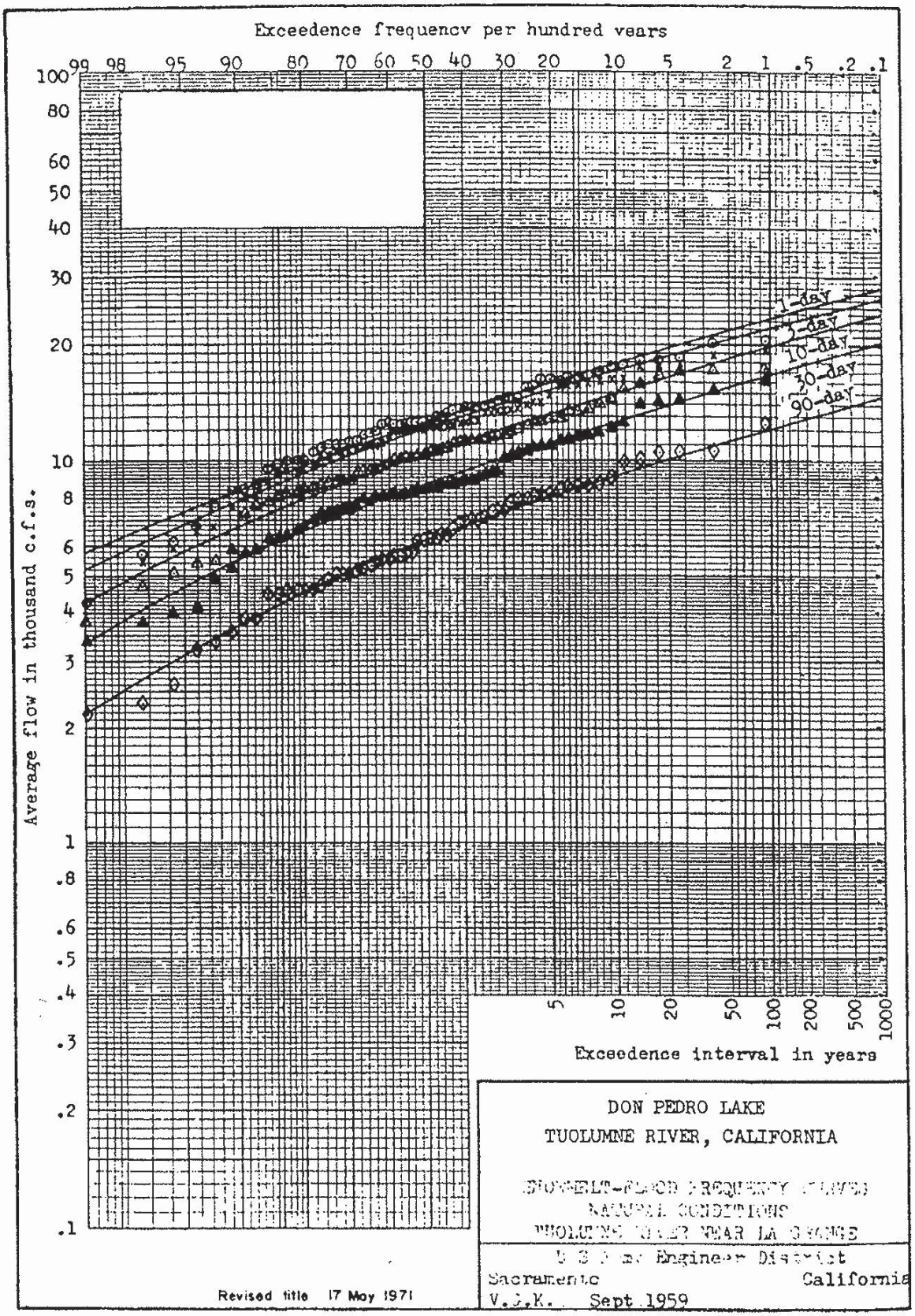
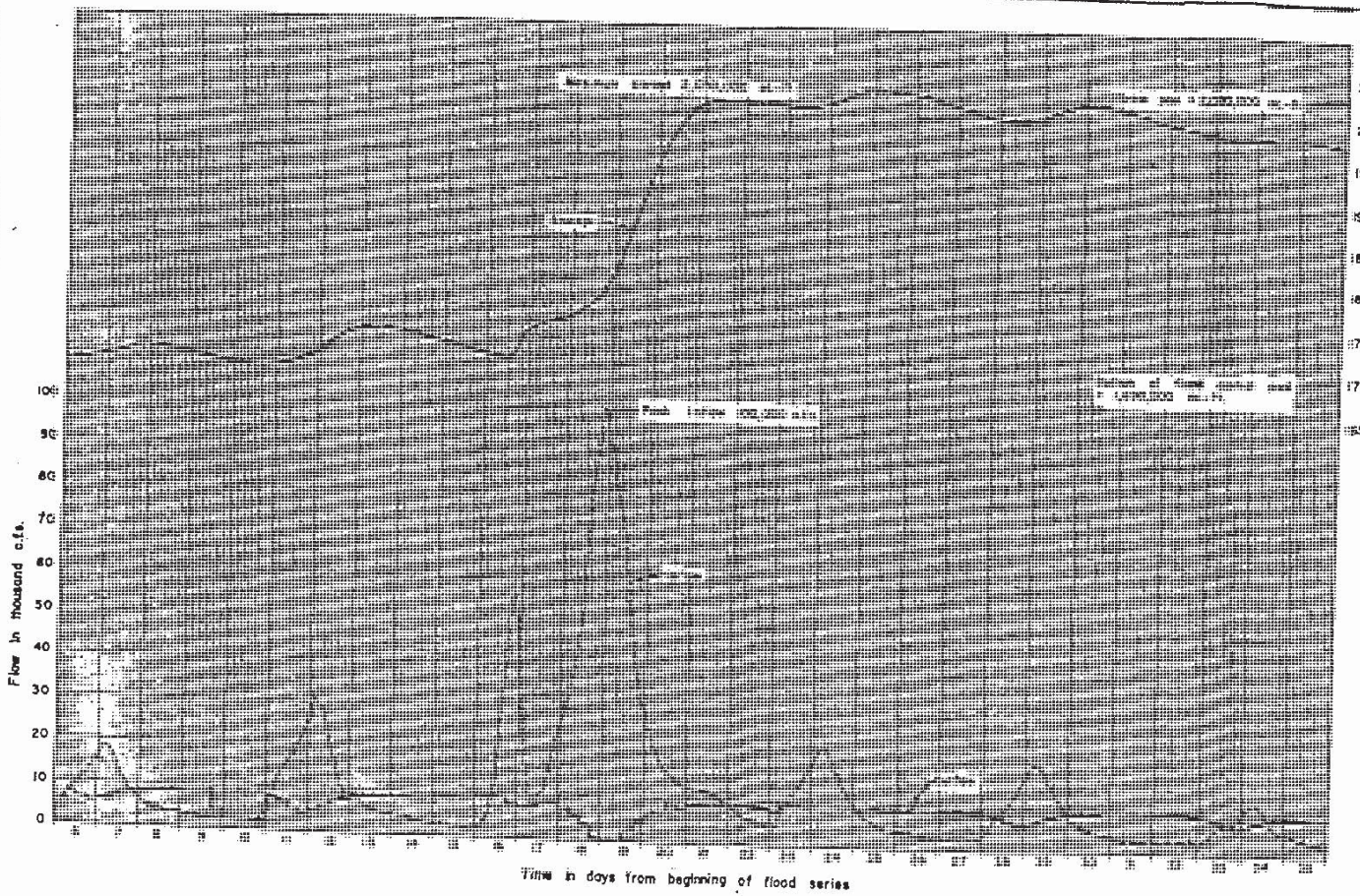

Exceedence frequency per hundred years
99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 .5 .2 .1
Average flow in thousand c.f.s.
100 80 60 50 40 30 20 10 8 6 5 4 3 2 1 .8 .6 .5 .4 .3 .2 .1
1-day
3-day
10-day
30-day
90-day
5 10 20 50 100 200 500 1000
Exceedence interval in years
DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA
Sacramento
California
V.J.K. Sept 1959
Revised title 17 May 1971

CHART 12




NOTES:

(1) For this routing it was assumed that 220,000 acre-feet of empty space was available in upstream reservoirs at the beginning of the Reservoir Design Flood Series, a maximum of 340,000 acre-feet of empty space was assumed available in Don Pedro Lake.

(2) Don Pedro Lake outflows were determined in accordance with criteria shown on the Flood Control Diagram, chart A-6, and the Emergency Spillway Release Diagram, chart A-8.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

ROUTING OF
RESERVOIR DESIGN RAINFLOOD
(64% of S.P.F.)

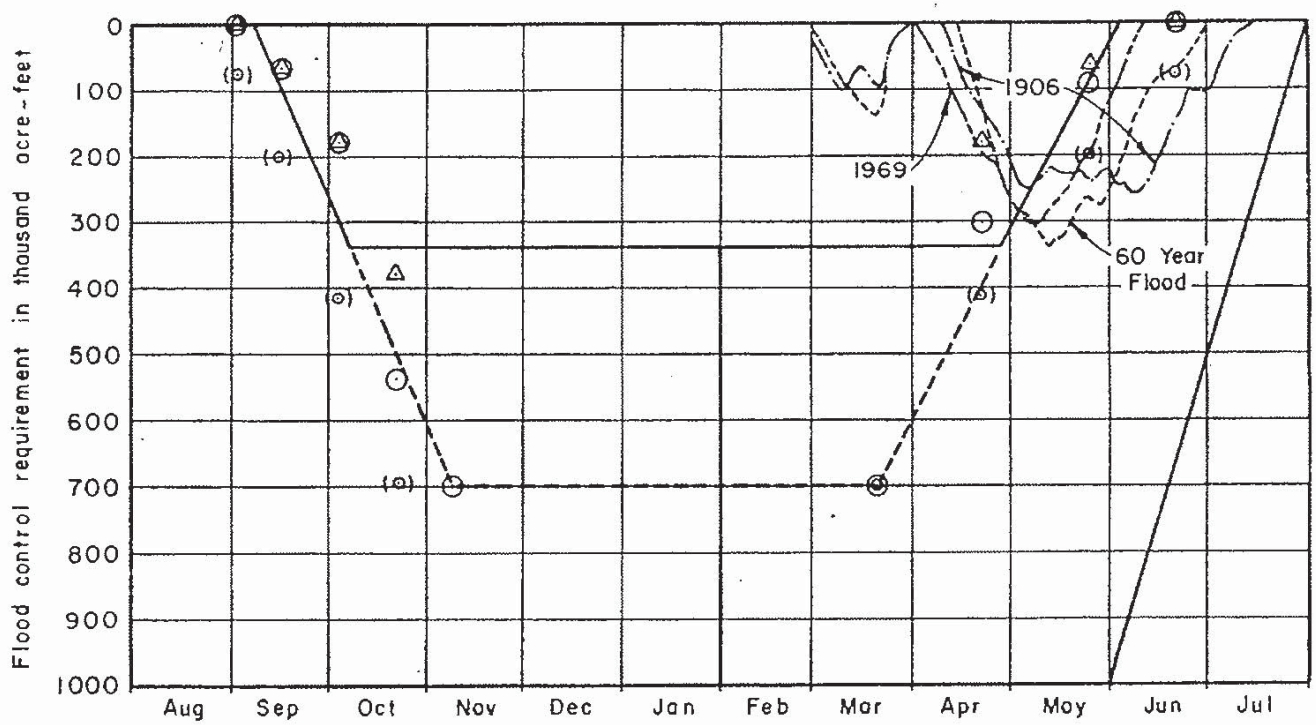
CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: D.D.D.
Drawn: T.G.K.
Date: SEPTEMBER 1971

CHART 13

USCE000268

062




LEGEND

⊙ Requirement to control runoff from reservoir design storm (seasonally adjusted for flood potential) on wet ground to 7200 c.f.s. (80 percent of project flows) at Modesto. Values in parenthesis used for interpolation only.

△ Requirement to control runoff from reservoir design storm (seasonally adjusted for flood potential) on dry ground.

○ Requirement to control runoff from reservoir design storm, with seasonal adjustment of both storm potential and ground-wetness potential.

Minimum reservation required to control indicated snowmelt floods to 9,000 c.f.s. (100 percent of project flows).

—·—·— 1906; - - - - - - - - 60 Year Flood; ———————1969.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

SEASONAL FLOOD CONTROL SPACE REQUIREMENT DON PEDRO LAKE

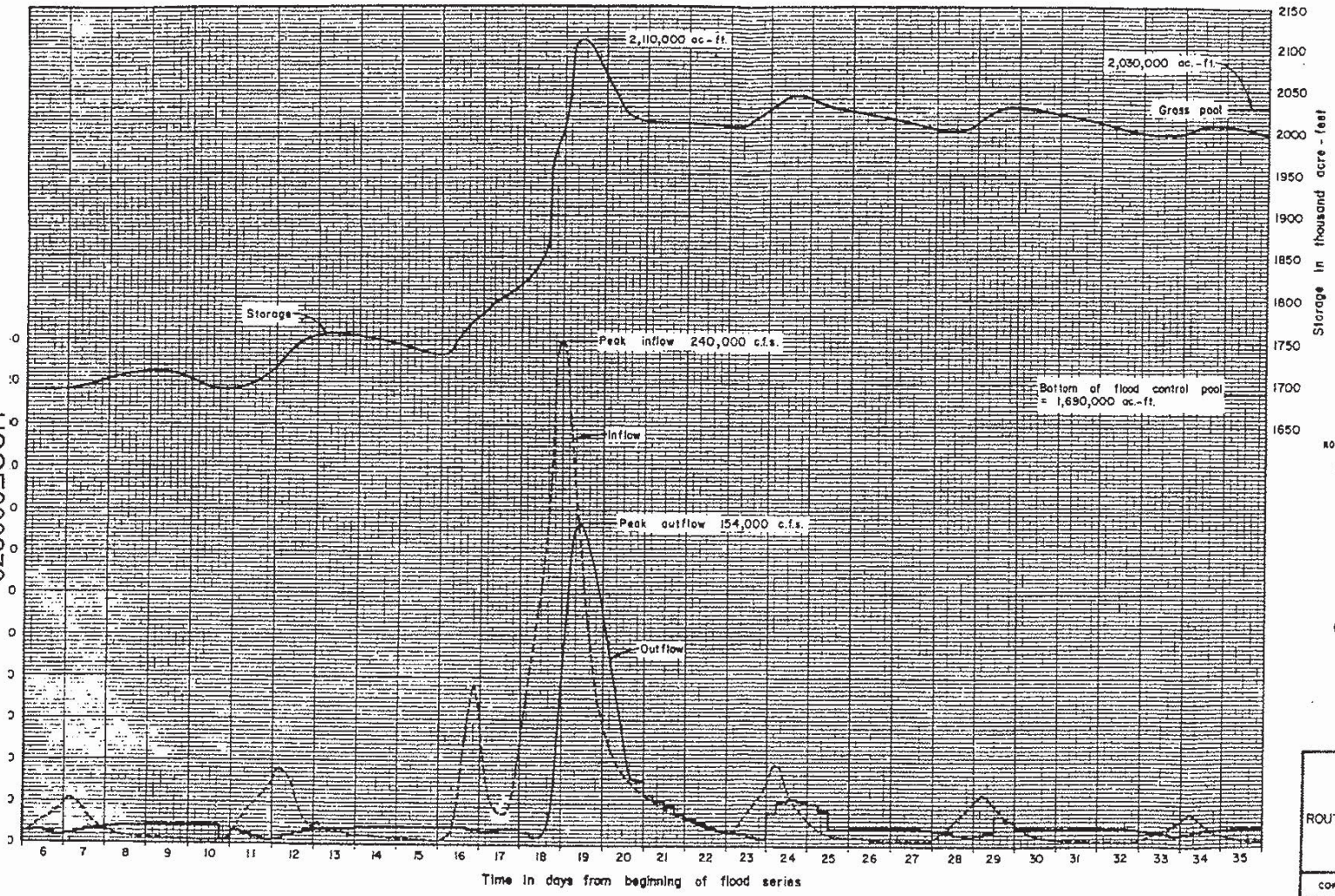
CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: R.F.C.
Drawn: T.G.K.
Date: SEPTEMBER 1971

CHART 14

063

USCE000269




NOTES:

(1) For this routing it was assumed that 220,000 acre-feet of empty space was available in upstream reservoirs at the beginning of the Standard Project Flood Series, and inflow hydrograph is, therefore, modified from that shown on chart 8. A maximum of 340,000 acre-feet of empty space was assumed available in Don Pedro Lake

(2) Don Pedro Lake outflows were determined in accordance with criteria shown on the Flood Control Diagram, chart A-8, and the Emergen Spillway Release Diagram, chart A-1

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

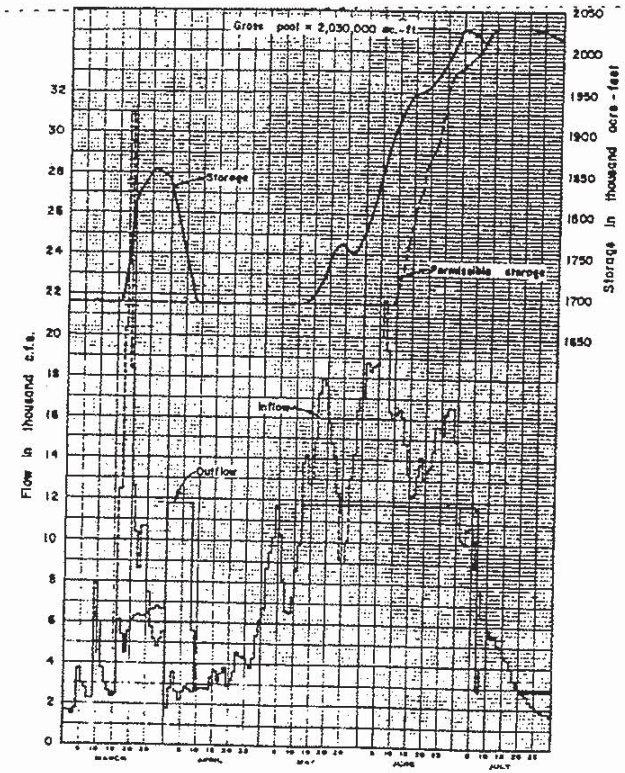
ROUTING OF STANDARD PROJECT
(RAIN-FLOOD SERIES)

CORPS OF ENGINEERS, SACRAMENTO, CALIFO

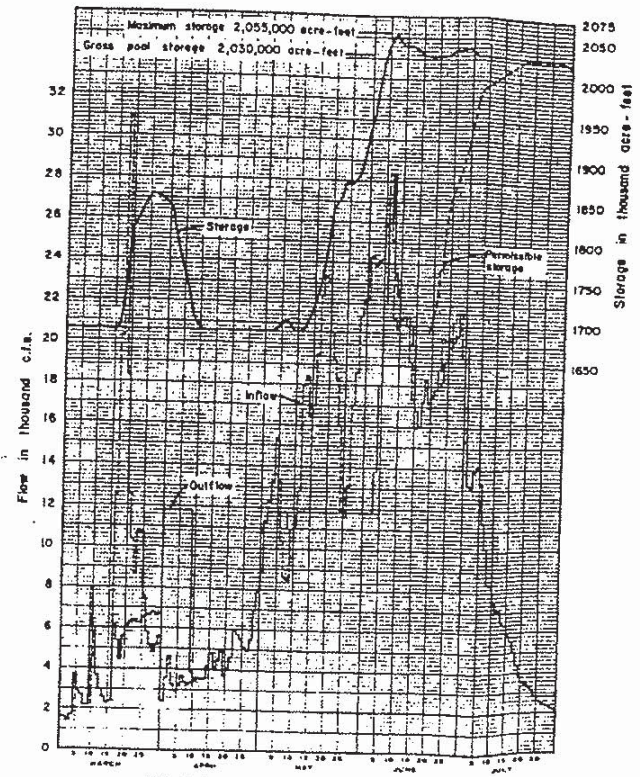
Prepared: D.D.D.
Drawn T.G.K.
Date: SEPTEMBER

USCE000270

064




RESERVOIR DESIGN FLOOD ROUTING
(77% OF STANDARD PROJECT FLOOD)




STANDARD PROJECT FLOOD ROUTING

NOTES:

(1) All upstream reservoirs were assumed to be full at the beginning of each flood routing.

(2) In both routings, the forecast and actual run-off volumes were assumed to be identical.

(3) Permissible storage was determined by using the criteria shown on the Flood Control Diagram, chart A-8.

(4) The April thru July inflows shown are hypothetical flood flows. The March inflows are the highest March flows of record (March 1907) modified for present conditions of upstream reservoir storage.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

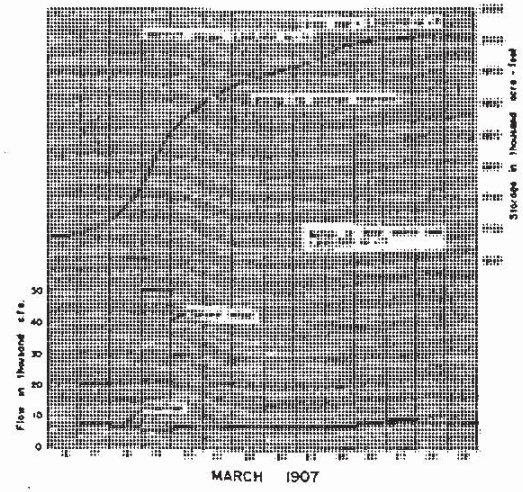
ROUTING OF
HYPOTHETICAL SNOWMELT FLOW

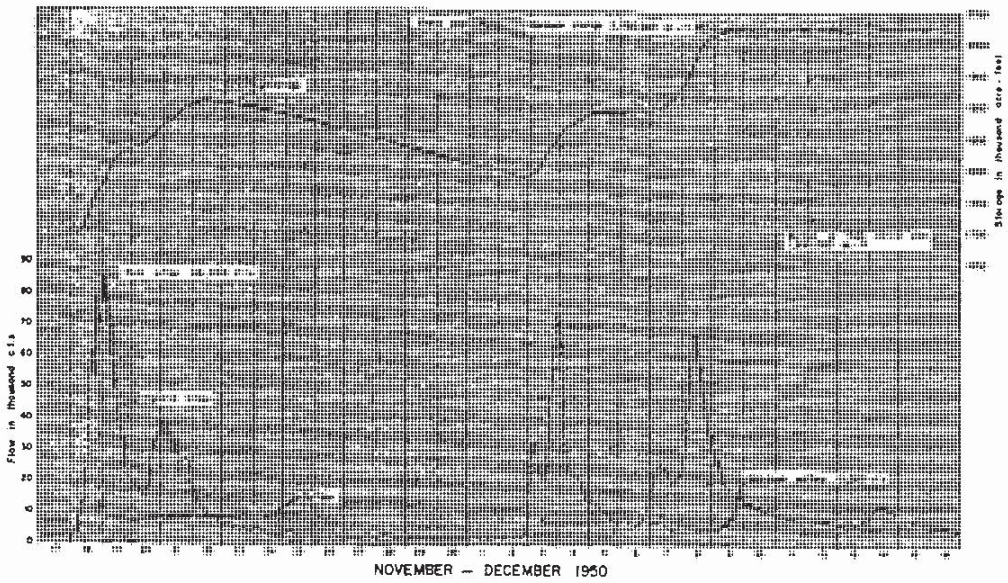
CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

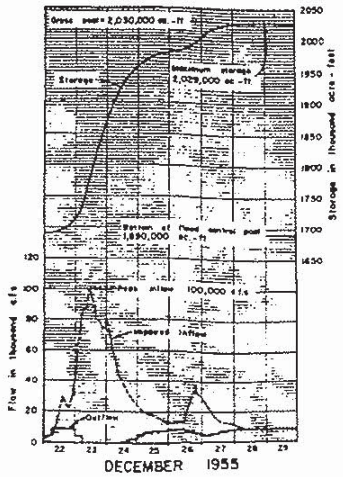
Prepared: D.D.D.
Drawn: T.G.K.
Date: SEPTEMBER 1971

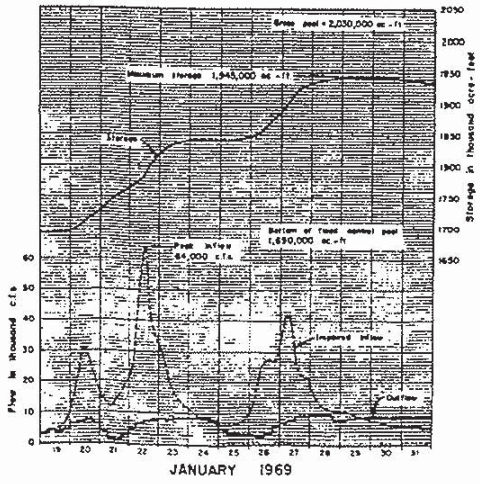
USCE000271

065




NOTES:

(1) At the beginning of each flood routing, it was assumed that there was 350,000 acre-feet of empty space in Don Pedro Lake.

(2) Storage conditions in the upstream reservoirs are those that actually existed at the beginning of each respective flood period as follows:

(a) March 1907 flood - inflows to Don Pedro Lake are natural, since there were no upstream reservoirs.

(b) November-December 1950 flood - inflows to Don Pedro Lake were impaired by operating Hetch Hetchy Reservoir and Lake Eleanor.

(c) December 1955 flood - inflows to Don Pedro Lake were impaired by operating Hetch Hetchy and Lake Eleanor, and to a certain extent by operating Eleanor Valley Reservoir which was under construction at the time.

(d) January 1969 flood - inflows to Don Pedro Lake were impaired by all present-day working upstream reservoirs.

(3) All routings are based on criteria on chart A-6, with diversions to Hetch Hetchy Aqueduct neglected.

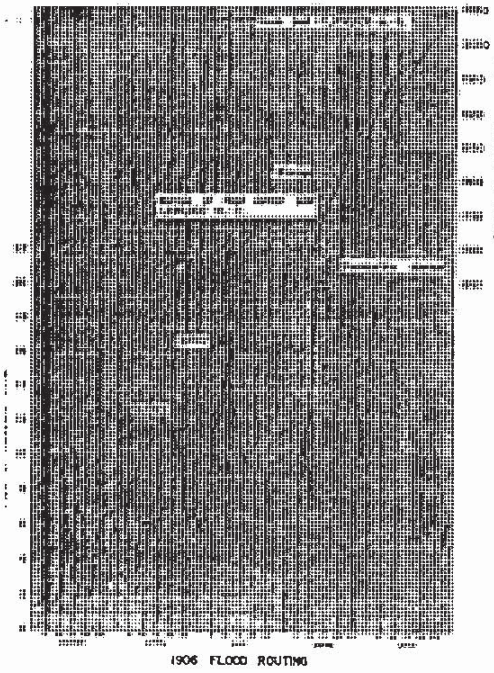
DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

ROUTING OF
HISTORICAL RAIN FLOODS

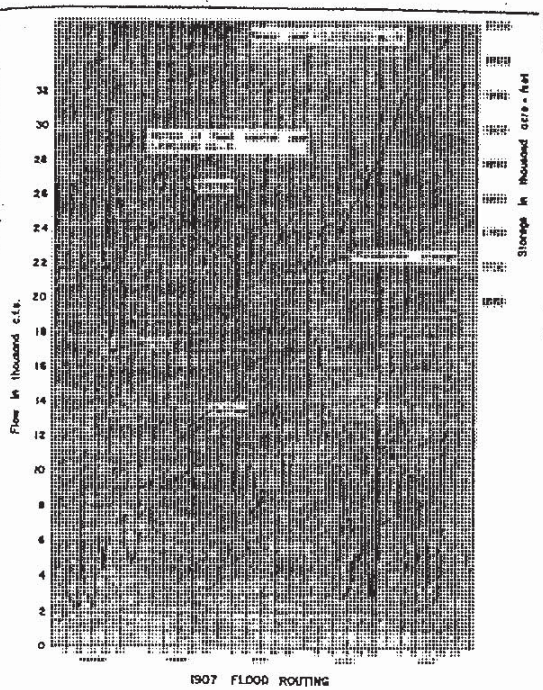
CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared D.O.D.
Drawn T.G.K.
Date SEPTEMBER 1971

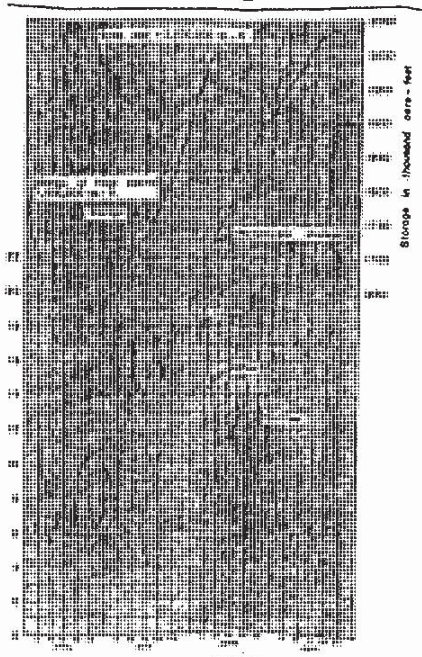
CHART A-6




1906 FLOOD ROUTING




1907 FLOOD ROUTING




1969 FLOOD ROUTING

NOTES:

(1) Upstream reservoirs full at beginning of routing.

(2) Permissible storage based on Flood Control Diagram, chart 1-B, estimate forecasts published by the State of California Dept. of Water Resources for 1996, and forecasts obtained by use of precipitation data and criteria shown on chart 22 of the Flood-Control generals Operation Report for 1996 and 1997.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

ROUTING OF
HISTORICAL SNOWMELT FLOODS

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

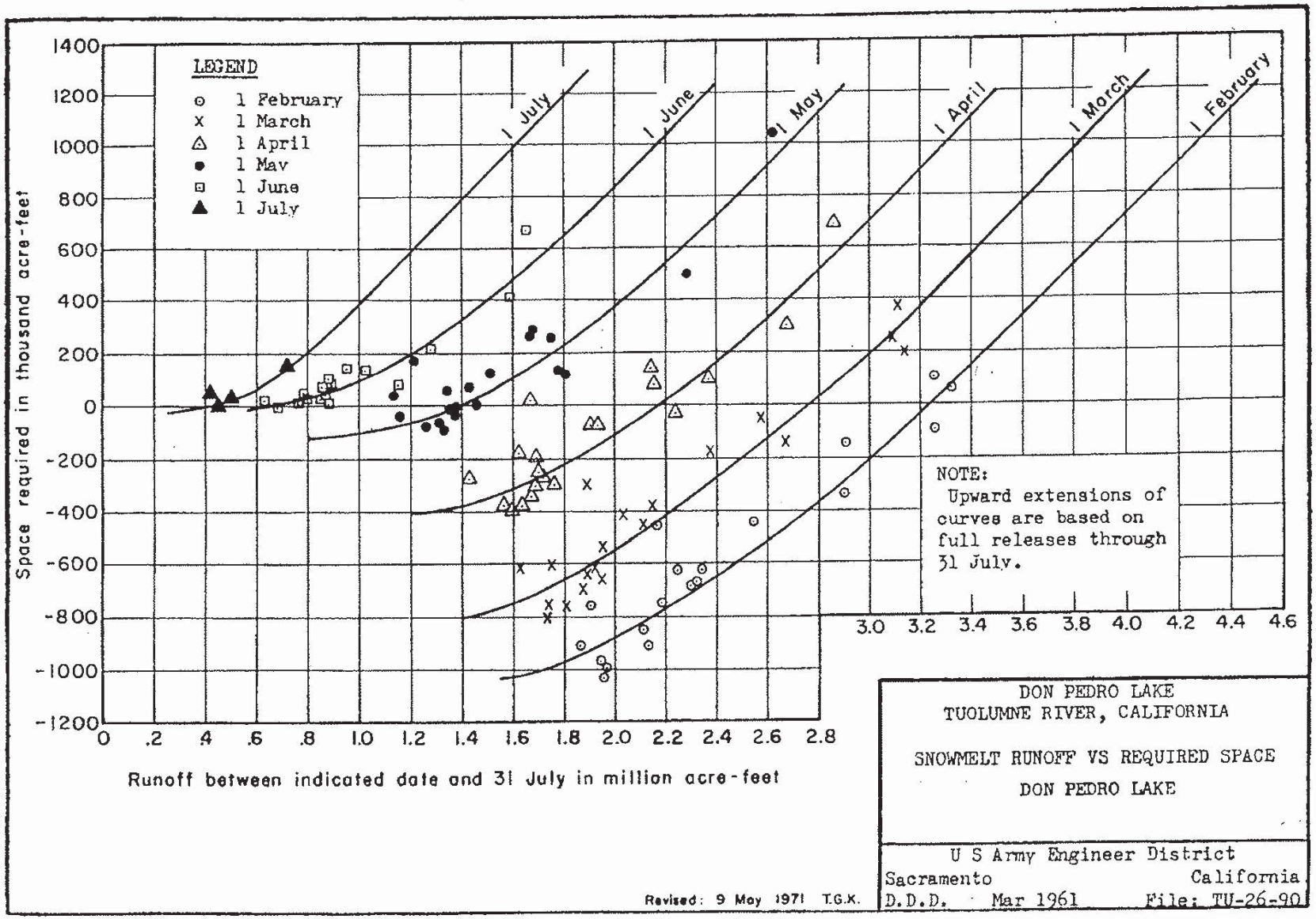
Prepared O.D.D.
Drawn T.E.K.

DATE SEPTEMBER 1971

CHART 18

USCE000273

067




DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

SNOWMELT RUNOFF VS REQUIRED SPACE
DON PEDRO LAKE

U S Army Engineer District
Sacramento California
D.D.D. Mar 1961 File: TU-26-90

USCE000274

068

CHART 19

MONTHLY REQUIRED FLOOD CONTROL RESERVATION

DON PEDRO LAKE

(See footnote for adjustment)

| Year | Required space in thousand-acre feet at end of month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| 1906 | 340 | 340 | 340 | 340 | 340 | 260 | 0 | 0 | 257 | 340 | 340 | 340 |
| 1907 | | | | 340 | 340 | 100 | | | | | | |
| 1908 | | | | 317 | 28 | 0 | | | | | | |
| 1909 | | | | 317 | 135 | 0 | | | | | | |
| 1910 | | | | 317 | 28 | 0 | | | | | | |
| 1911 | | | | 340 | 240 | 0 | | | | | | |
| 1912 | | | | 317 | 28 | 0 | | | | | | |
| 1913 | | | | 317 | 28 | 0 | | | | | | |
| 1914 | | | | 317 | 175 | 5 | | | | | | |
| 1915 | | | | 317 | 280 | 15 | | | | | | |
| 1916 | | | | 317 | 28 | 0 | | | | | | |
| 1917 | | | | 317 | 130 | 0 | | | | | | |
| 1918 | | | | 317 | 30 | 0 | | | | | | |
| 1919 | | | | 317 | 28 | 0 | | | | | | |
| 1920 | | | | 317 | 28 | 0 | | | | | | |
| 1921 | | | | 317 | 60 | 0 | | | | | | |
| 1922 | | | | 317 | 28 | 0 | | | | | | |
| 1923 | | | | 317 | 28 | 0 | | | | | | |
| 1924 | | | | 317 | 28 | 0 | | | | | | |
| 1925 | | | | 340 | 250 | 95 | | | | | | |
| 1926 | | | | 317 | 28 | 0 | | | | | | |
| 1927 | | | | 317 | 160 | 0 | | | | | | |
| 1928 | | | | 317 | 70 | 15 | | | | | | |
| 1929 | | | | 317 | 28 | 0 | | | | | | |
| 1930 | | | | 317 | 40 | 0 | | | | | | |
| 1931 | | | | 317 | 28 | 0 | | | | | | |
| 1932 | | | | 317 | 50 | 0 | | | | | | |
| 1933 | | | | 317 | 40 | 0 | | | | | | |
| 1934 | | | | 317 | 28 | 0 | | | | | | |
| 1935 | | | | 317 | 135 | 0 | | | | | | |
| 1936 | | | | 317 | 70 | 0 | | | | | | |
| 1937 | | | | 317 | 40 | 0 | | | | | | |
| 1938 | | | | 340 | 300 | 5 | | | | | | |
| 1939 | | | | 317 | 28 | 0 | | | | | | |
| 1940 | | | | 317 | 40 | 0 | | | | | | |
| 1941 | | | | 340 | 200 | 0 | | | | | | |
| 1942 | | | | 317 | 265 | 3 | | | | | | |
| 1943 | | | | 317 | 60 | 0 | | | | | | |
| 1944 | | | | 317 | 40 | 0 | | | | | | |
| 1945 | 340 | 340 | 340 | 317 | 55 | 0 | 0 | 0 | 257 | 340 | 340 | 340 |

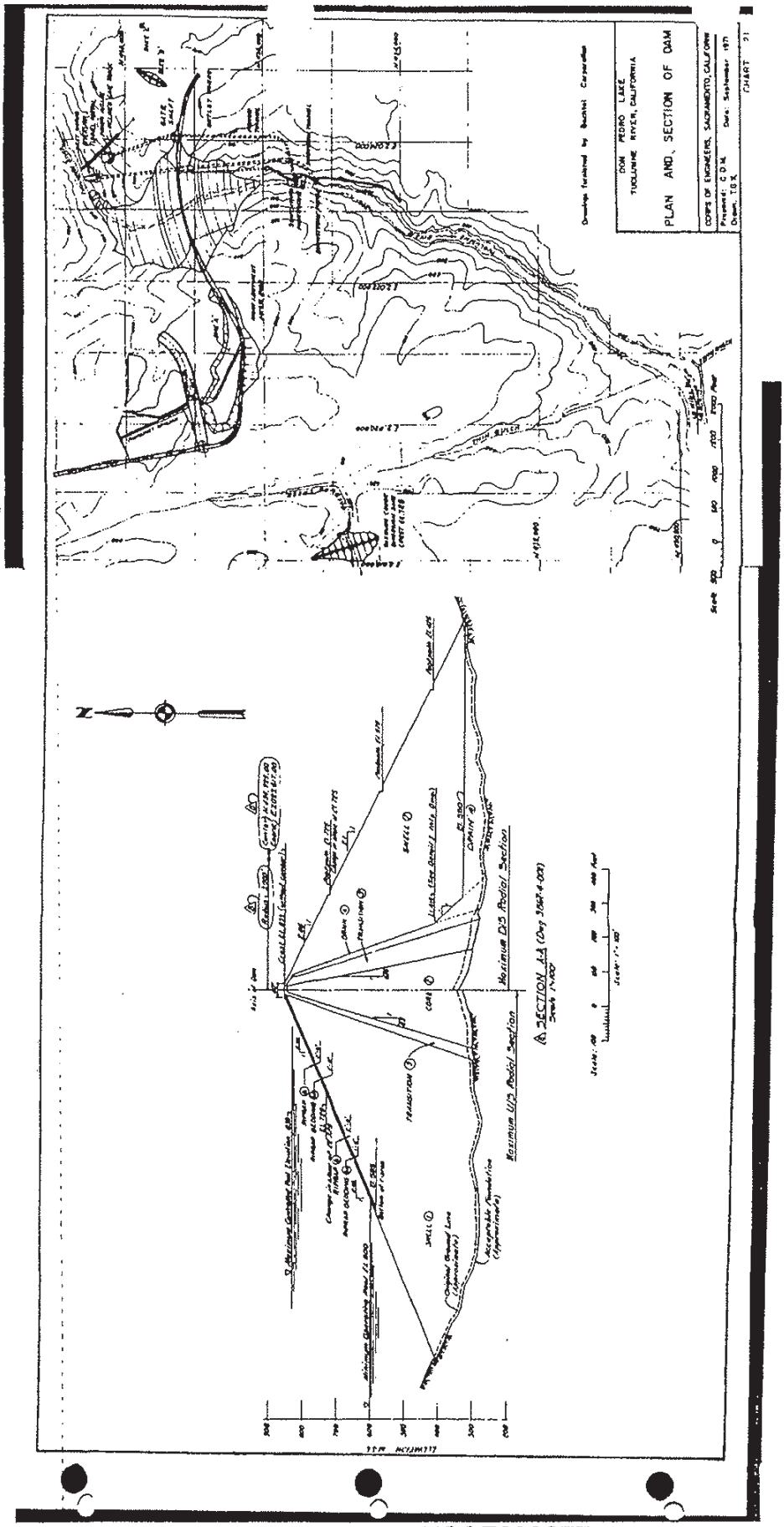
Sheet 1 of 2 Sheets CHART 20

MONTHLY REQUIRED FLOOD CONTROL RESERVATION

DON PEDRO LAKE

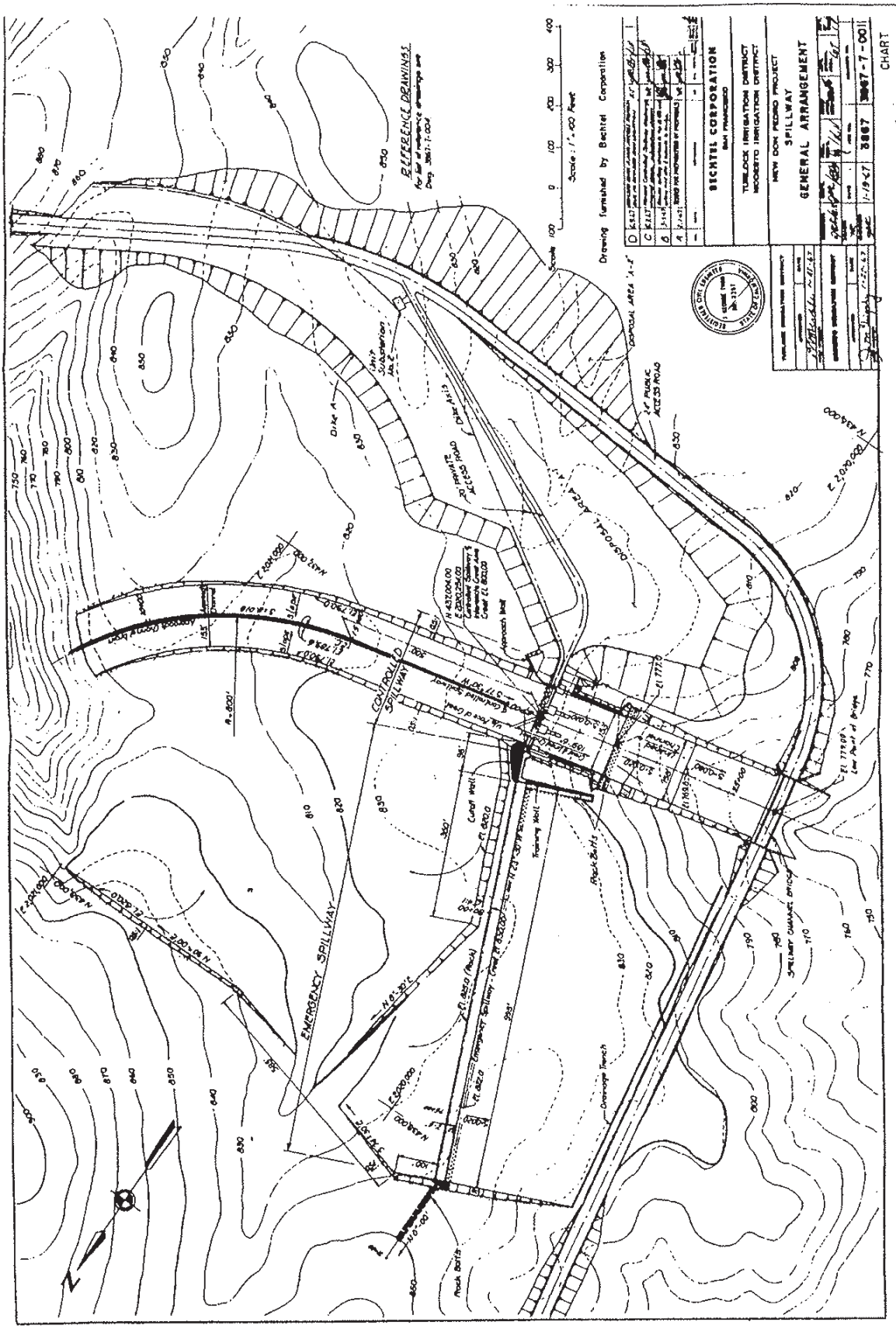
| Year | Required space in thousand acre-feet at end of month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| 1946 | 340 | 340 | 340 | 317 | 55 | 0 | 0 | 0 | 257 | 340 | 340 | 340 |
| 1947 | | | | 317 | 28 | 0 | | | | | | |
| 1948 | | | | 317 | 80 | 0 | | | | | | |
| 1949 | | | | 317 | 28 | 0 | | | | | | |
| 1950 | | | | 317 | 28 | 0 | | | | | | |
| 1951 | | | | 317 | 75 | 0 | | | | | | |
| 1952 | | | | 340 | 135 | 0 | | | | | | |
| 1953 | | | | 317 | 40 | 0 | | | | | | |
| 1954 | | | | 317 | 28 | 0 | | | | | | |
| 1955 | | | | 317 | 28 | 0 | | | | | | |
| 1956 | | | | 317 | 115 | 0 | | | | | | |
| 1957 | | | | 317 | 55 | 0 | | | | | | |
| 1958 | | | | 340 | 120 | 0 | | | | | | |
| 1959 | | | | 317 | 28 | 0 | | | | | | |
| 1960 | | | | 317 | 28 | 0 | | | | | | |
| 1961 | | | | 317 | 28 | 0 | | | | | | |
| 1962 | | | | 317 | 28 | 0 | | | | | | |
| 1963 | | | | 317 | 50 | 0 | | | | | | |
| 1964 | | | | 317 | 28 | 0 | | | | | | |
| 1965 | | | | 317 | 130 | 0 | | | | | | |
| 1966 | | | | 317 | 28 | 0 | | | | | | |
| 1967 | | | | 340 | 150 | 0 | | | | | | |
| 1968 | | | | 317 | 28 | 0 | | | | | | |
| 1969 | | | | 340 | 100 | 0 | | | | | | |
| 1970 | 340 | 340 | 340 | 317 | 28 | 0 | 0 | 0 | 257 | 340 | 340 | 340 |

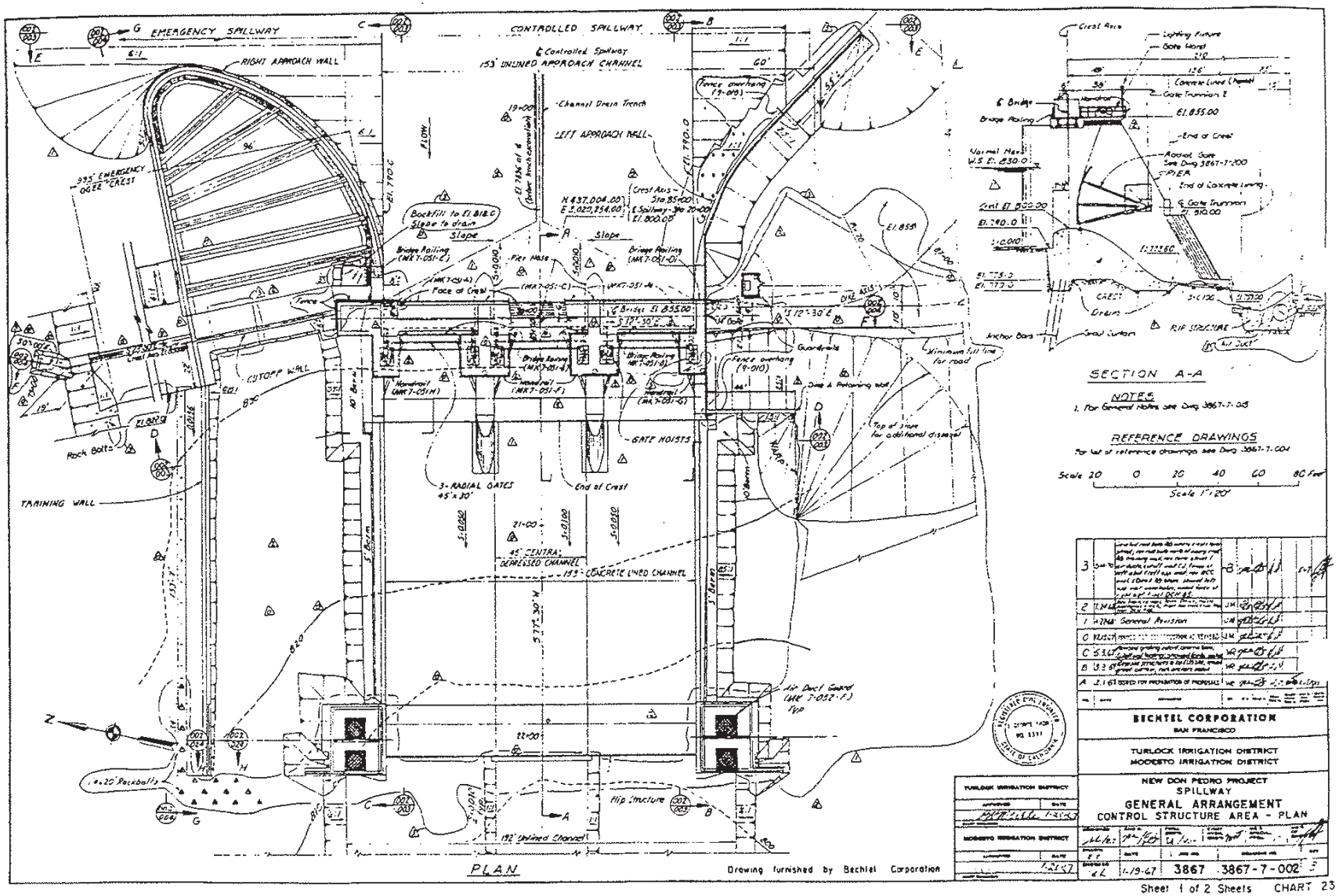
Note: The required flood control space shown on the above table is based on the maximum available flood control reservation in Don Pedro Lake (340,000 acre-feet). During some wet years the space needed for flood control is actually greater than this maximum available space of 340,000 acre-feet. The flood control space requirements shown above are based on the flood control diagram shown on chart A-8 in conjunction with snowmelt forecasts obtained by use of historical precipitation data and forecast criteria shown on chart 23 of Flood Control Reservoir Operation Report for all years from 1906 through 1958. Forecasts made by the State of California were used for all years from 1959 through 1970.




071

USCE000277


REFERENCE DRAWINGS
Drawing furnished by Bechtel Corporation
Scale: 1" = 100 Feet
BECHTEL CORPORATION
SAN FRANCISCO
TURLOCK IRRIGATION DISTRICT
MODESTO IRRIGATION DISTRICT
NEW DON PEDRO PROJECT
SPILLWAY
GENERAL ARRANGEMENT
3867-7-00
CHART
CONTROLLED SPILLWAY
EMERGENCY SPILLWAY
DISPOSAL AREA "A-5"
DISPOSAL AREA "A-4"
DIKE A
Rock Bolts
Cutoff Wall
Training Wall
Approach Wall
Drainage Trench
SPILLWAY CHANNEL DITCH

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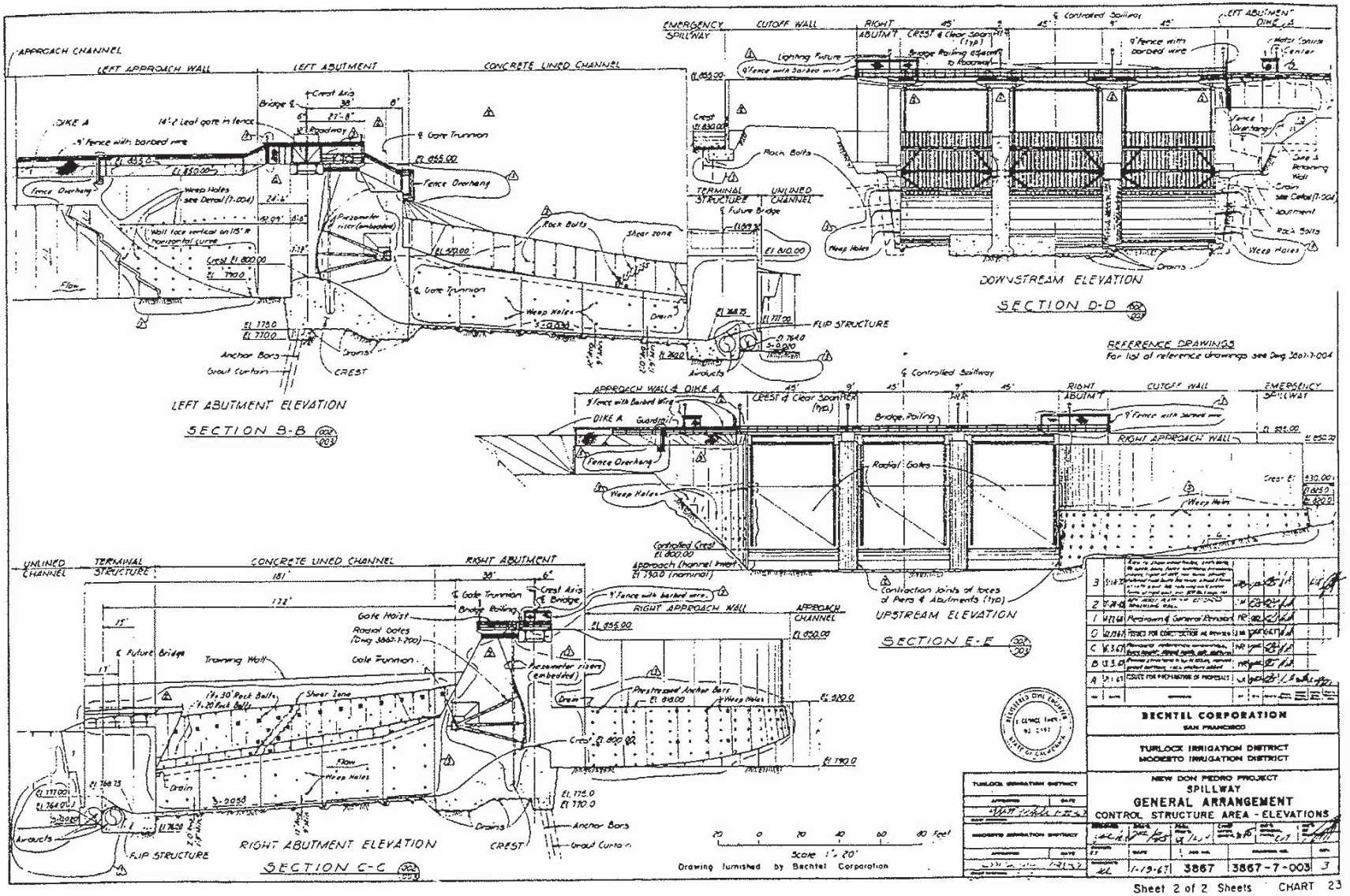
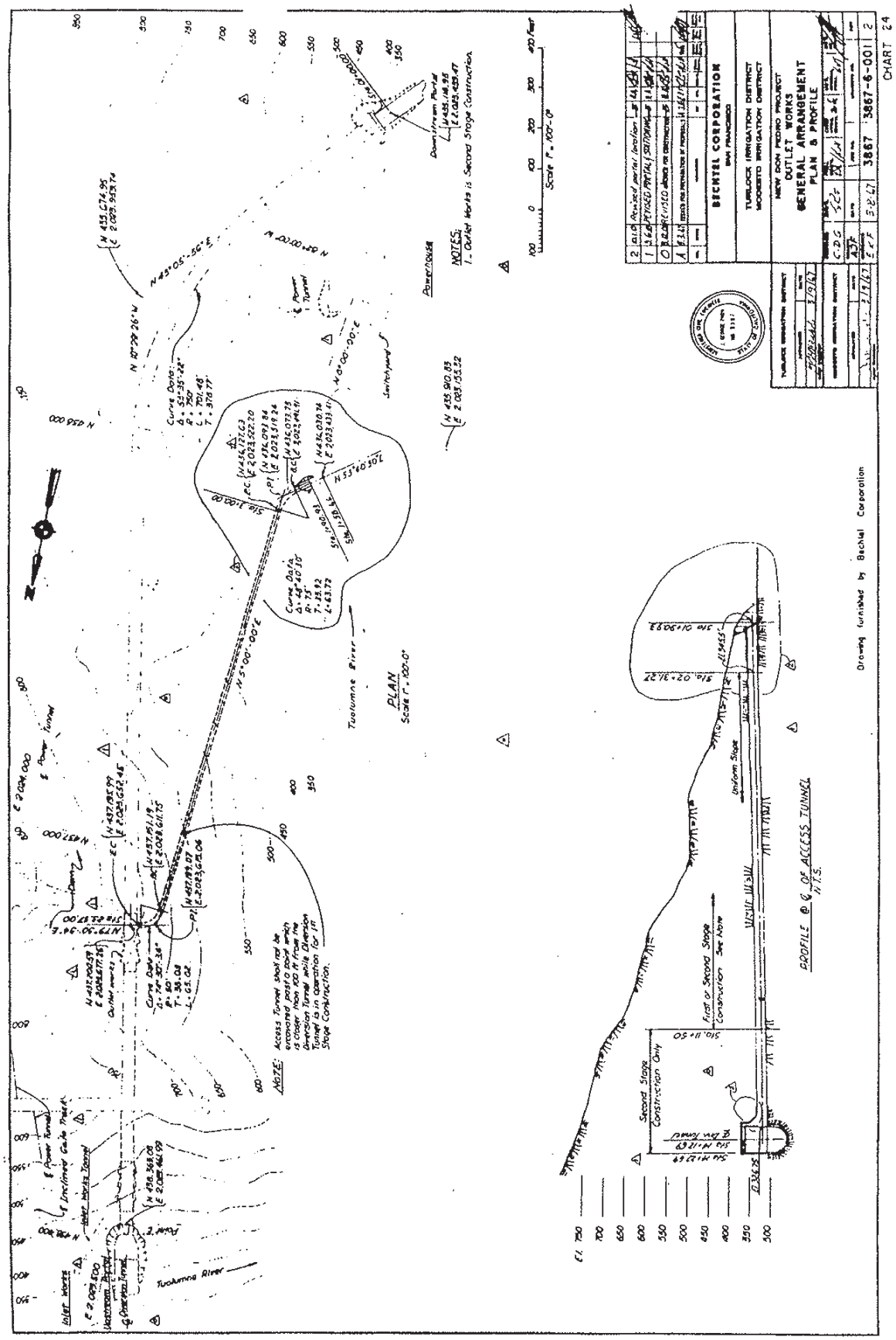
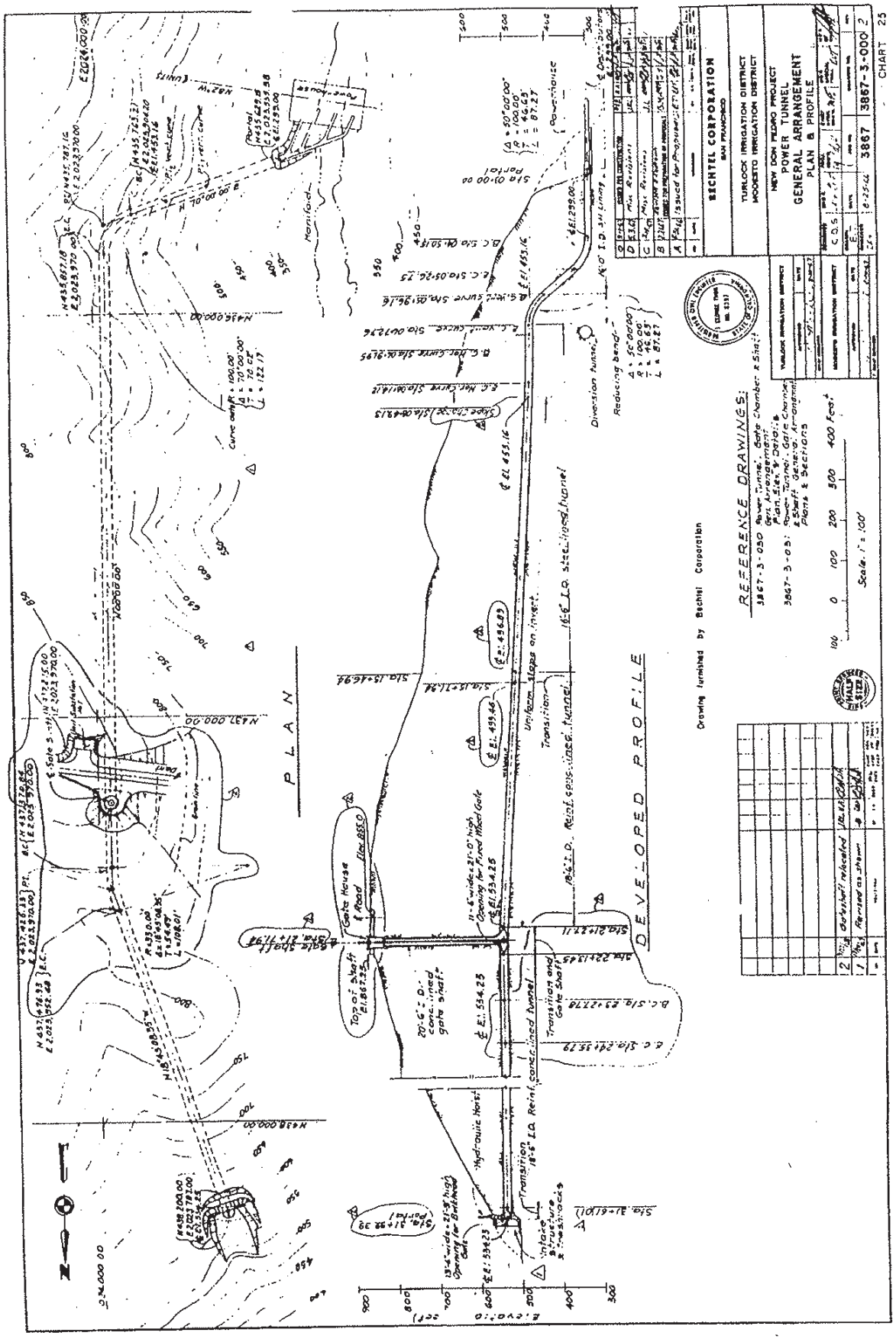
073

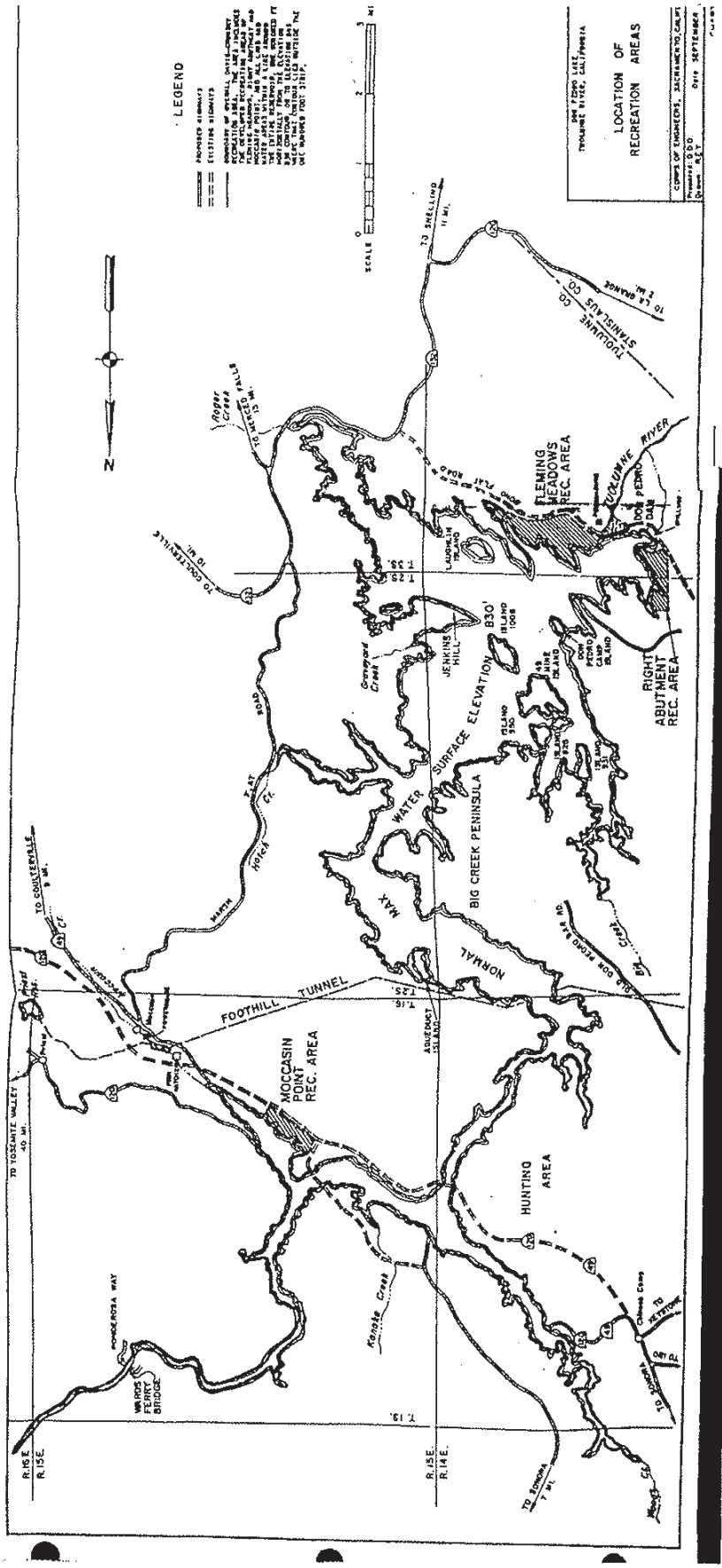



USCE000280

074

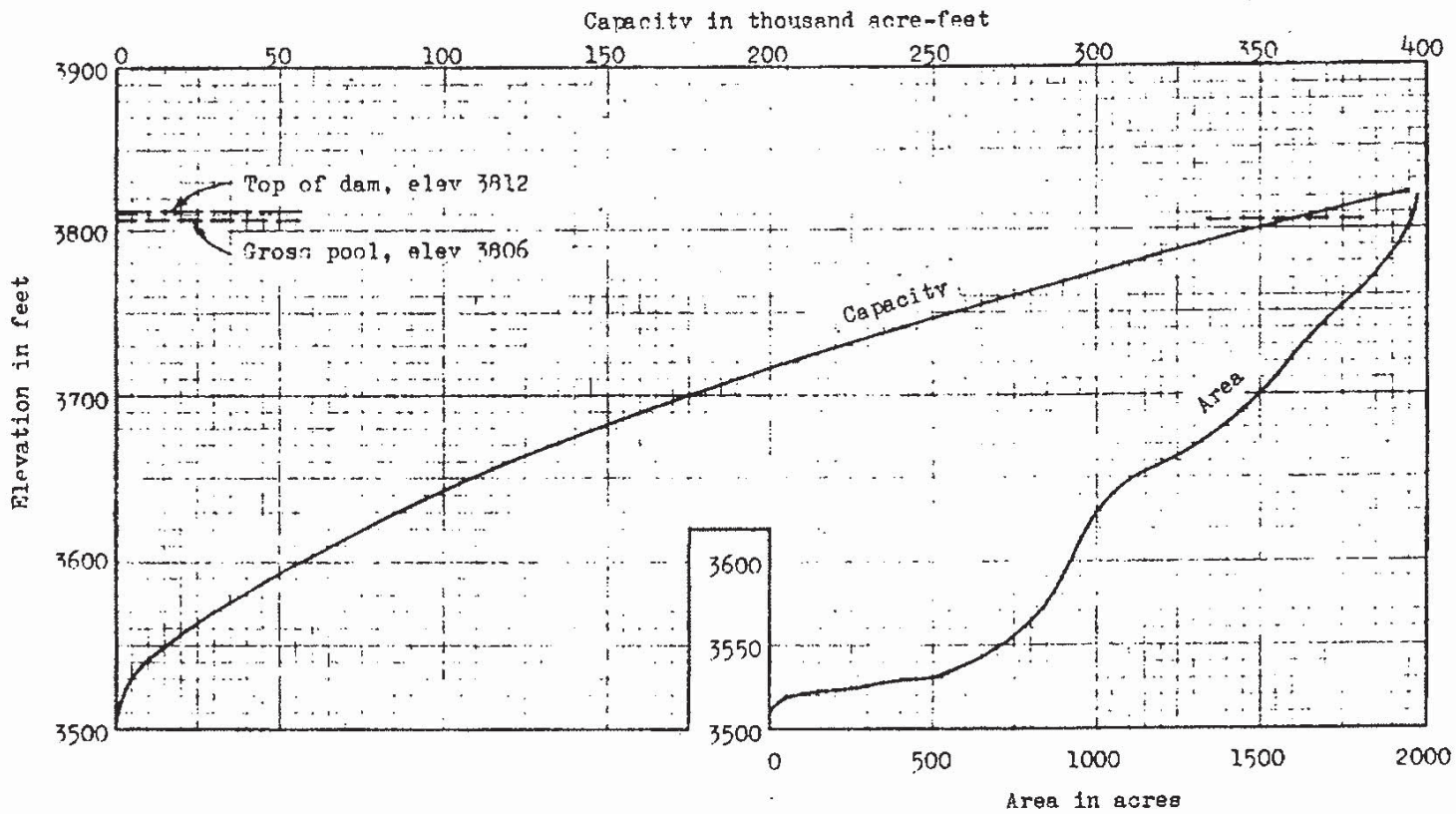

BECHTEL CORPORATION
SAN FRANCISCO
TURLOCK IRRIGATION DISTRICT
MODESTO IRRIGATION DISTRICT
NEW DON PEDRO PROJECT
OUTLET WORKS
GENERAL ARRANGEMENT
PLAN & PROFILE
3867-6-001
CHART 24
PLAN
Scale 1" = 100'-0"
Tuolumne River
NOTES:
1. Outlet Works is Second Stage Construction.
PROFILE @ ℄ OF ACCESS TUNNEL
N.T.S.
Uniform Slope
First or Second Stage Construction See Note
Second Stage Construction Only
Drawing furnished by Bechtel Corporation


PLAN
DEVELOPED PROFILE
BECHTEL CORPORATION
SAN FRANCISCO
TURLOCK IRRIGATION DISTRICT
MODESTO IRRIGATION DISTRICT
NEW DON PEDRO PROJECT
POWER TUNNEL
GENERAL ARRANGEMENT
PLAN & PROFILE
3867-3-000
3867
REFERENCE DRAWINGS:
Drawing furnished by Bechtel Corporation
Scale: 1" = 100'
CHART 25




077

USCE000283




NOTE:

Data furnished by the City and County of San Francisco

Revised title 17 May 1971

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

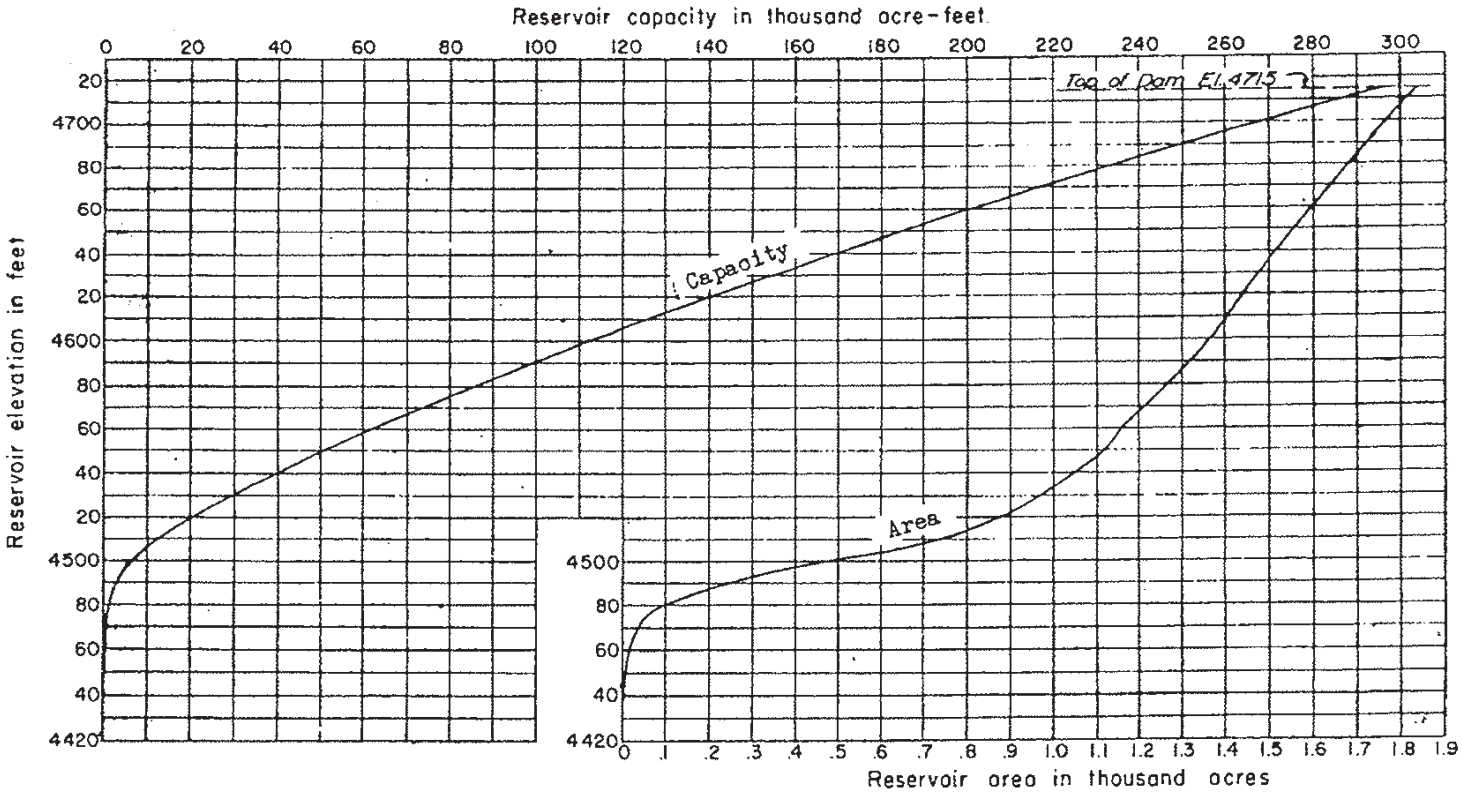
AREA AND CAPACITY CURVES
HETCH-HETCHY RESERVOIR

U S Army Engineer District
Sacramento California
V.G.K. July 1959 File: TU-26-42

USCE000284

078

CHART 27




NOTE:

Data furnished by the City and County of San Francisco

Revised title 17 May 1971

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

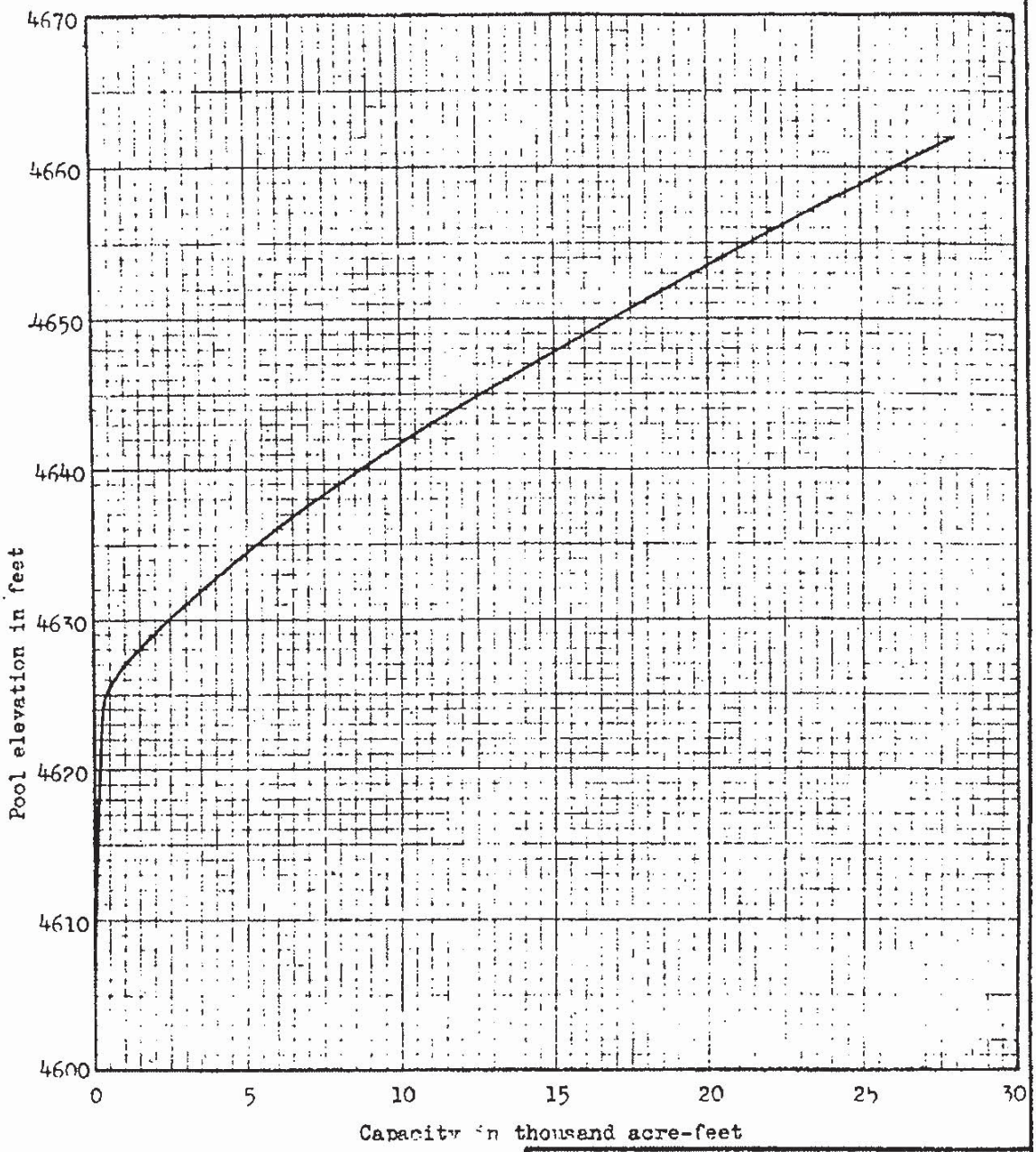
AREA AND CAPACITY CURVES
CHERRY VALLEY RESERVOIR
(LAKE LLOYD)

U S Army Engineer District
Sacramento California
L.R.B. August 1954 File: TU-26-52

CHART 28

USCE000285

079




Note:

Data furnished by City and county of San Francisco.

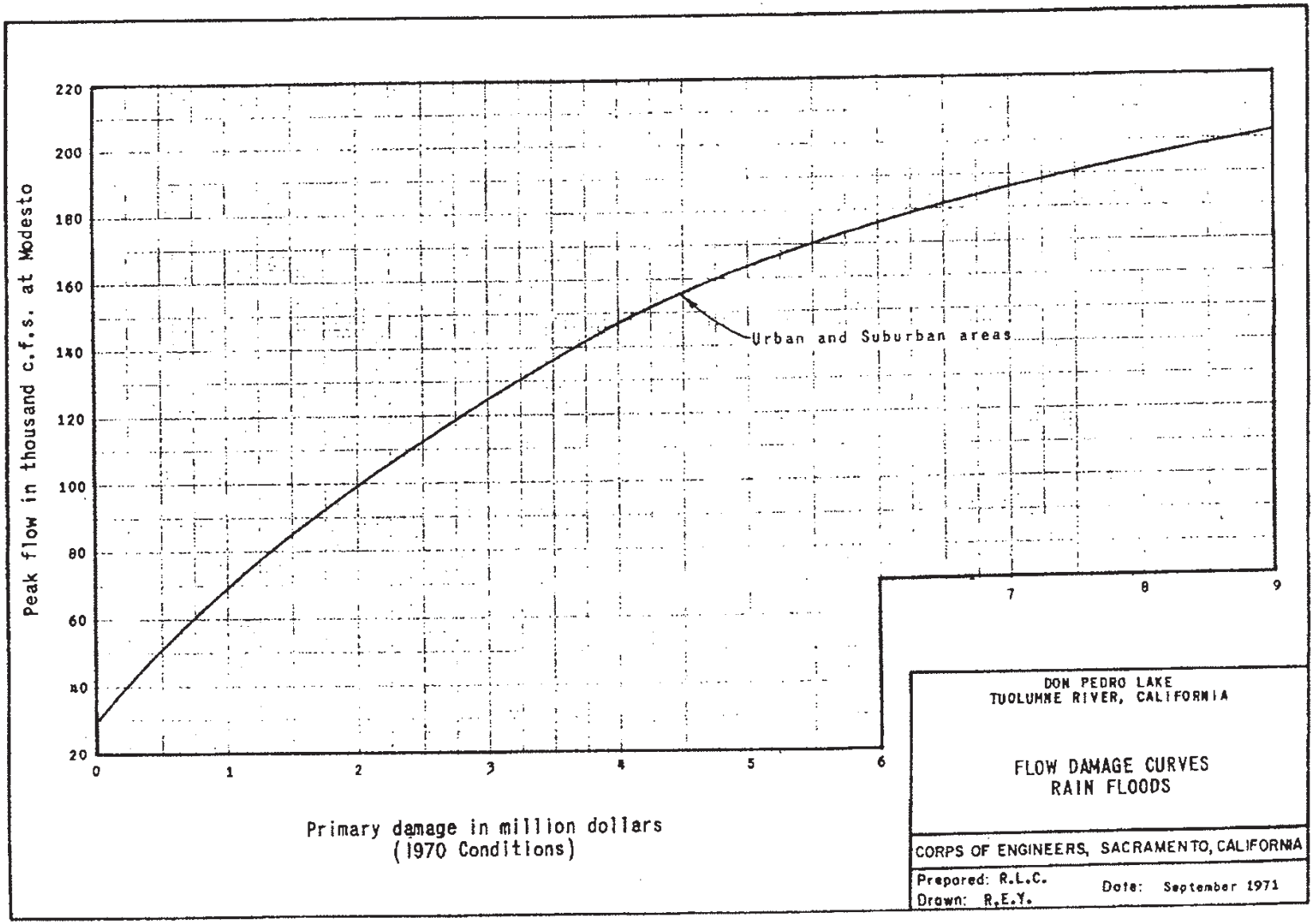
Revised title 17 May 1971

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

CAPACITY CURVE
LAKE ELEANOR

U S Army Engineer District
Sacramento California
A.G.C. 9 June 54 File: TU-26-47

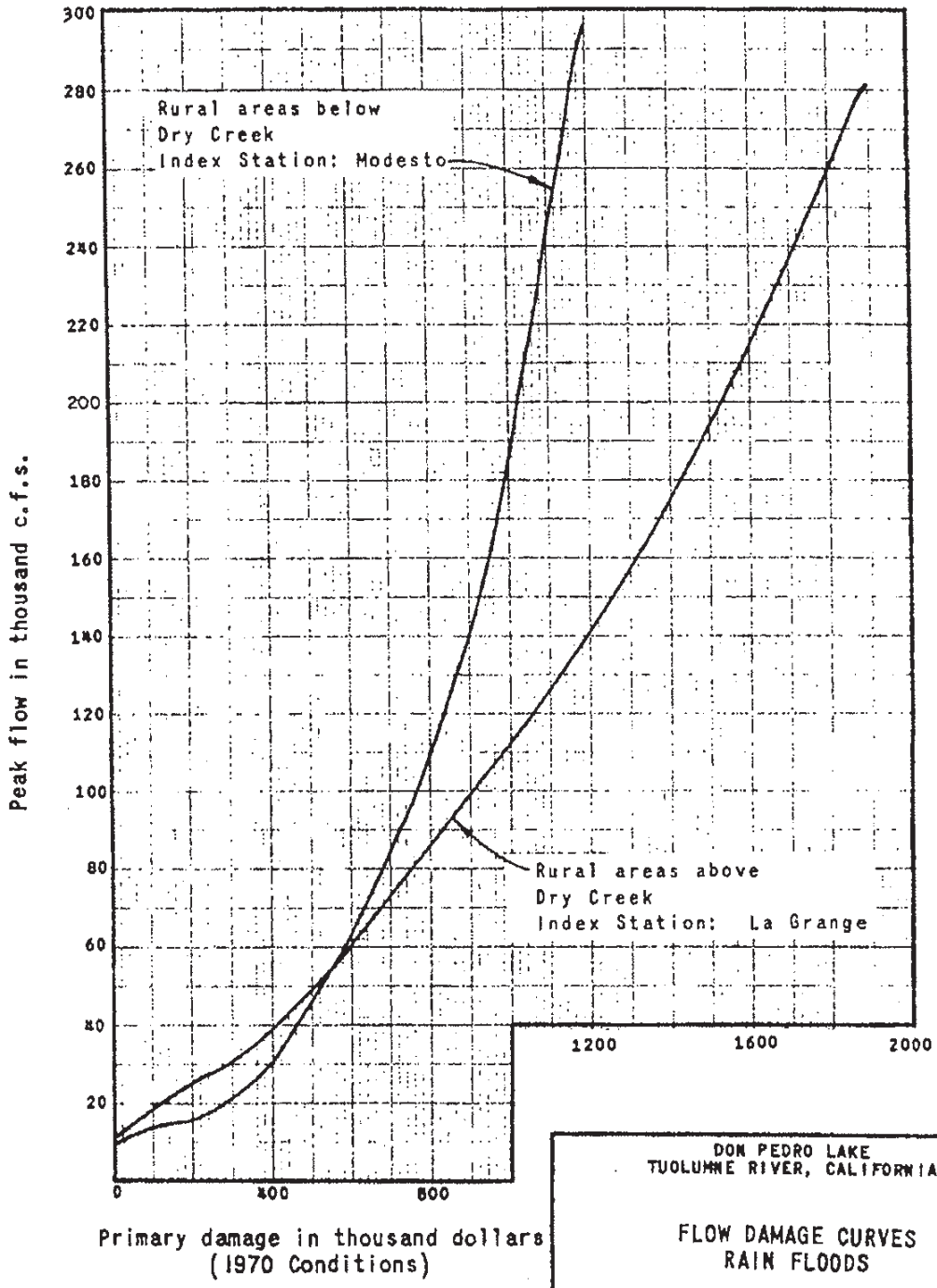
CHART 29




Sheet 1 of 2 CHART 30

USCE000287

081



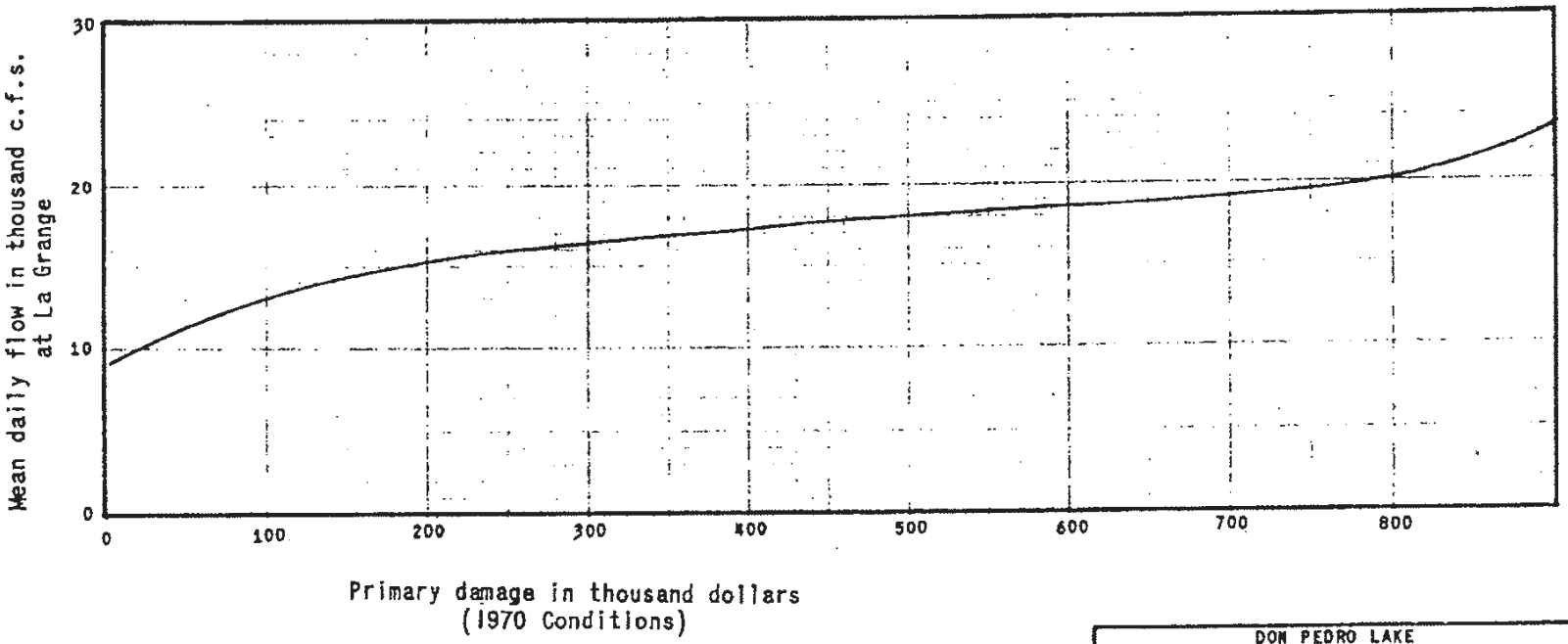

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

FLOW DAMAGE CURVES
RAIN FLOODS

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: R.L.C.
Drawn: R.E.Y.
Date: September 1971

Sheet 2 of 2 CHART 30




DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

FLOW-DAMAGE CURVE
SNOWMELT FLOODS

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: R.L.C.
Drawn: R.E.Y.
Date: September 1971

CHART 31

083

USCE000289

FORECAST VERIFICATION DATA
NATURAL APRIL-JULY FLOWS
TULUMNE RIVER AT LA GRANGE

(Values in thousand acre-feet)

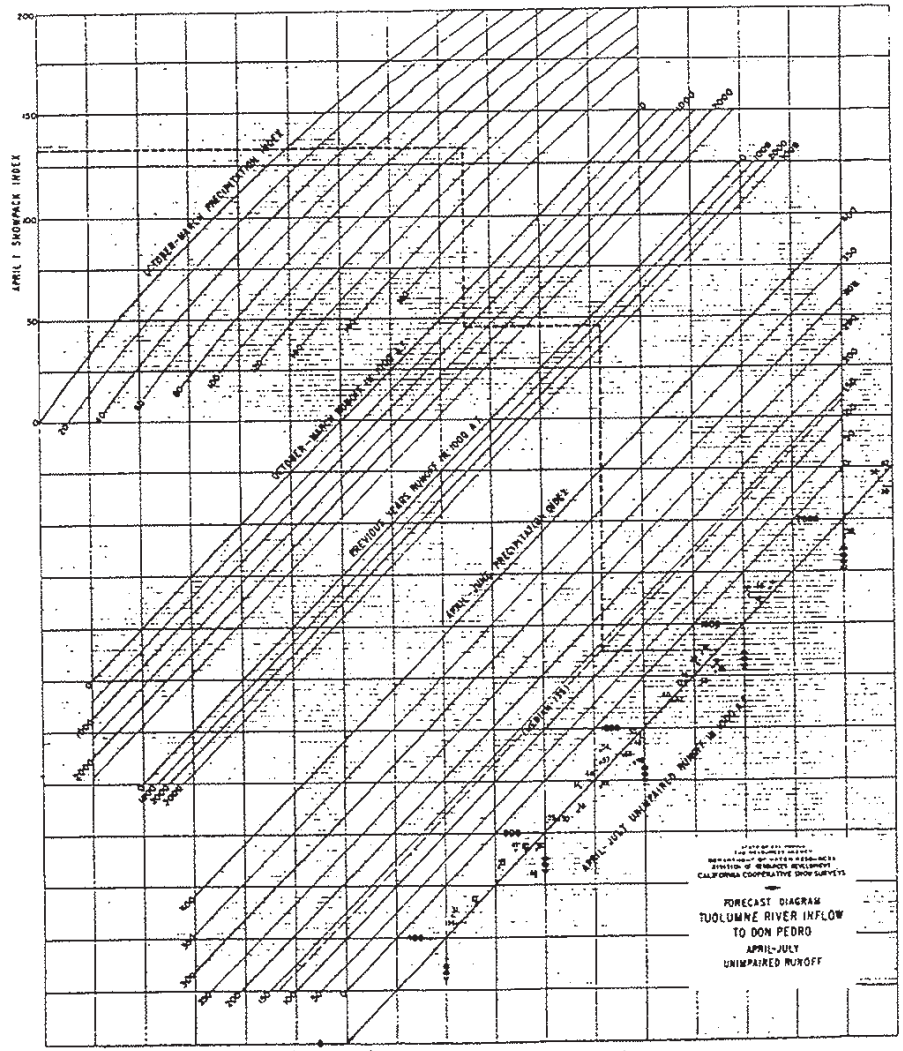
| Year | Unimpaired runoff April-July | 1 February Forecast | 1 February Error | 1 March Forecast | 1 March Error | 1 April Forecast | 1 April Error | 1 May Forecast | 1 May Error |
|---|---|---|---|---|---|---|---|---|---|
| 1936 | 1431 | | | | | 1412 | -18 | | |
| 1937 | 1418 | | | | | 1636 | 218 | 1636 | 218 |
| 1938 | 2164 | | | | | 1800 | - 364 | 1800 | -364 |
| 1939 | 584 | | | | | 600 | 16 | 540 | - 44 |
| 1940 | 1301 | | | | | 1150 | -151 | 1150 | -151 |
| 1941 | 1706 | | | | | 1800 | 94 | 1900 | 194 |
| 1942 | 1671 | | | | | 1400 | -271 | 1550 | -121 |
| 1943 | 1372 | | | | | 1350 | - 22 | 1350 | - 22 |
| 1944 | 979 | | | | | 1070 | 91 | 1070 | 91 |
| 1945 | 1370 | | | | | 1450 | 80 | 1350 | - 20 |
| 1946 | 1156 | | | | | 1350 | 194 | 1225 | 69 |
| 1947 | 680 | | | | | 770 | 90 | 730 | 50 |
| 1948 | 1183 | | | | | 650 | -533 | 950 | -223 |
| 1949 | 1026 | | | | | 1250 | 224 | 1100 | 74 |
| 1950 | 1180 | | | | | 1150 | - 30 | 1210 | 30 |
| 1951 | 947 | | | | | 750 | -197 | 750 | -197 |
| 1952 | 2145 | | | | | 2400 | 255 | 2400 | 255 |
| 1953 | 1118 | | | | | 900 | -218 | 900 | -218 |
| 1954 | 1028 | 950 | - 78 | 950 | - 78 | 1150 | 122 | 1050 | 22 |
| 1955 | 846 | 1200 | 354 | 1020 | 174 | 750 | - 96 | 850 | 4 |
| 1956 | 1668 | 2300 | 632 | 2000 | 332 | 1650 | - 18 | 1780 | 112 |
| 1957 | 1027 | 900 | -127 | 820 | -207 | 820 | -207 | 800 | -227 |
| 1958 | 1902 | 1080 | -822 | 1230 | -672 | 1900 | - 2 | 1800 | -102 |
| 1959 | 615 | 850 | 235 | 960 | 345 | 670 | 55 | 600 | - 15 |
| 1960 | 721 | 660 | - 61 | 800 | 79 | 750 | 29 | 720 | - 1 |
| 1961 | 528 | 700 | 172 | 500 | - 28 | 520 | - 8 | 480 | -48 |
| 1962 | 1317 | 750 | -567 | 1260 | - 57 | 1440 | 123 | 1340 | 23 |
| 1963 | 1418 | 700 | -718 | 640 | -778 | 850 | -568 | 1140 | -278 |
| 1964 | 762 | 920 | 158 | 640 | -122 | 600 | -162 | 550 | -212 |
| 1965 | 1483 | 1560 | 77 | 1370 | -113 | 1260 | -223 | 1440 | - 43 |
| 1966 | 767 | 1160 | 393 | 1020 | 253 | 760 | - 7 | 680 | - 87 |
| 1967 | 2161 | 1320 | -841 | 1100 | -1061 | 1425 | -736 | 2060 | -101 |
| 1968 | 648 | 880 | 232 | 830 | 182 | 740 | 92 | 640 | - 8 |
| 1969 | 2405 | 2000 | -405 | 2500 | 95 | 2450 | 45 | 2500 | 95 |
| 1970 | 920 | 1300 | 380 | 1170 | 250 | 1080 | 160 | 1030 | 110 |
| Average | | | 368 | | 284 | | 163 | | 109 |
| Extreme | | | -841 | | -1061 | | -736 | | -364 |

Note: All forecasts prepared and published by State of California.

CHART 32



Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G




NOTE:
Data shown for 1967 snowmelt forecast

Fig. 1

DON PEDRO LAKE
Tuolumne River, California

SNOWMELT FORECAST CRITERIA

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared O.D.D.
Drawn: R.E.Y.
Date: September 1971

Sheet 1 of 2 Sheets CHART 33

USCE000291

085

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES DEVELOPMENT

CALIFORNIA COOPERATIVE SNOW SURVEYS

# FORECAST COMPUTATION FORM
## TUOLUMNE RIVER, INFLOW TO DON PEDRO
APRIL - JULY UNIMPAIRED RUNOFF

### OCTOBER - MARCH PRECIPITATION

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DUDLEYS | 2530 | 25.62 | 0 | — | 7.88 | — | 7.88 | — | 6.97 | — | — | — | 1.14 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| | | | — | 0 | — | 4.61 | — | 5.52 | — | 7.10 | 17.31 | 69 | — | 4 | | | | | | | | | | | 9.78 | 32 | | |
| HETCH HETCHY | 3939 | 22.03 | 0 | — | 6.80 | — | 8.47 | — | 7.86 | — | — | — | .58 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| | | | — | 0 | — | 3.96 | — | 8.83 | — | 6.30 | 16.19 | 74 | — | 3 | | | | | | | | | | | 9.82 | 45 | | |
| PINECREST | 6893 | 26.51 | 0 | — | 10.19 | — | 8.84 | — | 10.78 | — | — | — | .87 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| | | | — | 0 | — | 6.11 | — | 5.98 | — | 8.60 | 20.69 | 78 | — | 3 | | | | | | | | | | | 15.7 | 58 | | |
| SONORA | 8353 | 21.34 | 0 | — | 6.87 | — | 7.87 | — | 7.18 | — | — | — | .78 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| | | | — | 0 | — | 4.12 | — | 6.30 | — | 5.72 | 16.14 | 71 | — | 4 | | | | | | | | | | | 6.36 | 30 | | |
| YOSEMITE | 9859 | 23.61 | 0 | — | 7.12 | — | 10.97 | — | 8.08 | — | — | — | .53 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| | | | — | 0 | — | 4.27 | — | 7.61 | — | 6.46 | 18.34 | 78 | — | 4 | | | | | | | | | | | 10.86 | 45 | | |
| | | | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| | | | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| | | | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| | | | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| | | | | | | | | | | | Total | 389 | | | | | | | | | | | | | Total | 217 | | |
| | | | | | | | | | | | Base Index October - January | 74 | | | | | | | | | | | | | February | 43 | | |

### SNOW PACK INDEX

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 4 | DANA MEADOWS | 137 | 1.2 | 29.3 | | | | | | | | | | | | | | | | | | | | | 329 | 36.3 | .84 | 1.00 | 37.3 | 127 |
| 2444 | TIOGA PASS | 161 | 1.0 | 25.8 | | | | | | | | | | | | | | | | | | | | | 329 | 32.8 | .84 | 0.8 | 33.7 | 131 |
| 2 4 | ELLERY LAKE | 284 | 1.2 | 30.1 | | | | | | | | | | | | | | | | | | | | | 329 | 37.2 | .84 | 1.00 | 38.2 | 127 |
| 2345 | VIRGINIA LAKES | 250 | 0.79 | 17.0 | | | | | | | | | | | | | | | | | | | | | 322 | 29.6 | 2.09 | 1.5 | 31.1 | 183 |
| 234 | CENTER MOUNT. | 184 | 1.34 | 28.4 | | | | | | | | | | | | | | | | | | | | | 324 | 49.4 | 2.09 | 3.1 | 52.5 | 148 |
| 2 4 | RAFFERTY MOWE | 156 | 1.2 | 30.2 | | | | | | | | | | | | | | | | | | | | | 323 | 47.0 | .84 | 1.0 | 48.0 | 159 |
| 234 | BOND PASS | 199 | 1.84 | 42.4 | | | | | | | | | | | | | | | | | | | | | 409 | 64.6 | 3.09 | -8.6 | 59.0 | 139 |
| 2345 | SNOW FLAT | 178 | 1.6 | 41.2 | | | | | | | | | | | | | | | | | | | | | 350 | 50.6 | .84 | 1.3 | 51.9 | 124 |
| 234 | HORSE MEADOW | 162 | 1.9 | 46.2 | | | | | | | | | | | | | | | | | | | | | 409 | 85.9 | 3.09 | -5.9 | 59.6 | 152 |
| 2345 | L. RELIEF VALLEY | 138 | 1.44 | 38.5 | | | | | | | | | | | | | | | | | | | | | 408 | 88.3 | 3.18 | -4.5 | 50.8 | 132 |
| 2345 | BIG FLAT | 179 | 1.3 | 33.8 | | | | | | | | | | | | | | | | | | | | | 330 | 29.4 | .84 | 1.1 | 30.5 | 90 |
| 2345 | BEEHIVE MEADOW | 170 | 1.19 | 26.4 | | | | | | | | | | | | | | | | | | | | | 411 | 53.1 | 4.01 | -4.4 | 28.7 | 109 |

* HETCH HETCHY
+ PINECREST

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | | | | | | | | | | | | |
| February - Snow Pack Index | | | | | 32 | | | | | | | |
| Average February - March increment | | | | | | | | | | | | |
| April - Snow Pack Index Estimated as of February 1 | | | | | | | | | | | | |
| Total | | | | | | | | | | | | |
| March - Snow Pack Index | | | | | 14 | | | | | | | |
| Average March increment | | | | | | | | | | | | |
| April - Snow Pack Index Estimated as of March 1 | | | | | | | | | | | | |
| Total | | | | | | | | | | | | |
| April - Snow Pack Index | | | | | 133 | | | | | | | |

NOTE:
Data shown snowmelt fore

### APRIL - JUNE PRECIPITATION

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DUDLEYS | 3.54 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HETCH HETCHY | 3.17 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PINECREST | 3.98 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SONORA | 2.80 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| YOSEMITE | 3.25 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Base Index April | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Fig. 2

### PRECIPITATION INDEXES

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| October - January | | | | | 74 | | | | | | | | | | | | | | | | | | | | | | | | |
| February | 20 | | | | 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| March | 20 | 20 | | | 43 | | | | | | | | | | | | | | | | | | | | | | | | |
| October - March | | | | | 121 | | | | | | | | | | | | | | | | | | | | | | | | |
| April | | | | | | 46 | | | | | | | | | | | | | | | | | | | | | | | |
| May | | | | | | 6 | 6 | | | | | | | | | | | | | | | | | | | | | | |
| June | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| April - June | 138 | 139 | 135 | | | | | | | | | | | | | | | | | | | | | | | | | | |

### OCTOBER - MARCH RUNOFF

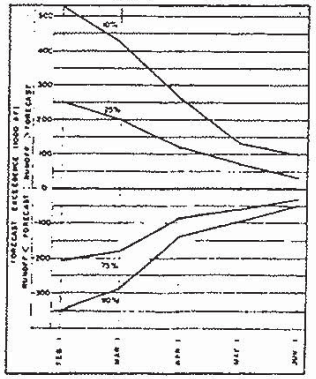
| Period | February 1 | March 1 | April 1 |
|---|---|---|---|
| October - January Runoff | | | 433 |
| February Runoff | 128 | | 116 |
| March Runoff | 152 | 152 | 306 |
| October - March Runoff | | | 855 |

### FORECAST SUMMARY

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| February 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| March 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| April 1 | 133 | 121 | 785 | 135 | 1500 | 1360 | 1760 | | | | | | | | | | | | | | | | | | | | | | |
| May 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| June 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Fig 3

### FORECAST RANGE DIAGRAM




DON
TUOLUMNE

SNOWMELT FO

CORPS OF ENGINEERS,

Prepared: D.D.D.
Drawn: T.G.K.

USCE000292

086

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

RAIN FLOOD
FORECASTING CRITERIA

CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA

Prepared: D.R.B.
Drawn: R.E.T. & R.E.H.

CHART 54

(Figure 6)

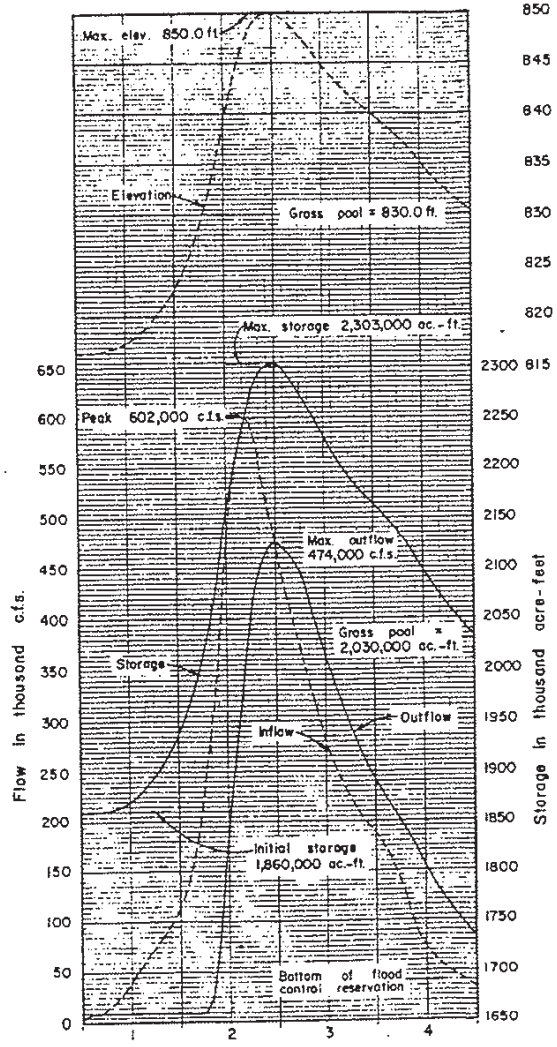


Index for Area Above Don Pedro Lake

Adjusted runoff (inches)



Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G




NOTES:

(1) All upstream reservoirs were assumed to be full and 170,000 acre-feet of empty space was available in Don Pedro Lake at the beginning of this flood routing.

(2) The flood was routed in accordance with criteria shown on the Emergency Spillway Release Diagram, chart A-9.

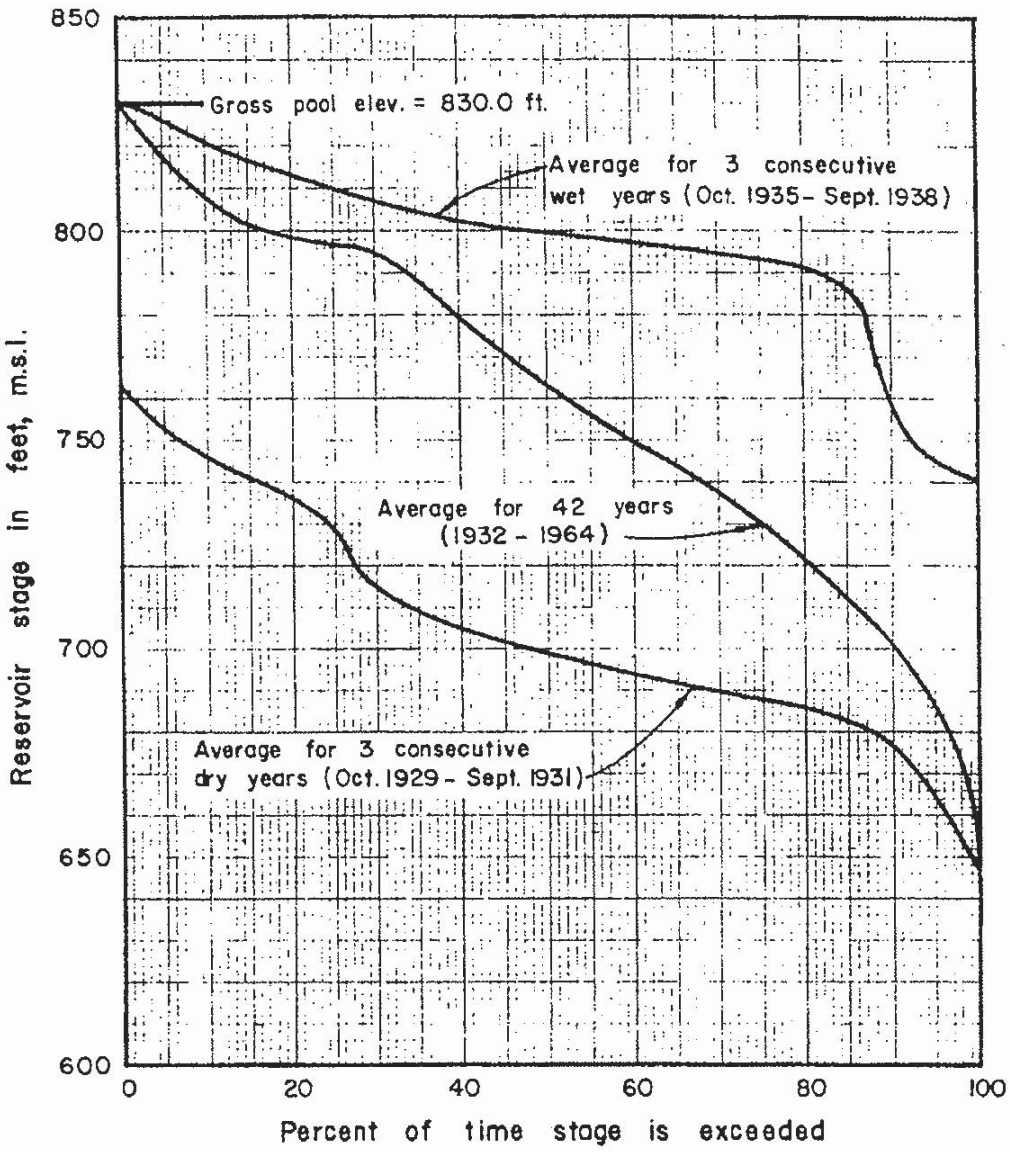
DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

ROUTING OF
PROBABLE MAXIMUM FLOOD

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared D.D.D
Drawn T.G.K
Date SEPTEMBER 1971

CHART 35




NOTE:

Curves based on hypothetical monthly routings, furnished by Modesto and Turlock Irrigation Districts.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

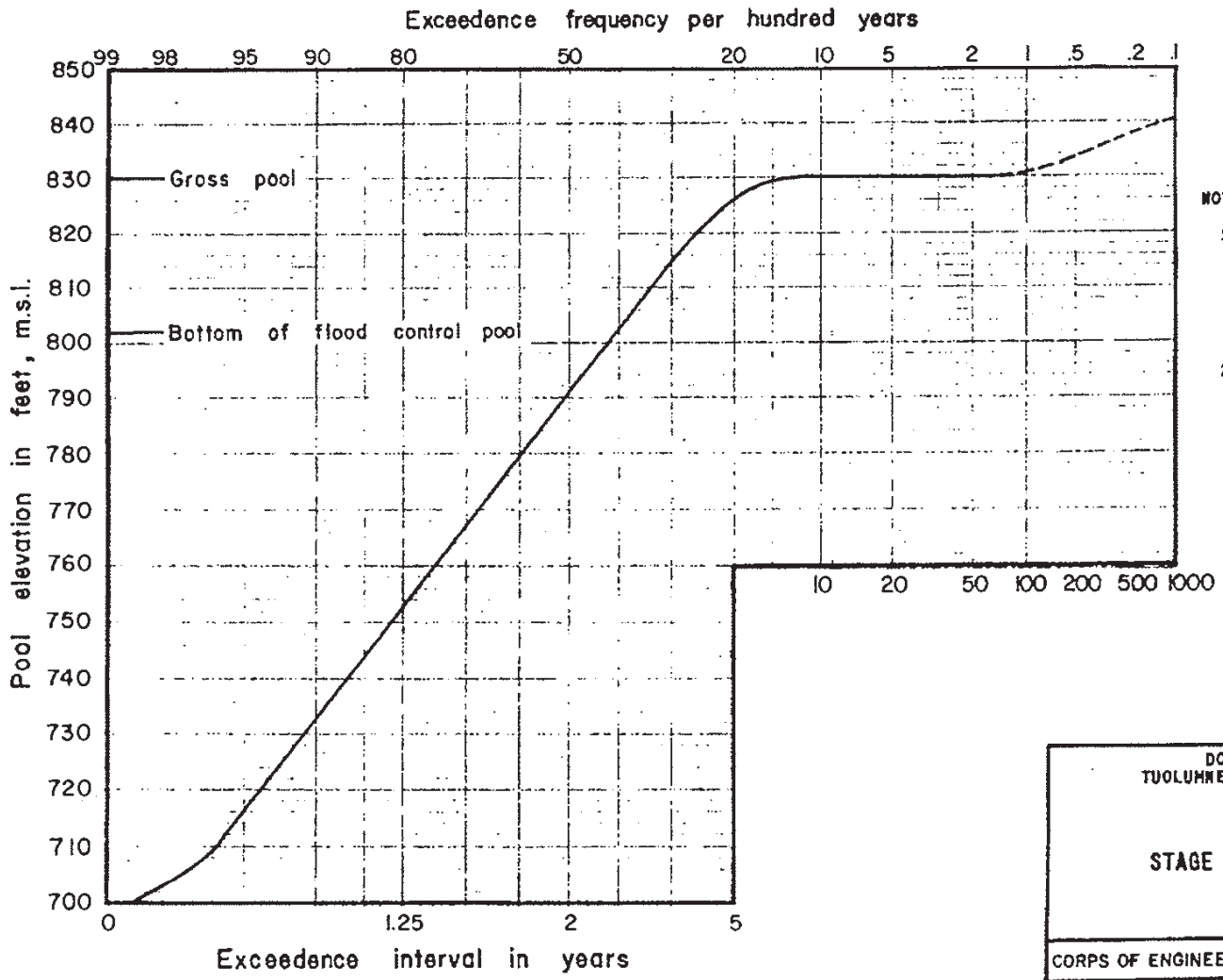
STAGE - DURATION CURVES

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: D.D.D.
Drawn: T.G.K.

Date: September 1971

CHART 36




NOTES:

1 Curve based on hypothetical multiple-purpose monthly reservoir operation (1923-1964), using flood-control storage reservation diagram shown on chart A-8.

2 Extension of curve above gross pool, estimated on basis of routings of hypothetical floods.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

STAGE FREQUENCY CURVE

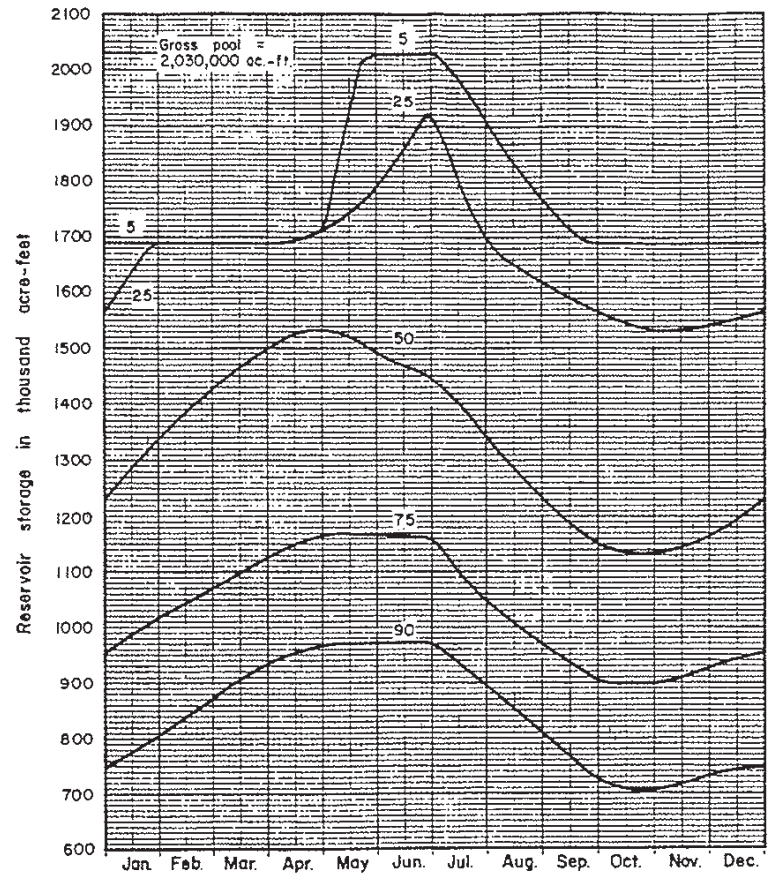
CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: D.D.D.
Drawn: R.E.Y.
Date: September 1971

CHART 37

090

USCE000296




NOTES:

(1) Indicated value is percentage of years that storage is exceeded on given date. (Based on total storage at end of month.)

(2) Curves computed from data furnished by Modesto and Turlock Irrigation Districts.

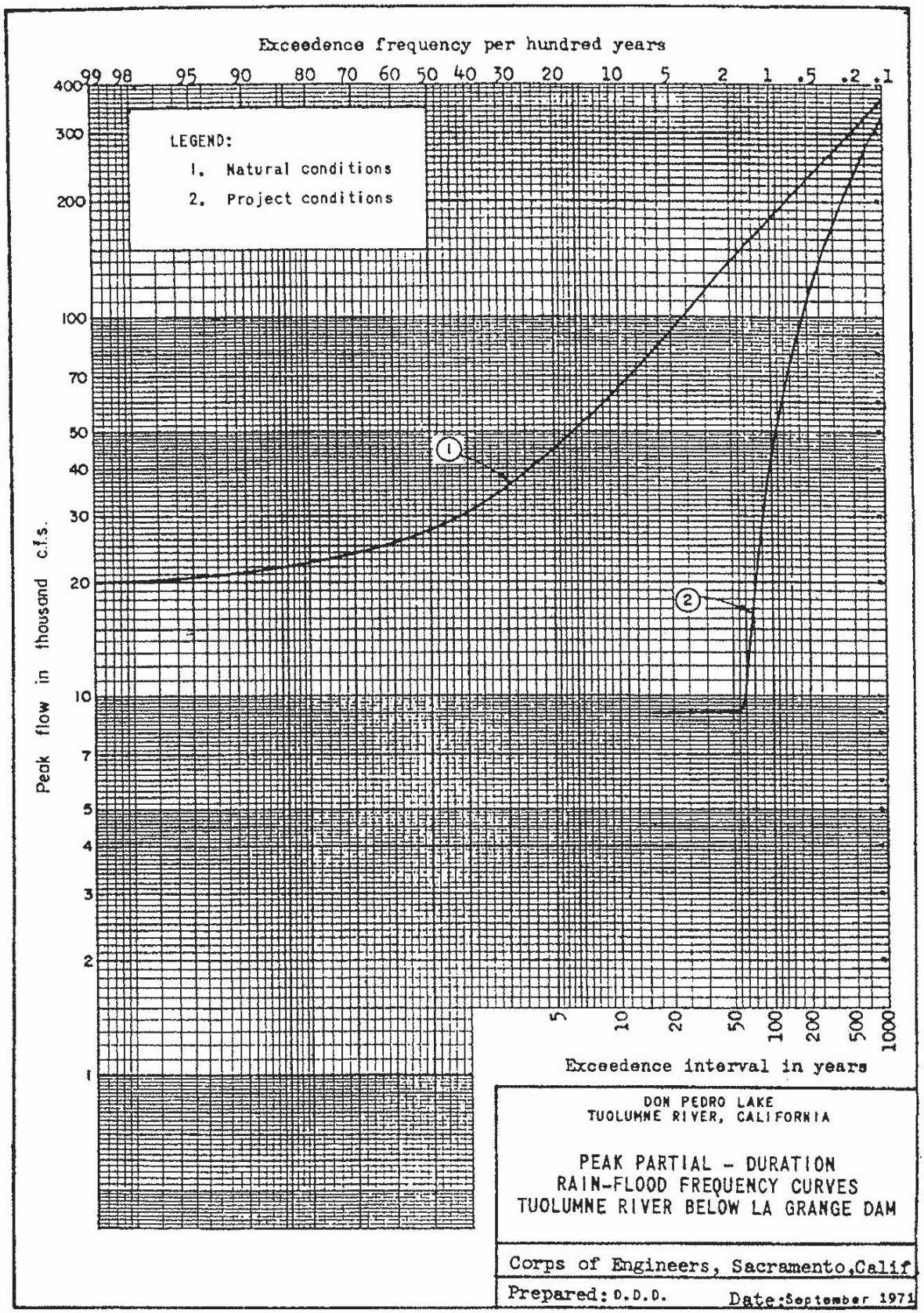
DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

SEASONAL VARIATION OF RESERVOIR STORAGE FREQUENCY

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: D.D.D. Drawn: T.G.K. Date: SEPTEMBER 1971

CHART 38




DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

PEAK PARTIAL - DURATION
RAIN-FLOOD FREQUENCY CURVES
TUOLUMNE RIVER BELOW LA GRANGE DAM

Corps of Engineers, Sacramento, Calif

Prepared: D.D.D. Date: September 1971

CHART 39

USCE000298

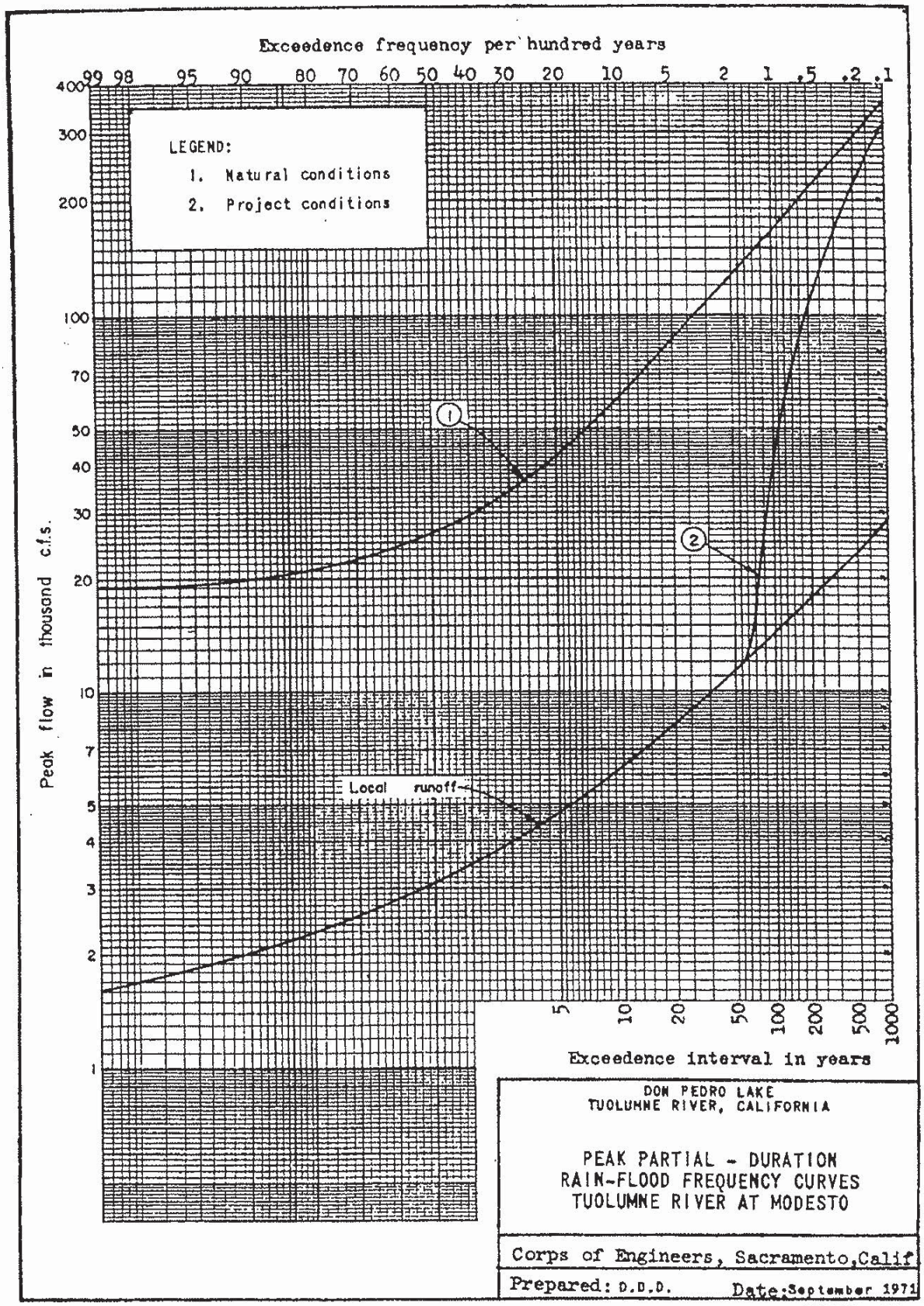
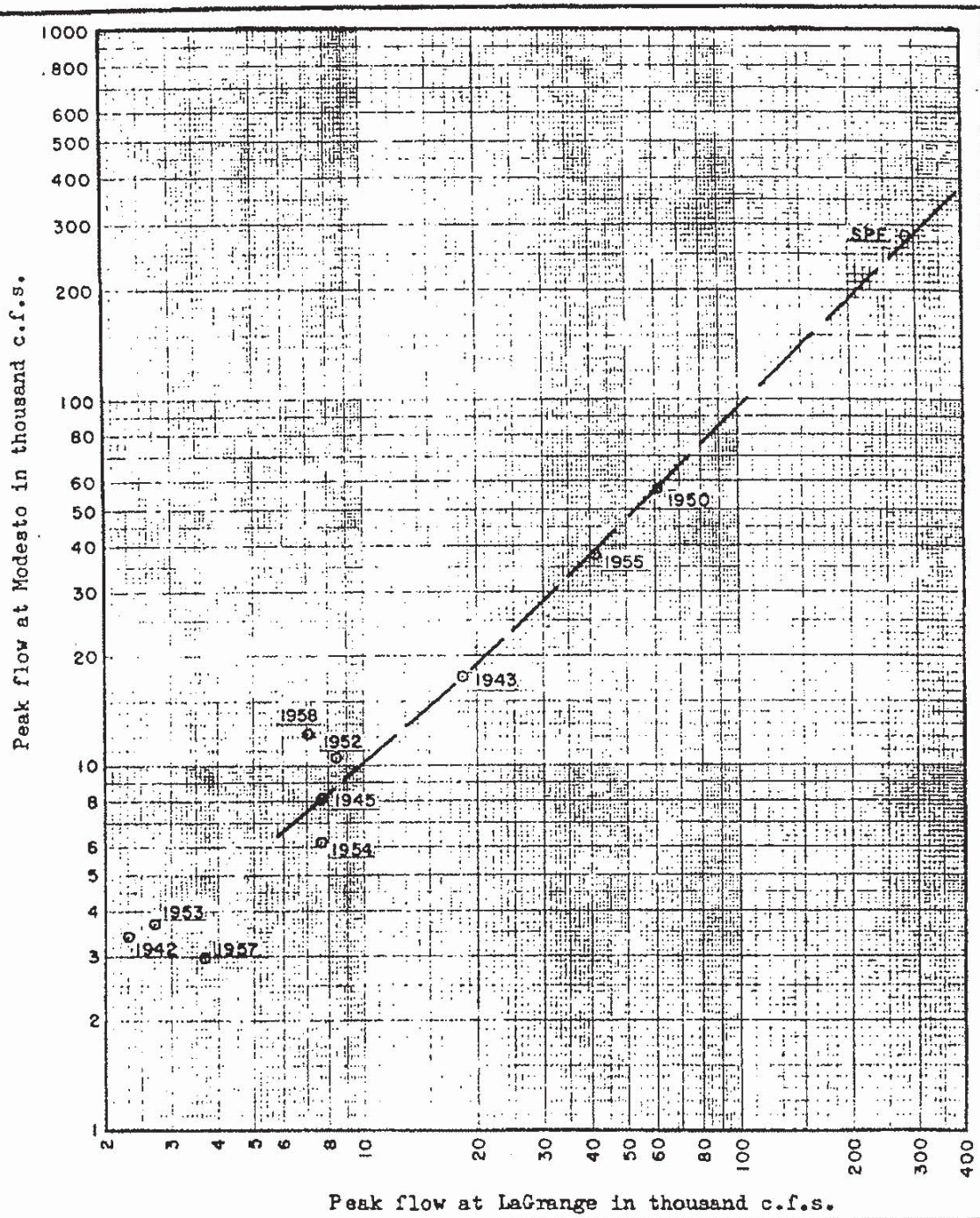

Exceedence frequency per hundred years
99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 .5 .2 .1
LEGEND:
1. Natural conditions
2. Project conditions
Peak flow in thousand c.f.s.
400
300
200
100
70
50
40
30
20
10
7
5
4
3
2
1
Local runoff
5 10 20 50 100 200 500 1000
Exceedence interval in years
DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA
PEAK PARTIAL - DURATION
RAIN-FLOOD FREQUENCY CURVES
TUOLUMNE RIVER AT MODESTO
Corps of Engineers, Sacramento, Calif
Prepared: D.D.D.
Date: September 1971

CHART 40




Note:
Values are observed rain-flood flows

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

RELATION OF RAINFLOODS
AT MODESTO AND LAGRANGE

U S Army Engineer District
Sacramento California
V.C.K. Mar 1961 File: TU-26-107

Revised title 17 May 1971

CHART 41

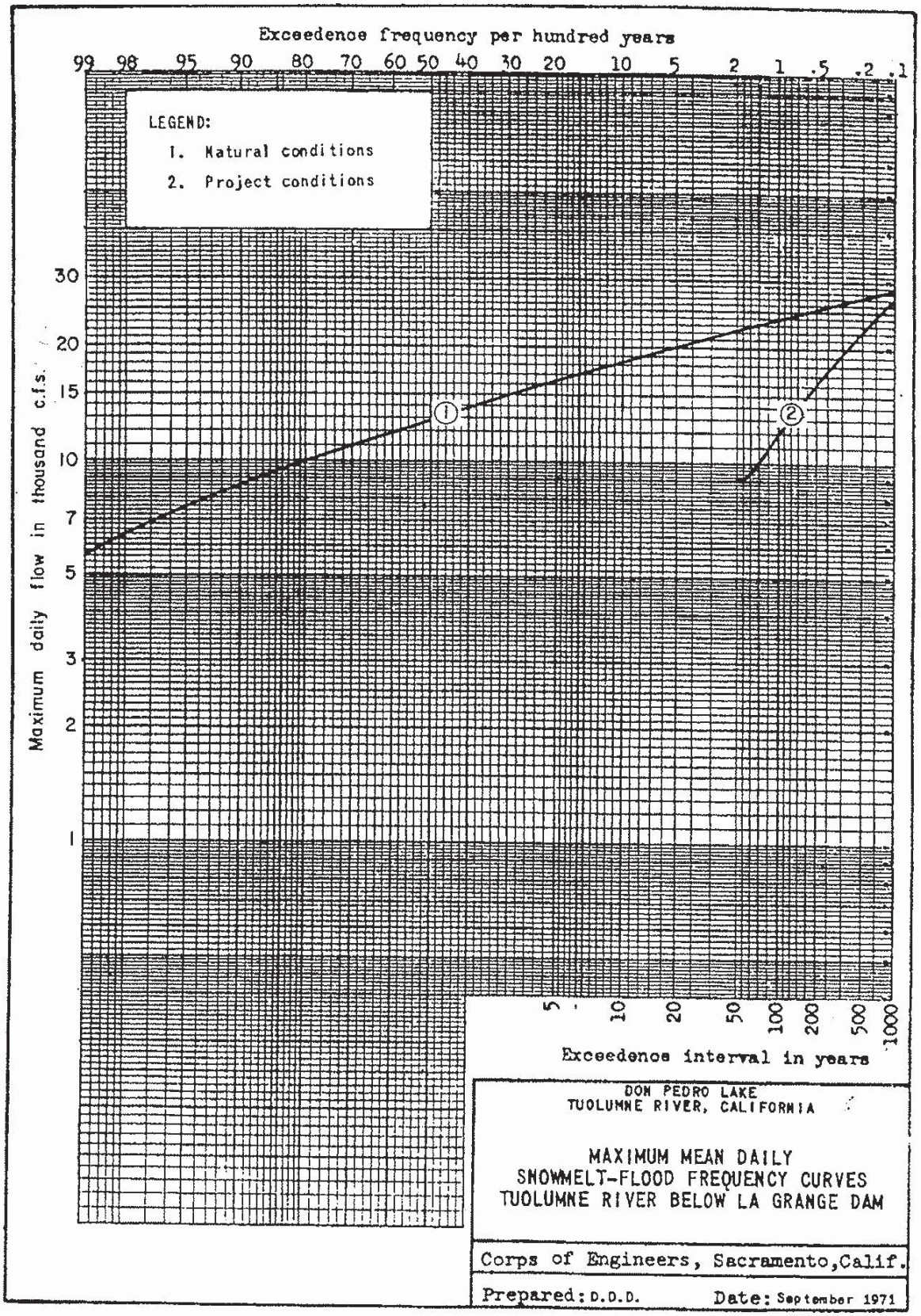
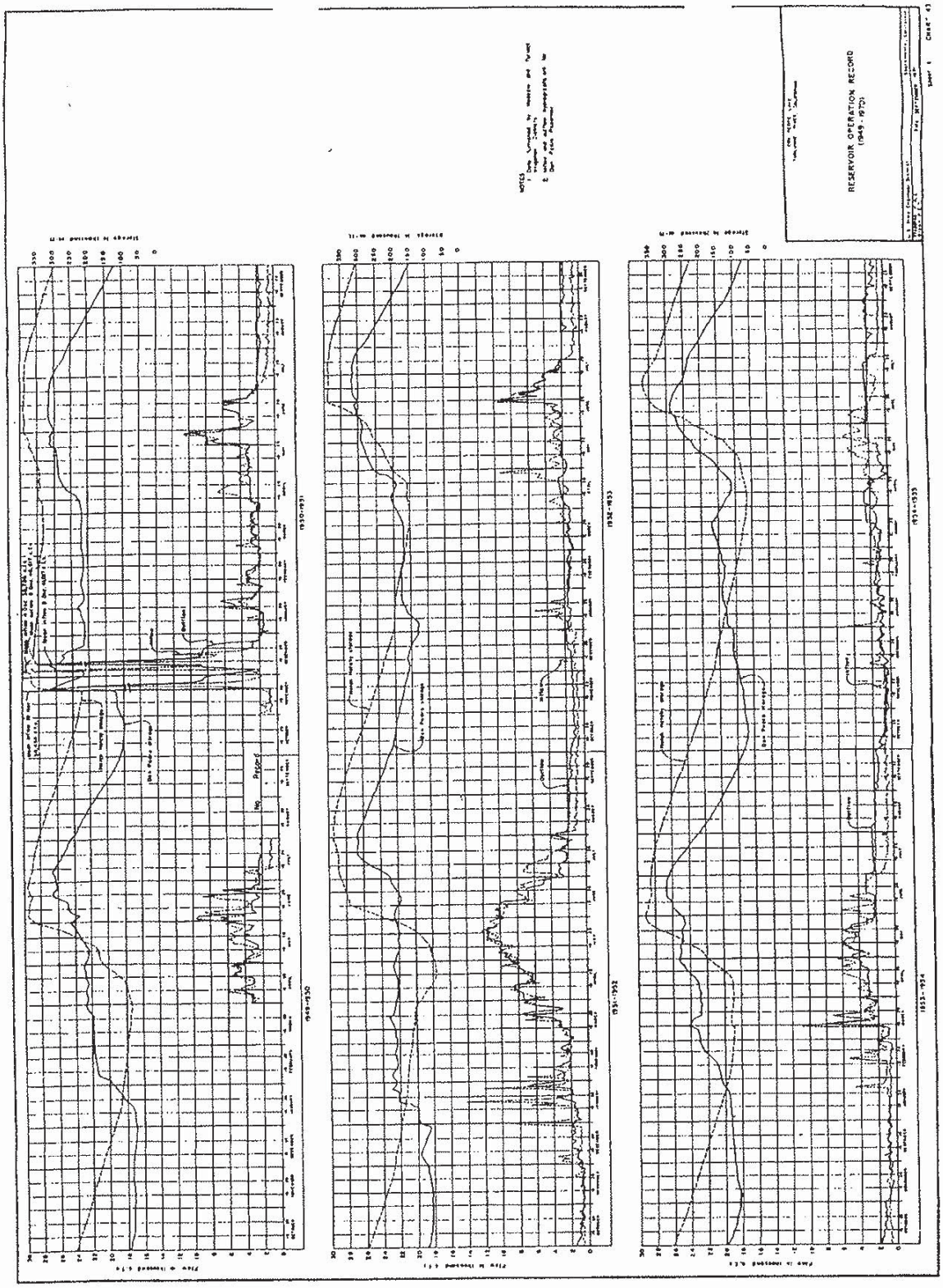
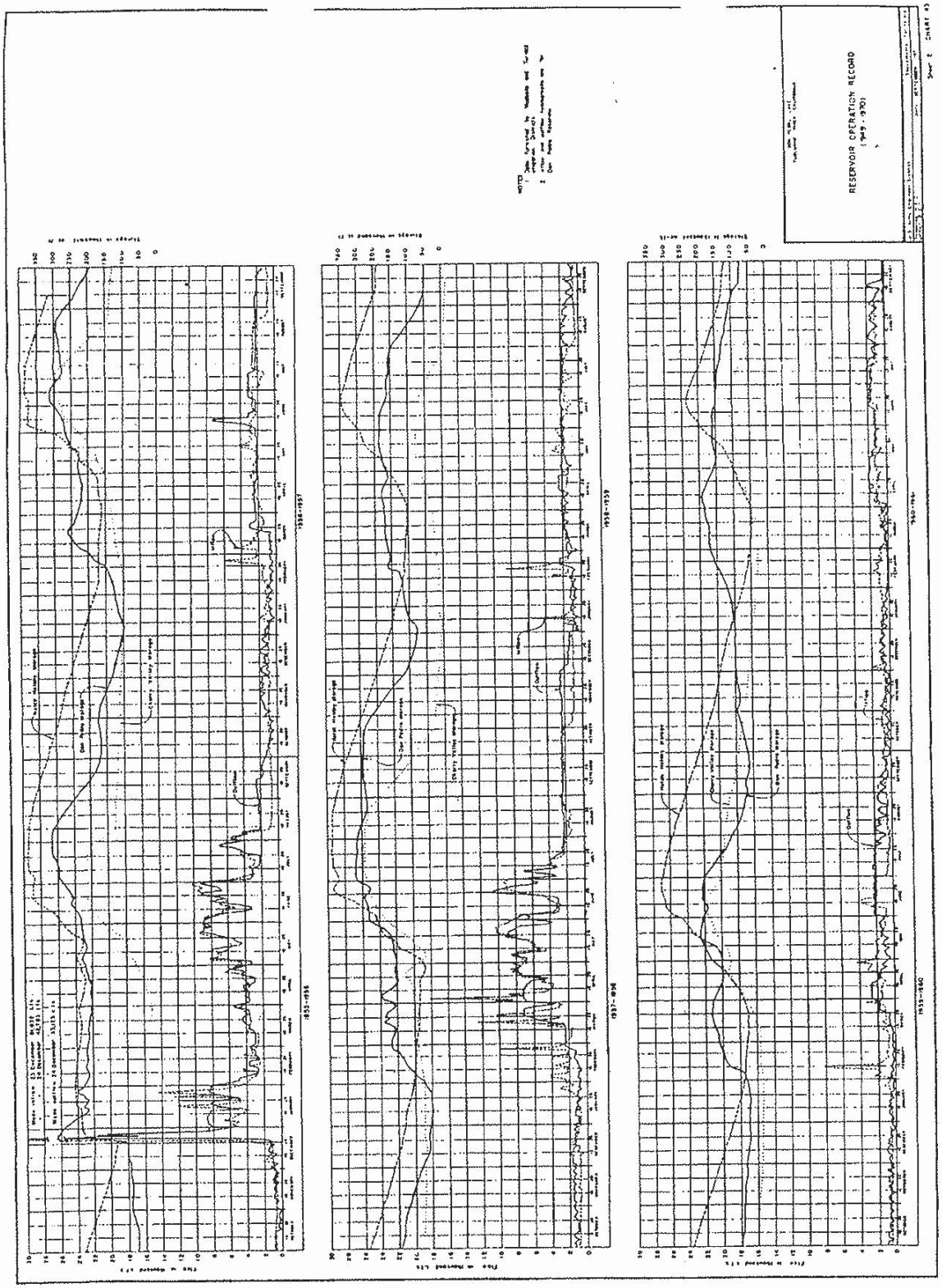
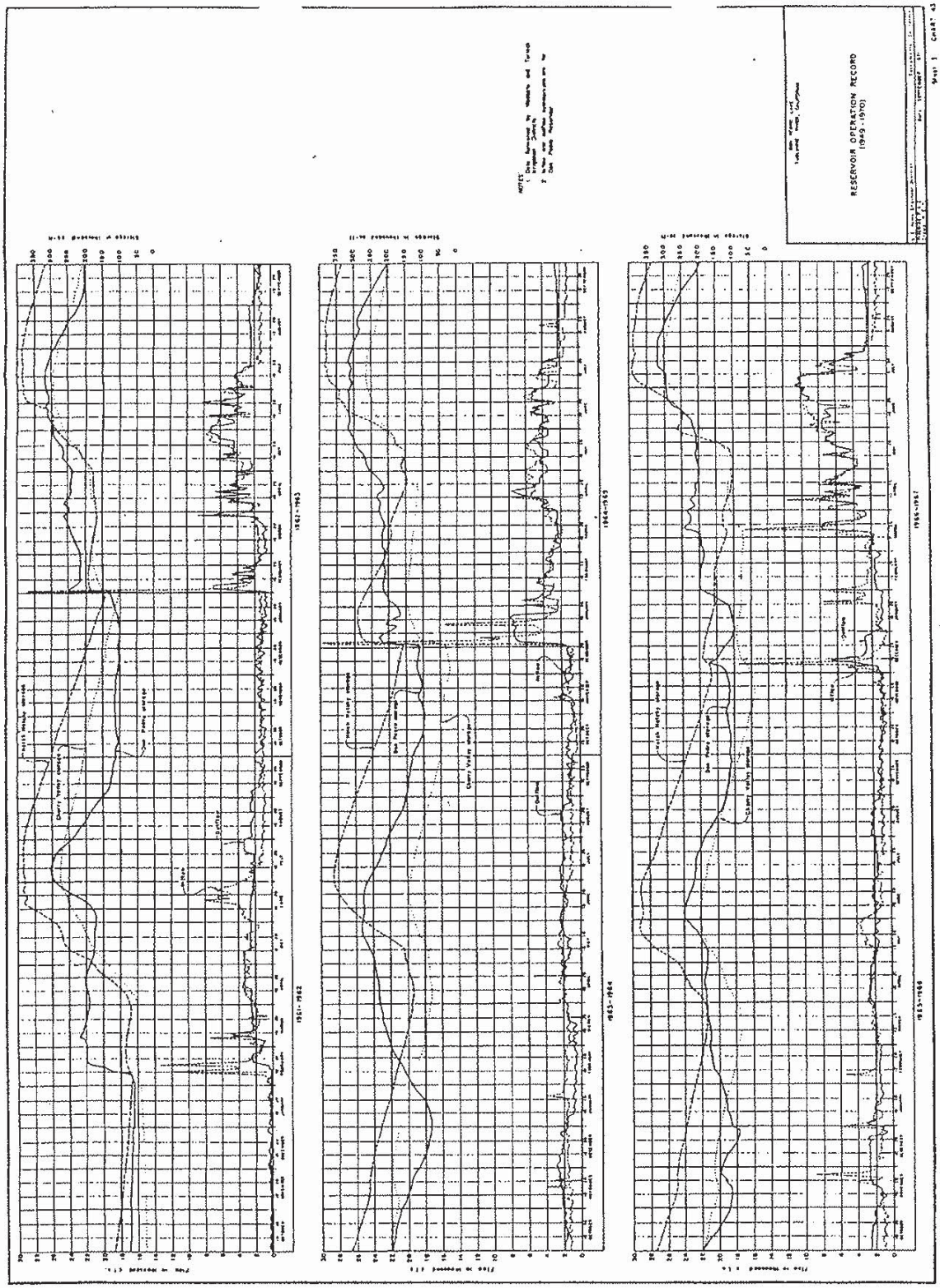
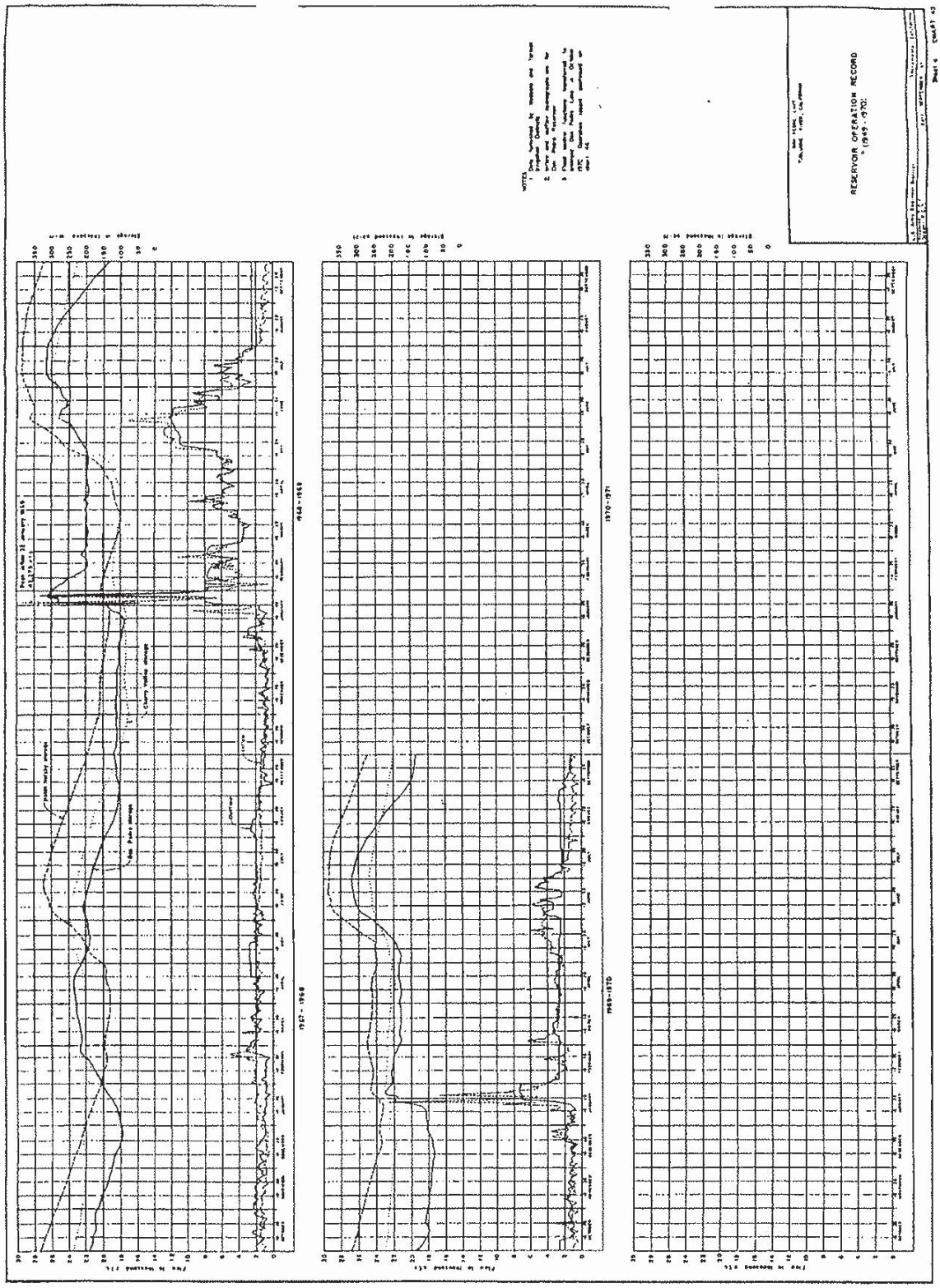

Exceedence frequency per hundred years
99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 .5 .2 .1
LEGEND:
1. Natural conditions
2. Project conditions
Maximum daily flow in thousand c.f.s.
30
20
15
10
7
5
3
2
1
5 10 20 50 100 200 500 1000
Exceedence interval in years
DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA
MAXIMUM MEAN DAILY
SNOWMELT-FLOOD FREQUENCY CURVES
TUOLUMNE RIVER BELOW LA GRANGE DAM
Corps of Engineers, Sacramento, Calif.
Prepared: D.D.D.
Date: September 1971

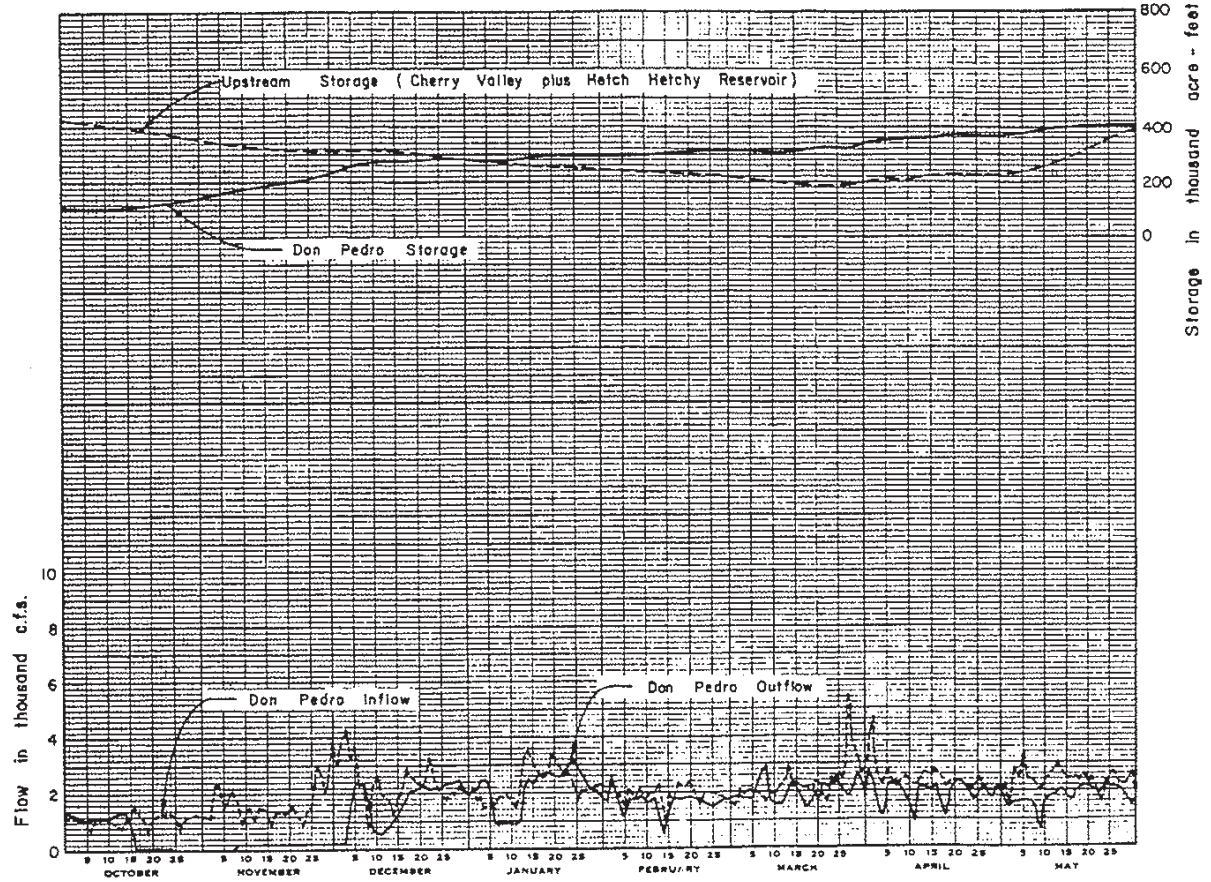
CHART 42


RESERVOIR OPERATION RECORD
(1949-1970)
1949-1950
1950-1951
1951-1952
1952-1953
1953-1954
1954-1955


RESERVOIR OPERATION RECORD
(1949 - 1970)


RESERVOIR OPERATION RECORD
(1949-1970)
1961-1962
1962-1963
1963-1964
1964-1965
1965-1966
1966-1967


RESERVOIR OPERATION RECORD
1969-1970
1970-1971




1970 - 1971
DON PEDRO LAKE

NOTE:
Inlarged Don Pedro Lake began operation October 1970.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

OPERATION RECORD
DON PEDRO LAKE

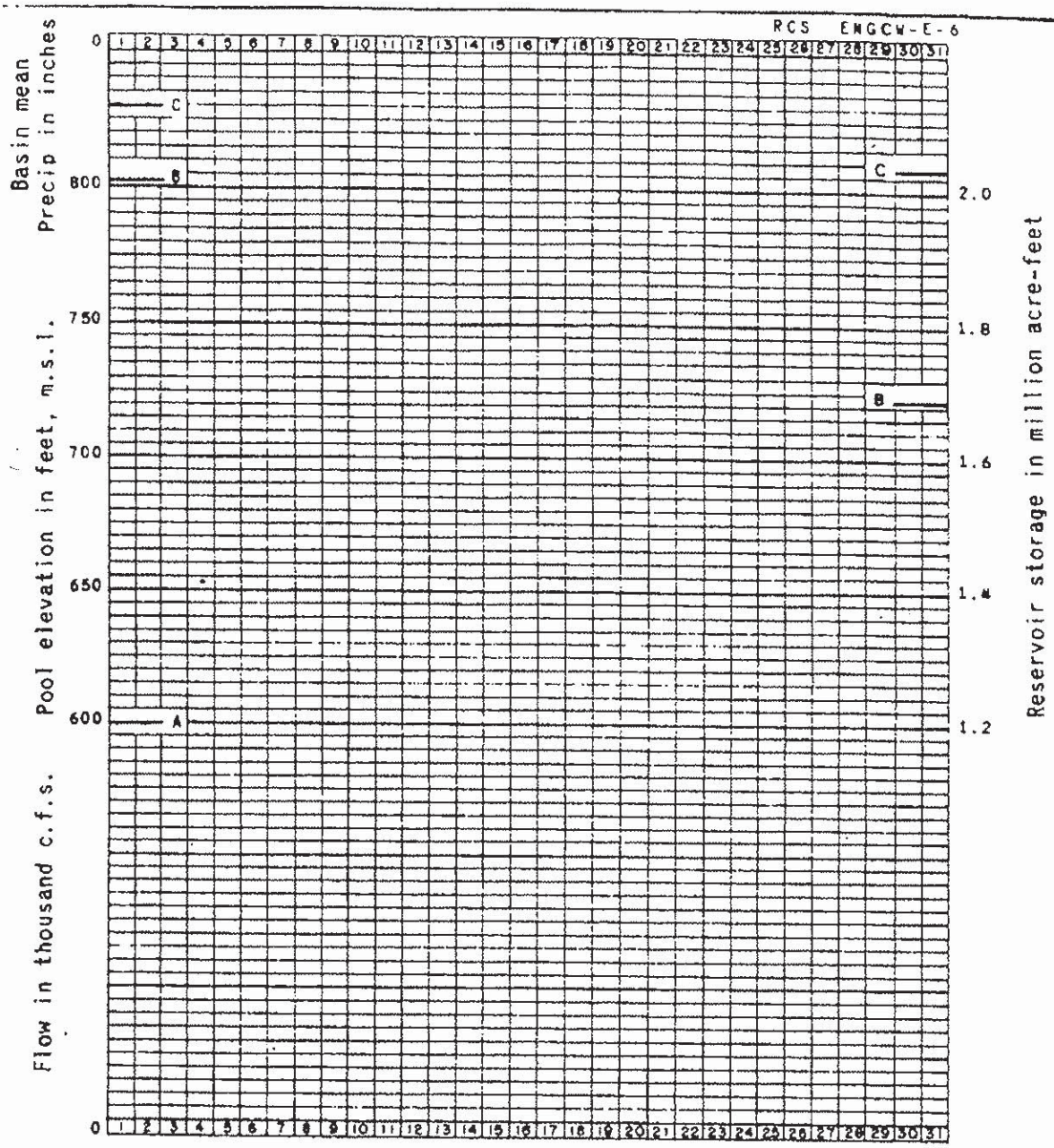
CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: D.D.D.
Drawn: T.G.K.
Date: SEPTEMBER 1971

CHART 44

USCE000306

099




A. Min. power pool elev: 600.0 ft.
storage: 309,000 ac-ft

B. Bottom flood-control reservation:
elev: 802.0 ft.
storage: 1,690,000 ac-ft

C. Gross pool elev: 830.0 ft.
storage: 2,030,000 ac-ft

Release capacities @ pool elev. 830.0 ft.
Outlet works - - - - - - 7,370 c.f.s.

Powerhouse:
Flood control valve - - 3,140 c.f.s.
Turbines - - - - - - - - 4,500 c.f.s.

MONTHLY RESERVOIR OPERATION

DON PEDRO LAKE

(OPERATED JOINTLY BY TURLOCK AND MODESTO IRRIGATION DISTRICTS)

TUOLUMNE RIVER, CALIFORNIA

DRAINAGE AREA: 1,533 SQ. MILES

SOUTH PACIFIC DIVISION
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

SPK FORM 359
1 JUL. 66

CHART 45



Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G

REPORT ON RESERVOIR REGULATION
FOR FLOOD CONTROL

DON PEDRO DAM AND LAKE
TUOLUMNE RIVER, CALIFORNIA

APPENDIX A
STANDING INSTRUCTIONS TO DAMTENDERS
INCLUDING EMERGENCY SPILLWAY OPERATIONS
AND FLOOD CONTROL REGULATIONS

AUGUST 1972

Department of the Army
Sacramento District, Corps of Engineers
Sacramento, California



USCE000308

Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G

REPORT ON RESERVOIR REGULATION
FOR FLOOD CONTROL

DON PEDRO DAM AND LAKE
TUOLUMNE RIVER, CALIFORNIA

APPENDIX A
STANDING INSTRUCTIONS TO DAMTENDERS
INCLUDING EMERGENCY SPILLWAY OPERATIONS
AND FLOOD CONTROL REGULATIONS

TABLE OF CONTENTS


| Paragraph | Subject | Page |
|---|---|---|
| | PART I - STANDING OPERATING INSTRUCTIONS | |
| 1. | GENERAL | 1 |
| 2. | FLOOD CONTROL OPERATION REQUIREMENTS | 1 |
| 3. | LIMITATIONS ON STORAGE | 2 |
| 4. | LIMITATIONS ON RELEASES | 2 |
| 5. | EMERGENCY OPERATION OF GATED SPILLWAY | 3 |
| 6. | STANDING INSTRUCTIONS DURING FLOOD EMERGENCY | 4 |
| 7. | OPERATIONAL REQUIREMENTS | 4 |
| 8. | OPERATION REPORTS | 6 |
| 9. | MODIFICATION OF REGULATIONS | 7 |
| | PART II - FLOOD CONTROL REGULATIONS | |

## LIST OF CHARTS


| Chart No. | |
|---|---|
| A-1 | Area and Capacity Curves |
| A-2 | Area and Capacity Tables (15 sheets) |
| A-3 | Discharge Rating Curves (River Outlet Works) |
| A-4 | Discharge Rating Curves (Flood Control Valve and Turbines) |
| A-5 | Spillway Rating Curves (Gates fully open) |
| A-6 | Spillway Rating Curves (Gates partially open) |
| A-7 | Stage Discharge Rating Curves |
| A-8 | Flood Control Diagram |
| A-9 | Emergency Spillway Release Diagram |

REPORT ON RESERVIOR REGULATION
FOR FLOOD CONTROL

DON PEDRO DAM AND LAKE
TUOLUMNE RIVER, CALIFORNIA

APPENDIX A
STANDING INSTRUCTIONS TO DAMTENDERS
INCLUDING EMERGENCY SPILLWAY OPERATIONS
AND FLOOD CONTROL REGULATIONS

PART I - STANDING OPERATING INSTRUCTIONS

1. GENERAL

a. This appendix to the "Report on Reservoir Regulation for Flood Control, Tuolumne River Basin, California" is prepared in accordance with instructions contained in EM 1110-2-3600, paragraph 4-07, (Standing Instructions to Damtenders) and pertains to duties and responsibilities of the damtender in connection with the functional operation of Don Pedro Dam and Lake, and the reporting of required hydrologic data.

b. Operational instructions to the damtender are briefly outlined with specific emphasis on his duties and responsibilities during extreme flood emergencies when communication facilities between him and his operating office (Modesto and Turlock Irrigation Districts) may have been disrupted. It is designed to be used independently as an emergency flood control regulation guide, or in conjunction with the "Report on Reservoir Regulation for Flood Control, Don Pedro Dam and Lake, Tuolumne River, California".

2. FLOOD CONTROL OPERATION REQUIREMENTS

a. Don Pedro Dam and Lake will be operated for flood control in accordance with flood control regulations prescribed by the Secretary of the Army, a copy of which is contained in this appendix. Accompanying the regulations are the flood control diagram, chart A-8, and the emergency spillway release diagram, chart A-9, which together define the requirements for flood control operation of Don Pedro Lake. The flood control objectives for Don Pedro Lake are to restrict flows in Tuolumne River downstream of Don Pedro Dam to non-damaging rates, insofar as possible and to minimize damage along Lower San Joaquin River.

b. A maximum of 340,000 acre-feet of space is dedicated to flood control during the winter rain flood season as shown on the flood control diagram. During the snowmelt season, flood control space requirements are defined by the parameter lines on the flood control diagram in terms of space required versus predicted snowmelt runoff. Capacity curves are shown on chart A-1 and area and capacity tables are listed on chart A-2.

runoff downstream to recede, maximum releases should be regulated as closely as possible by gradually closing the river outlet gates and thereafter restricting outflows according to the induced-surcharge curve of the emergency spillway release diagram. Accordingly, it is essential that such releases be made immediately in order that it will not subsequently become necessary to make larger releases. For this reason the reservoir operators at the dam should be thoroughly familiar with the emergency spillway release diagram and should be authorized to initiate use of the diagram, if required, when communication with Modesto and Turlock Irrigation Districts office is disrupted.

6. STANDING INSTRUCTIONS DURING FLOOD EMERGENCY

Whenever communications between the Turlock and Modesto Irrigation Districts office and the damtender are broken during a flood period, the damtender shall continue to operate in accordance with the latest instructions until communications are restored or until emergency spillway operation, in accordance with paragraph 5 above, becomes necessary.

7. OPERATIONAL REQUIREMENTS

a. Don Pedro Lake is operated by Turlock and Modesto Irrigation Districts and these districts are jointly responsible for:

(1) Accomplishing the physical operation of the reservoir and associated facilities in accordance with the official regulations.

(2) Advising the District Engineer, Sacramento District, Corps of Engineers, of any need for emergency change in operation.

(3) Reporting to the District Engineer, Sacramento District, Corps of Engineers, any unusual condition in the reservoir or along downstream channels that might temporarily interfere with the planned flood control operation of the reservoir.

(4) Keeping downstream interests advised of impending changes in flood control releases which may affect them.

(5) Reporting by telephone to the Reservoir Regulation Section, Sacramento District, Corps of Engineers, the data outlined in paragraph 8-a below, and other data that may be requested from time to time.

(6) Keeping informed of the rules and regulations contained in this report and bringing to the attention of the District Engineer, Sacramento District, Corps of Engineers, any features contained herein that may require clarification or revision.

(1) Daily inflow, outflow, elevation, and storage at Don Pedro Lake.

(2) Daily storage at upstream reservoirs (Hetch Hetchy, Lake Lloyd, and Lake Eleanor).

(3) Daily diversion at La Grange Dam (Modesto and Turlock Canals).

(4) Daily flow in Tuolumne River below La Grange Dam.

(5) Daily precipitation amounts at Don Pedro, Hetch Hetchy, Sonora and Yosemite.

9. MODIFICATION OF REGULATIONS

a. The official regulations are subject to temporary modification by the District Engineer, Corps of Engineers, during flood emergencies. Permanent changes in the regulations may be made by reissuing them in the same manner as originally prescribed.

b. The Turlock and Modesto Irrigation Districts may temporarily suspend application of the flood control regulations for Don Pedro Lake in the event this is deemed necessary for emergency reasons to protect the safety of the dam, or to avoid other severe hazards. Revision of the flood control diagram for Don Pedro Dam and Lake may be made when necessary with the mutual consent of the Corps of Engineers and the Turlock and Modesto Irrigation Districts.

# DON PEDRO DAM AND LAKE
# TUOLUMNE RIVER, CALIFORNIA

## REPORT ON RESERVOIR REGULATION
## FOR FLOOD CONTROL

AUGUST 1972

## APPENDIX A
## FLOOD CONTROL REGULATIONS

Department of the Army
Sacramento District, Corps of Engineers
Sacramento, California

CODE OF FEDERAL REGULATIONS

TITLE 33 - NAVIGATION AND NAVIGABLE WATERS

Chapter II - Corps of Engineers
Department of the Army

PART 208 - FLOOD CONTROL REGULATIONS

DON PEDRO DAM AND LAKE
TUOLUMNE RIVER, CALIFORNIA

Pursuant to the provisions of Section 7 of the Act of Congress approved December 22, 1944 (58 Stat. 890; 33 U.S.C. 709), and of contract no. DA-04-167-Eng-38 dated August 29, 1949, as amended by Supplemental Agreement No. 1 dated 12 June 1967, between the United States of America and the City and County of San Francisco, California, the Modesto Irrigation District, Modesto, California and the Turlock Irrigation District, Turlock, California, the following Part #208 _____ regulations are hereby prescribed to govern the operation of Don Pedro Dam and Lake on Tuolumne River, California, in the interest of flood control:

PART 208. - DON PEDRO DAM AND LAKE, CALIFORNIA.

The Modesto Irrigation District, Modesto, California and Turlock Irrigation District, Turlock, California, hereinafter referred to as the Districts, shall operate or otherwise effect the operation of Don Pedro Dam and Lake in the interest of flood control in accordance with instructions furnished by the Department of the Army, represented by the District Engineer in charge of the locality, hereinafter referred to as the District Engineer, as follows:

a. Storage space in Don Pedro Lake of 340,000 acre-feet below

elevation 830.00 feet, shall be kept available for flood control purposes on a seasonal basis in accordance with the Flood Control Diagram currently in force. The Flood Control Diagram in force as of the promulgation of this section is that dated _____, File No. TU-1-19-9.

b. Except when greater releases are required as prescribed in paragraph (c) of this section, releases from Don Pedro Lake shall be restricted insofar as possible to quantities which will not cause flows in the Tuolumne River below Dry Creek to exceed the controlling flow rates specified on the Flood Control Diagram currently in force. Any water temporarily stored in the flood control space indicated by the Flood Control Diagram shall be released as rapidly as can be safely accomplished without causing downstream flows to exceed the rates of flow shown thereon.

c. In the event the water level at Don Pedro Lake exceeds the top of flood control pool, elevation 830, and is rising, subsequent operation shall be in accordance with the Emergency Spillway Release Diagram currently in force. When the lake level again recedes to elevation 830, subsequent operation shall be in accordance with the Flood Control Diagram. The Emergency Spillway Release Diagram in force as of the promulgation of this section is that dated _____, File No. TU-1-13-11.

d. Except as necessary in order to comply with the provisions of the Emergency Spillway Release Diagram under paragraph (c) above, the regulations of this section shall not be construed to require dangerously

rapid changes in magnitudes of release or that releases be made in a manner that will be inconsistent with requirements for protecting the dam and reservoir from major damages.

e. The Districts shall procure such current basic hydrologic data and make such current determinations of required flood control space and releases at the lake as are required to accomplish the flood control objectives prescribed in this section.

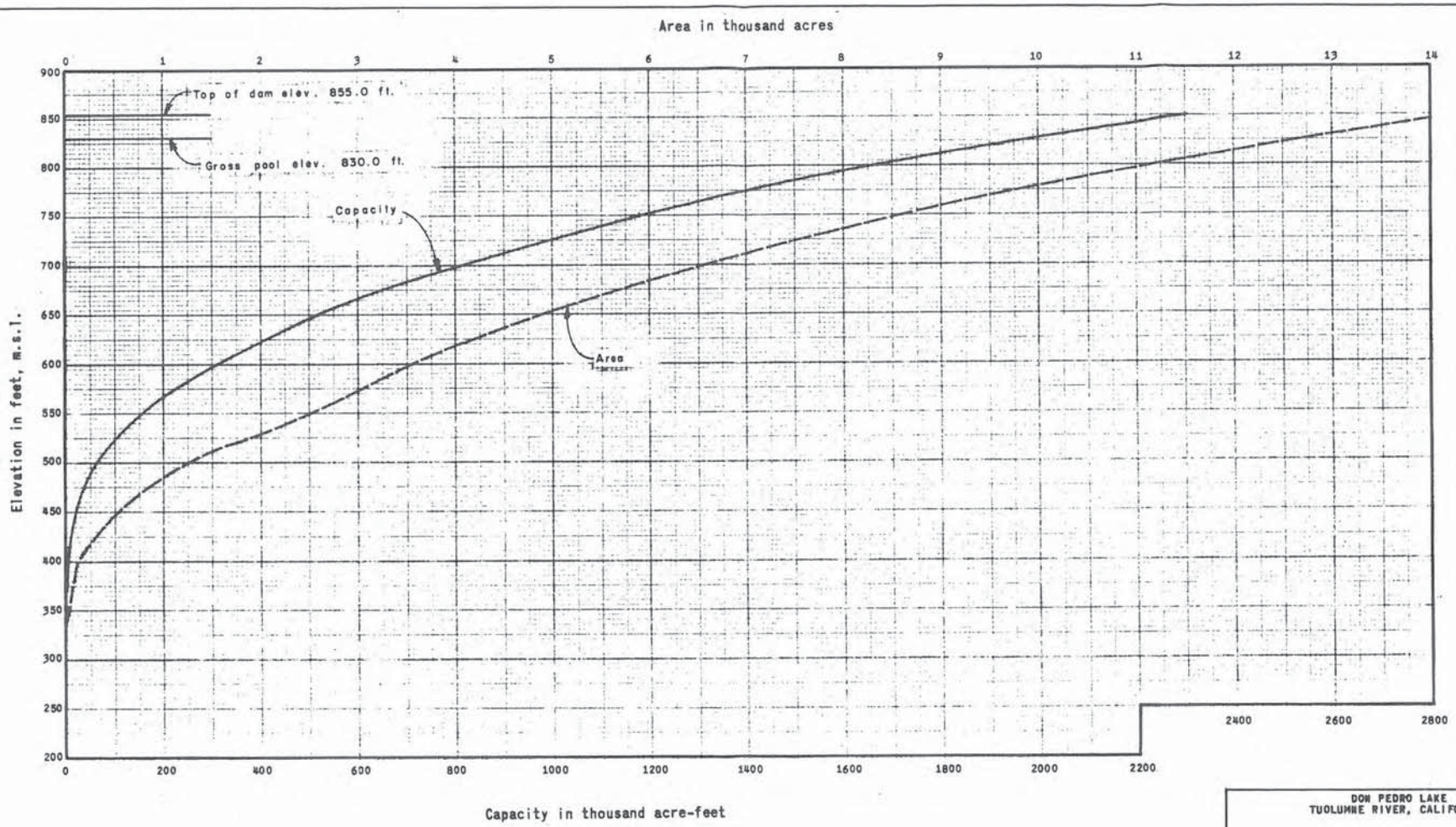
f. The Districts shall keep the District Engineer currently advised of lake storage and such other operating data as the District Engineer may request.

g. The flood control regulations of this section are subject to temporary modification by the District Engineer if found necessary in time of emergency. Requests for and action on such modifications may be made by any available means of communication, and the action taken by the District Engineer shall be confirmed in writing under date of same day to the office of the Districts.

h. The Districts may temporarily suspend application of the flood control regulations of this section in the event it is deemed necessary for emergency reasons to protect the safety of the dam, or to avoid other serious hazards. Such action shall be immediately reported by any available means of communication, and confirmed in writing under date of same day to the District Engineer.

i. Revision of the Flood Control or Emergency Spillway Release Diagrams requires approval of the Chief of Engineers, or his duly authorized representative, and the Modesto and Turlock Irrigation

Districts. Each such revision shall be effective upon the date specified in the approval, and from that date until replaced shall be the diagram in force for the purpose of this section. The Flood Control and Emergency Spillway Release Diagrams are on file in the Office, Chief of Engineers, Department of the Army, Washington, D. C., and the offices of the Modesto Irrigation District, Modesto, California and Turlock Irrigation District, Turlock, California. Copies of the diagrams currently in force shall be kept on file in and may be obtained from the offices of the District Engineer, Corps of Engineers, Sacramento, California, and the Modesto Irrigation District, Modesto, California and Turlock Irrigation District, Turlock, California.




NOTE:

Curves based on data furnished by Bechtel Corp.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

AREA AND CAPACITY CURVES

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: C.D.M.
Drawn: R.E.Y. & S.K.N.
Date: August 1970

CHART A-1

DON PEDRO LAKE, TUOLUMNE RIVER, CALIFORNIA - AREA AND CAPACITY TABLE AUG 1970

| ELEV FEET | CAP AREA 0 | CAP AREA 1 | CAP AREA 2 | CAP AREA 3 | CAP AREA 4 | CAP AREA 5 | CAP AREA 6 | CAP AREA 7 | CAP AREA 8 | CAP AREA 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 290.0 | 0 | 0 | 0 | 1 | 1 | 3 | 5 | 8 | 12 | 17 |
| | 0 | 0 | 0 | 1 | 1 | 2 | 3 | 3 | 4 | 6 |
| 300.0 | 35 | 42 | 50 | 57 | 65 | 74 | 82 | 91 | 100 | 110 |
| | 7 | 7 | 8 | 8 | 8 | 8 | 9 | 9 | 9 | 10 |
| 310.0 | 120 | 130 | 140 | 150 | 161 | 172 | 183 | 194 | 206 | 218 |
| | 10 | 10 | 10 | 11 | 11 | 11 | 11 | 11 | 12 | 12 |
| 320.0 | 229 | 242 | 255 | 268 | 283 | 297 | 313 | 330 | 347 | 364 |
| | 12 | 13 | 13 | 14 | 15 | 15 | 16 | 17 | 17 | 18 |
| 330.0 | 383 | 402 | 423 | 444 | 466 | 489 | 512 | 537 | 563 | 589 |
| | 19 | 20 | 21 | 22 | 22 | 23 | 24 | 25 | 26 | 27 |
| 340.0 | 617 | 645 | 673 | 702 | 732 | 762 | 792 | 822 | 853 | 885 |
| | 28 | 28 | 29 | 29 | 30 | 30 | 30 | 31 | 31 | 32 |
| 350.0 | 916 | 949 | 982 | 1016 | 1051 | 1087 | 1124 | 1162 | 1200 | 1240 |
| | 32 | 33 | 34 | 35 | 35 | 36 | 37 | 38 | 39 | 40 |
| 360.0 | 1280 | 1322 | 1365 | 1409 | 1455 | 1502 | 1551 | 1600 | 1652 | 1705 |
| | 41 | 42 | 44 | 45 | 46 | 48 | 49 | 51 | 52 | 54 |
| 370.0 | 1759 | 1815 | 1872 | 1932 | 1993 | 2056 | 2121 | 2188 | 2257 | 2328 |
| | 55 | 57 | 59 | 60 | 62 | 64 | 66 | 68 | 70 | 72 |
| 380.0 | 2401 | 2477 | 2554 | 2634 | 2717 | 2802 | 2890 | 2981 | 3074 | 3170 |
| | 74 | 76 | 79 | 81 | 84 | 87 | 89 | 92 | 94 | 97 |
| 390.0 | 3268 | 3370 | 3476 | 3587 | 3701 | 3820 | 3943 | 4071 | 4203 | 4340 |
| | 100 | 104 | 108 | 112 | 117 | 121 | 125 | 130 | 135 | 139 |

DON PEDRO LAKE, TUOLUMNE RIVER, CALIFORNIA - AREA AND CAPACITY TABLE AUG 1970

| ELEV FEET | CAP AREA 0 | CAP AREA 1 | CAP AREA 2 | CAP AREA 3 | CAP AREA 4 | CAP AREA 5 | CAP AREA 6 | CAP AREA 7 | CAP AREA 8 | CAP AREA 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 400.0 | 4481 | 4629 | 4783 | 4944 | 5113 | 5289 | 5472 | 5663 | 5862 | 6069 |
| | 144 | 151 | 158 | 165 | 172 | 180 | 187 | 195 | 203 | 211 |
| 410.0 | 6283 | 6507 | 6738 | 6978 | 7226 | 7483 | 7749 | 8025 | 8309 | 8603 |
| | 219 | 227 | 236 | 244 | 253 | 262 | 271 | 280 | 289 | 298 |
| 420.0 | 8906 | 9218 | 9538 | 9865 | 10201 | 10545 | 10898 | 11259 | 11628 | 12006 |
| | 308 | 316 | 324 | 332 | 340 | 348 | 357 | 365 | 374 | 382 |
| 430.0 | 12393 | 12787 | 13190 | 13601 | 14020 | 14447 | 14882 | 15325 | 15777 | 16237 |
| | 391 | 399 | 407 | 415 | 423 | 431 | 439 | 448 | 456 | 464 |
| 440.0 | 16706 | 17184 | 17670 | 18166 | 18671 | 19185 | 19709 | 20242 | 20785 | 21337 |
| | 473 | 482 | 491 | 500 | 510 | 519 | 528 | 538 | 548 | 557 |
| 450.0 | 21899 | 22471 | 23054 | 23647 | 24251 | 24865 | 25490 | 26126 | 26774 | 27432 |
| | 567 | 577 | 588 | 598 | 609 | 620 | 631 | 642 | 653 | 664 |
| 460.0 | 28101 | 28782 | 29473 | 30175 | 30888 | 31613 | 32348 | 33095 | 33853 | 34623 |
| | 675 | 686 | 697 | 708 | 719 | 730 | 741 | 752 | 764 | 775 |
| 470.0 | 35404 | 36198 | 37008 | 37832 | 38672 | 39527 | 40397 | 41284 | 42186 | 43103 |
| | 787 | 802 | 817 | 832 | 847 | 863 | 878 | 894 | 910 | 926 |
| 480.0 | 44037 | 44987 | 45952 | 46932 | 47928 | 48940 | 49967 | 51010 | 52070 | 53145 |
| | 942 | 957 | 973 | 988 | 1004 | 1019 | 1035 | 1051 | 1067 | 1084 |
| 490.0 | 54237 | 55344 | 56466 | 57603 | 58754 | 59921 | 61102 | 62298 | 63510 | 64737 |
| | 1100 | 1115 | 1129 | 1144 | 1159 | 1174 | 1189 | 1204 | 1219 | 1235 |
| 500.0 | 66110 | 67371 | 68654 | 69960 | 71288 | 72639 | 74014 | 75411 | 76832 | 78276 |
| | 1250 | 1272 | 1294 | 1317 | 1340 | 1363 | 1386 | 1409 | 1432 | 1456 |
| 510.0 | 79744 | 81232 | 82735 | 84254 | 85789 | 87340 | 88907 | 90490 | 92090 | 93705 |
| | 1480 | 1496 | 1511 | 1527 | 1543 | 1559 | 1575 | 1591 | 1607 | 1624 |
| 520.0 | 95337 | 96992 | 98679 | 100396 | 102145 | 103925 | 105738 | 107582 | 109460 | 111370 |
| | 1640 | 1671 | 1702 | 1733 | 1765 | 1796 | 1829 | 1861 | 1894 | 1927 |
| 530.0 | 113313 | 115290 | 117299 | 119341 | 121417 | 123527 | 125671 | 127848 | 130061 | 132308 |
| | 1960 | 1993 | 2026 | 2059 | 2093 | 2127 | 2161 | 2195 | 2230 | 2265 |
| 540.0 | 134591 | 136902 | 139236 | 141592 | 143971 | 146374 | 148799 | 151247 | 153718 | 156213 |
| | 2300 | 2323 | 2345 | 2368 | 2391 | 2414 | 2437 | 2460 | 2483 | 2507 |
| 550.0 | 158731 | 161269 | 163823 | 166393 | 168978 | 171579 | 174197 | 176830 | 179480 | 182146 |
| | 2530 | 2546 | 2562 | 2577 | 2593 | 2609 | 2625 | 2641 | 2658 | 2674 |
| 560.0 | 184827 | 187529 | 190253 | 192999 | 195749 | 198561 | 201376 | 204215 | 207076 | 209961 |
| | 2690 | 2713 | 2735 | 2758 | 2781 | 2804 | 2827 | 2850 | 2873 | 2897 |
| 570.0 | 212870 | 215797 | 218741 | 221701 | 224676 | 227668 | 230675 | 233699 | 236738 | 239794 |
| | 2920 | 2936 | 2952 | 2968 | 2983 | 2999 | 3015 | 3032 | 3048 | 3064 |
| 580.0 | 242866 | 245957 | 249069 | 252204 | 255360 | 258538 | 261738 | 264960 | 268204 | 271471 |
| | 3080 | 3102 | 3123 | 3145 | 3167 | 3189 | 3211 | 3233 | 3255 | 3278 |
| 590.0 | 274760 | 278070 | 281403 | 284757 | 288134 | 291532 | 294952 | 298394 | 301858 | 305345 |
| | 3300 | 3322 | 3343 | 3365 | 3387 | 3409 | 3431 | 3453 | 3475 | 3498 |



Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G

DON PEDRO LAKE, TUOLUMNE RIVER, CALIFORNIA - AREA AND CAPACITY TABLE AUG 1970

| ELEV FEET | CAP AREA .0 | CAP AREA .1 | CAP AREA .2 | CAP AREA .3 | CAP AREA .4 | CAP AREA .5 | CAP AREA .6 | CAP AREA .7 | CAP AREA .8 | CAP AREA .9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 600.0 | 308960 | 309312 | 309665 | 310017 | 310370 | 310723 | 311076 | 311430 | 311784 | 312138 |
| | 3520 | 3522 | 3525 | 3527 | 3529 | 3531 | 3534 | 3536 | 3538 | 3540 |
| 601.0 | 312492 | 312846 | 313201 | 313556 | 313911 | 314266 | 314621 | 314977 | 315333 | 315689 |
| | 3543 | 3545 | 3547 | 3549 | 3552 | 3554 | 3556 | 3559 | 3561 | 3563 |
| 602.0 | 316046 | 316402 | 316759 | 317116 | 317474 | 317831 | 318189 | 318547 | 318905 | 319264 |
| | 3565 | 3568 | 3570 | 3572 | 3575 | 3577 | 3579 | 3581 | 3584 | 3586 |
| 603.0 | 319623 | 319982 | 320341 | 320700 | 321060 | 321420 | 321780 | 322140 | 322500 | 322861 |
| | 3588 | 3591 | 3593 | 3595 | 3597 | 3600 | 3602 | 3604 | 3607 | 3609 |
| 604.0 | 323222 | 323583 | 323945 | 324307 | 324669 | 325031 | 325393 | 325756 | 326118 | 326482 |
| | 3611 | 3613 | 3615 | 3618 | 3620 | 3623 | 3625 | 3627 | 3629 | 3632 |
| 605.0 | 326845 | 327208 | 327572 | 327936 | 328300 | 328665 | 329029 | 329394 | 329759 | 330125 |
| | 3634 | 3636 | 3639 | 3641 | 3643 | 3646 | 3648 | 3650 | 3653 | 3655 |
| 606.0 | 330490 | 330856 | 331222 | 331589 | 331955 | 332322 | 332689 | 333056 | 333424 | 333791 |
| | 3657 | 3659 | 3662 | 3664 | 3666 | 3669 | 3671 | 3673 | 3676 | 3678 |
| 607.0 | 334159 | 334527 | 334896 | 335264 | 335633 | 336002 | 336371 | 336741 | 337111 | 337481 |
| | 3680 | 3683 | 3685 | 3687 | 3690 | 3692 | 3694 | 3696 | 3699 | 3701 |
| 608.0 | 337851 | 338221 | 338592 | 338963 | 339334 | 339706 | 340077 | 340449 | 340821 | 341193 |
| | 3703 | 3706 | 3708 | 3710 | 3713 | 3715 | 3717 | 3720 | 3722 | 3724 |
| 609.0 | 341566 | 341939 | 342312 | 342685 | 343059 | 343432 | 343806 | 344180 | 344555 | 344929 |
| | 3727 | 3729 | 3731 | 3734 | 3736 | 3738 | 3741 | 3743 | 3745 | 3748 |
| 610.0 | 345310 | 345679 | 346055 | 346430 | 346806 | 347182 | 347559 | 347935 | 348312 | 348689 |
| | 3750 | 3752 | 3755 | 3757 | 3760 | 3762 | 3765 | 3767 | 3770 | 3772 |
| 611.0 | 349067 | 349444 | 349822 | 350200 | 350578 | 350957 | 351336 | 351715 | 352094 | 352474 |
| | 3775 | 3777 | 3780 | 3782 | 3785 | 3787 | 3789 | 3792 | 3794 | 3797 |
| 612.0 | 352854 | 353234 | 353614 | 353995 | 354375 | 354756 | 355138 | 355519 | 355901 | 356283 |
| | 3799 | 3802 | 3804 | 3807 | 3809 | 3812 | 3814 | 3817 | 3819 | 3822 |
| 613.0 | 356665 | 357048 | 357431 | 357814 | 358197 | 358581 | 358964 | 359348 | 359733 | 360117 |
| | 3824 | 3827 | 3829 | 3832 | 3834 | 3837 | 3839 | 3842 | 3844 | 3847 |
| 614.0 | 360502 | 360887 | 361272 | 361658 | 362044 | 362430 | 362816 | 363202 | 363589 | 363976 |
| | 3849 | 3852 | 3854 | 3857 | 3859 | 3862 | 3864 | 3866 | 3869 | 3871 |
| 615.0 | 364363 | 364751 | 365139 | 365527 | 365915 | 366304 | 366692 | 367081 | 367471 | 367860 |
| | 3874 | 3876 | 3879 | 3881 | 3884 | 3887 | 3889 | 3892 | 3894 | 3897 |
| 616.0 | 368250 | 368640 | 369030 | 369421 | 369812 | 370203 | 370594 | 370985 | 371377 | 371769 |
| | 3899 | 3902 | 3904 | 3907 | 3909 | 3912 | 3914 | 3917 | 3919 | 3922 |
| 617.0 | 372162 | 372554 | 372947 | 373340 | 373733 | 374127 | 374521 | 374915 | 375309 | 375703 |
| | 3924 | 3927 | 3929 | 3932 | 3934 | 3937 | 3939 | 3942 | 3944 | 3947 |
| 618.0 | 376098 | 376493 | 376889 | 377284 | 377680 | 378076 | 378472 | 378869 | 379266 | 379663 |
| | 3949 | 3952 | 3954 | 3957 | 3959 | 3962 | 3965 | 3967 | 3970 | 3972 |
| 619.0 | 380060 | 380458 | 380856 | 381254 | 381652 | 382051 | 382450 | 382849 | 383248 | 383648 |
| | 3975 | 3977 | 3980 | 3982 | 3985 | 3987 | 3990 | 3992 | 3995 | 3997 |



Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G

DON PEDRO LAKE, TUOLUMNE RIVER, CALIFORNIA - AREA AND CAPACITY TABLE AUG 1970

| ELEV FEET | CAP AREA .0 | CAP AREA .1 | CAP AREA .2 | CAP AREA .3 | CAP AREA .4 | CAP AREA .5 | CAP AREA .6 | CAP AREA .7 | CAP AREA .8 | CAP AREA .9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 620.0 | 384060 | 384461 | 384861 | 385262 | 385663 | 386064 | 386466 | 386868 | 387270 | 387672 |
| | 4000 | 4003 | 4006 | 4009 | 4011 | 4014 | 4017 | 4020 | 4023 | 4026 |
| 621.0 | 388075 | 388478 | 388881 | 389285 | 389689 | 390093 | 390497 | 390902 | 391307 | 391712 |
| | 4029 | 4031 | 4034 | 4037 | 4040 | 4043 | 4046 | 4049 | 4051 | 4054 |
| 622.0 | 392118 | 392524 | 392930 | 393336 | 393743 | 394150 | 394557 | 394965 | 395373 | 395781 |
| | 4057 | 4060 | 4063 | 4066 | 4069 | 4072 | 4074 | 4077 | 4080 | 4083 |
| 623.0 | 396189 | 396598 | 397007 | 397416 | 397826 | 398236 | 398646 | 399056 | 399467 | 399878 |
| | 4086 | 4089 | 4092 | 4095 | 4097 | 4100 | 4103 | 4106 | 4109 | 4112 |
| 624.0 | 400290 | 400701 | 401113 | 401525 | 401938 | 402351 | 402764 | 403177 | 403591 | 404005 |
| | 4115 | 4118 | 4121 | 4123 | 4126 | 4129 | 4132 | 4135 | 4138 | 4141 |
| 625.0 | 404419 | 404833 | 405248 | 405663 | 406079 | 406494 | 406910 | 407327 | 407743 | 408160 |
| | 4144 | 4147 | 4150 | 4152 | 4155 | 4158 | 4161 | 4164 | 4167 | 4170 |
| 626.0 | 408577 | 408995 | 409412 | 409830 | 410249 | 410667 | 411086 | 411505 | 411925 | 412344 |
| | 4173 | 4176 | 4179 | 4182 | 4184 | 4187 | 4190 | 4193 | 4196 | 4199 |
| 627.0 | 412764 | 413185 | 413605 | 414026 | 414448 | 414869 | 415291 | 415713 | 416135 | 416558 |
| | 4202 | 4205 | 4208 | 4211 | 4214 | 4217 | 4219 | 4222 | 4225 | 4228 |
| 628.0 | 416981 | 417404 | 417828 | 418252 | 418676 | 419100 | 419525 | 419950 | 420375 | 420801 |
| | 4231 | 4234 | 4237 | 4240 | 4243 | 4246 | 4249 | 4252 | 4255 | 4258 |
| 629.0 | 421227 | 421653 | 422080 | 422506 | 422933 | 423361 | 423789 | 424216 | 424645 | 425073 |
| | 4261 | 4263 | 4266 | 4269 | 4272 | 4275 | 4278 | 4281 | 4284 | 4287 |
| 630.0 | 425510 | 425931 | 426361 | 426790 | 427221 | 427651 | 428081 | 428512 | 428944 | 429375 |
| | 4290 | 4293 | 4296 | 4299 | 4302 | 4305 | 4308 | 4311 | 4314 | 4317 |
| 631.0 | 429807 | 430239 | 430671 | 431104 | 431537 | 431970 | 432404 | 432838 | 433272 | 433707 |
| | 4320 | 4323 | 4325 | 4328 | 4331 | 4334 | 4337 | 4340 | 4343 | 4346 |
| 632.0 | 434141 | 434576 | 435012 | 435447 | 435883 | 436320 | 436756 | 437193 | 437630 | 438068 |
| | 4349 | 4352 | 4355 | 4358 | 4361 | 4364 | 4367 | 4370 | 4373 | 4376 |
| 633.0 | 438505 | 438943 | 439382 | 439820 | 440259 | 440699 | 441138 | 441578 | 442018 | 442458 |
| | 4379 | 4382 | 4385 | 4388 | 4391 | 4394 | 4397 | 4400 | 4403 | 4406 |
| 634.0 | 442899 | 443340 | 443782 | 444223 | 444665 | 445107 | 445550 | 445993 | 446436 | 446879 |
| | 4409 | 4412 | 4415 | 4418 | 4421 | 4424 | 4427 | 4430 | 4433 | 4436 |
| 635.0 | 447323 | 447767 | 448211 | 448656 | 449101 | 449546 | 449992 | 450437 | 450884 | 451330 |
| | 4439 | 4442 | 4445 | 4448 | 4451 | 4454 | 4457 | 4460 | 4463 | 4466 |
| 636.0 | 451777 | 452224 | 452671 | 453119 | 453567 | 454015 | 454463 | 454912 | 455361 | 455811 |
| | 4469 | 4472 | 4475 | 4478 | 4481 | 4484 | 4487 | 4490 | 4493 | 4496 |
| 637.0 | 456261 | 456711 | 457161 | 457612 | 458063 | 458514 | 458965 | 459417 | 459869 | 460322 |
| | 4499 | 4502 | 4505 | 4508 | 4511 | 4514 | 4517 | 4520 | 4523 | 4526 |
| 638.0 | 460775 | 461228 | 461681 | 462135 | 462589 | 463043 | 463498 | 463952 | 464408 | 464863 |
| | 4529 | 4532 | 4535 | 4538 | 4541 | 4544 | 4547 | 4550 | 4553 | 4557 |
| 639.0 | 465319 | 465775 | 466231 | 466688 | 467145 | 467603 | 468060 | 468518 | 468976 | 469435 |
| | 4560 | 4563 | 4566 | 4569 | 4572 | 4575 | 4578 | 4581 | 4584 | 4587 |

DON PEDRO LAKE, TUOLUMNE RIVER, CALIFORNIA - AREA AND CAPACITY TABLE AUG 1970

| ELEV FEET | CAP AREA .0 | CAP AREA .1 | CAP AREA .2 | CAP AREA .3 | CAP AREA .4 | CAP AREA .5 | CAP AREA .6 | CAP AREA .7 | CAP AREA .8 | CAP AREA .9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 640.0 | 469910 | 470370 | 470829 | 471289 | 471749 | 472210 | 472671 | 473132 | 473593 | 474055 |
| | 4590 | 4593 | 4596 | 4600 | 4603 | 4606 | 4609 | 4613 | 4616 | 4619 |
| 641.0 | 474517 | 474979 | 475442 | 475905 | 476369 | 476832 | 477296 | 477761 | 478225 | 478690 |
| | 4622 | 4626 | 4629 | 4632 | 4636 | 4639 | 4642 | 4645 | 4649 | 4652 |
| 642.0 | 479156 | 479621 | 480087 | 480554 | 481020 | 481487 | 481955 | 482422 | 482890 | 483359 |
| | 4655 | 4658 | 4662 | 4665 | 4668 | 4671 | 4675 | 4678 | 4681 | 4685 |
| 643.0 | 483827 | 484296 | 484765 | 485235 | 485705 | 486175 | 486646 | 487117 | 487588 | 488059 |
| | 4688 | 4691 | 4694 | 4698 | 4701 | 4704 | 4707 | 4711 | 4714 | 4717 |
| 644.0 | 488531 | 489004 | 489476 | 489949 | 490422 | 490896 | 491370 | 491844 | 492318 | 492793 |
| | 4721 | 4724 | 4727 | 4731 | 4734 | 4737 | 4740 | 4744 | 4747 | 4750 |
| 645.0 | 493268 | 493744 | 494220 | 494696 | 495173 | 495649 | 496127 | 496604 | 497082 | 497560 |
| | 4754 | 4757 | 4760 | 4763 | 4767 | 4770 | 4773 | 4777 | 4780 | 4783 |
| 646.0 | 498039 | 498517 | 498997 | 499476 | 499956 | 500436 | 500917 | 501397 | 501878 | 502360 |
| | 4787 | 4790 | 4793 | 4797 | 4800 | 4803 | 4807 | 4810 | 4813 | 4816 |
| 647.0 | 502842 | 503324 | 503806 | 504289 | 504772 | 505256 | 505740 | 506224 | 506708 | 507193 |
| | 4820 | 4823 | 4826 | 4830 | 4833 | 4836 | 4840 | 4843 | 4846 | 4850 |
| 648.0 | 507678 | 508164 | 508649 | 509136 | 509622 | 510109 | 510596 | 511084 | 511571 | 512060 |
| | 4853 | 4856 | 4860 | 4863 | 4866 | 4870 | 4873 | 4876 | 4880 | 4883 |
| 649.0 | 512548 | 513037 | 513526 | 514015 | 514505 | 514995 | 515486 | 515977 | 516468 | 516959 |
| | 4886 | 4890 | 4893 | 4897 | 4900 | 4903 | 4907 | 4910 | 4913 | 4917 |
| 650.0 | 517450 | 517943 | 518436 | 518929 | 519422 | 519915 | 520409 | 520902 | 521397 | 521891 |
| | 4920 | 4923 | 4926 | 4929 | 4932 | 4935 | 4938 | 4941 | 4944 | 4947 |
| 651.0 | 522386 | 522881 | 523377 | 523872 | 524368 | 524865 | 525361 | 525858 | 526355 | 526853 |
| | 4950 | 4953 | 4956 | 4958 | 4961 | 4964 | 4967 | 4970 | 4973 | 4976 |
| 652.0 | 527350 | 527849 | 528347 | 528846 | 529345 | 529844 | 530343 | 530843 | 531343 | 531844 |
| | 4979 | 4982 | 4985 | 4988 | 4991 | 4994 | 4997 | 5000 | 5003 | 5006 |
| 653.0 | 532345 | 532846 | 533347 | 533849 | 534351 | 534853 | 535355 | 535858 | 536361 | 536865 |
| | 5009 | 5012 | 5015 | 5018 | 5021 | 5024 | 5027 | 5030 | 5033 | 5036 |
| 654.0 | 537369 | 537873 | 538377 | 538882 | 539387 | 539892 | 540397 | 540903 | 541409 | 541916 |
| | 5039 | 5042 | 5045 | 5048 | 5051 | 5054 | 5057 | 5060 | 5063 | 5066 |
| 655.0 | 542423 | 542930 | 543437 | 543945 | 544452 | 544961 | 545469 | 545978 | 546487 | 546997 |
| | 5069 | 5072 | 5075 | 5078 | 5081 | 5084 | 5087 | 5090 | 5093 | 5096 |
| 656.0 | 547506 | 548016 | 548527 | 549037 | 549548 | 550060 | 550571 | 551083 | 551595 | 552108 |
| | 5099 | 5102 | 5105 | 5108 | 5111 | 5114 | 5117 | 5120 | 5123 | 5126 |
| 657.0 | 552620 | 553133 | 553647 | 554160 | 554674 | 555189 | 555703 | 556218 | 556733 | 557249 |
| | 5129 | 5132 | 5135 | 5138 | 5141 | 5144 | 5147 | 5150 | 5153 | 5156 |
| 658.0 | 557765 | 558281 | 558797 | 559314 | 559831 | 560348 | 560866 | 561384 | 561902 | 562420 |
| | 5159 | 5162 | 5165 | 5168 | 5171 | 5174 | 5177 | 5180 | 5184 | 5187 |
| 659.0 | 562939 | 563458 | 563978 | 564497 | 565017 | 565538 | 566058 | 566579 | 567100 | 567622 |
| | 5190 | 5193 | 5196 | 5199 | 5202 | 5205 | 5208 | 5211 | 5214 | 5217 |

DON PEDRO LAKE, TUOLUMNE RIVER, CALIFORNIA - AREA AND CAPACITY TABLE AUG 1970

| ELEV FEET | CAP AREA .0 | CAP AREA .1 | CAP AREA .2 | CAP AREA .3 | CAP AREA .4 | CAP AREA .5 | CAP AREA .6 | CAP AREA .7 | CAP AREA .8 | CAP AREA .9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 660.0 | 568150 | 568673 | 569195 | 569718 | 570241 | 570764 | 571288 | 571812 | 572337 | 572861 |
| | 5220 | 5223 | 5226 | 5229 | 5233 | 5236 | 5239 | 5242 | 5245 | 5248 |
| 661.0 | 573386 | 573912 | 574437 | 574963 | 575489 | 576016 | 576543 | 577070 | 577598 | 578126 |
| | 5252 | 5255 | 5258 | 5261 | 5264 | 5267 | 5271 | 5274 | 5277 | 5280 |
| 662.0 | 578654 | 579182 | 579711 | 580240 | 580770 | 581299 | 581829 | 582360 | 582890 | 583422 |
| | 5283 | 5286 | 5290 | 5293 | 5296 | 5299 | 5302 | 5305 | 5309 | 5312 |
| 663.0 | 583953 | 584485 | 585016 | 585549 | 586081 | 586614 | 587148 | 587681 | 588215 | 588749 |
| | 5315 | 5318 | 5321 | 5325 | 5328 | 5331 | 5334 | 5337 | 5340 | 5344 |
| 664.0 | 589284 | 589819 | 590354 | 590889 | 591425 | 591961 | 592498 | 593034 | 593571 | 594109 |
| | 5347 | 5350 | 5353 | 5356 | 5360 | 5363 | 5366 | 5369 | 5372 | 5376 |
| 665.0 | 594647 | 595185 | 595723 | 596262 | 596801 | 597340 | 597880 | 598420 | 598960 | 599501 |
| | 5379 | 5382 | 5385 | 5388 | 5392 | 5395 | 5398 | 5401 | 5404 | 5408 |
| 666.0 | 600041 | 600583 | 601124 | 601666 | 602208 | 602751 | 603294 | 603837 | 604380 | 604924 |
| | 5411 | 5414 | 5417 | 5420 | 5424 | 5427 | 5430 | 5433 | 5437 | 5440 |
| 667.0 | 605468 | 606013 | 606558 | 607103 | 607648 | 608194 | 608740 | 609286 | 609833 | 610380 |
| | 5443 | 5446 | 5449 | 5453 | 5456 | 5459 | 5462 | 5466 | 5469 | 5472 |
| 668.0 | 610927 | 611475 | 612023 | 612571 | 613120 | 613669 | 614218 | 614768 | 615318 | 615868 |
| | 5475 | 5478 | 5482 | 5485 | 5488 | 5491 | 5495 | 5498 | 5501 | 5504 |
| 669.0 | 616419 | 616970 | 617521 | 618073 | 618624 | 619177 | 619729 | 620282 | 620835 | 621389 |
| | 5508 | 5511 | 5514 | 5517 | 5521 | 5524 | 5527 | 5530 | 5534 | 5537 |
| 670.0 | 621950 | 622497 | 623051 | 623606 | 624161 | 624716 | 625272 | 625828 | 626384 | 626941 |
| | 5540 | 5543 | 5546 | 5549 | 5552 | 5555 | 5558 | 5561 | 5564 | 5567 |
| 671.0 | 627497 | 628055 | 628612 | 629170 | 629728 | 630286 | 630845 | 631403 | 631963 | 632522 |
| | 5570 | 5573 | 5576 | 5579 | 5582 | 5584 | 5587 | 5590 | 5593 | 5596 |
| 672.0 | 633082 | 633642 | 634202 | 634763 | 635324 | 635885 | 636447 | 637009 | 637571 | 638133 |
| | 5599 | 5602 | 5605 | 5608 | 5611 | 5614 | 5617 | 5620 | 5623 | 5626 |
| 673.0 | 638696 | 639259 | 639823 | 640386 | 640950 | 641515 | 642079 | 642644 | 643209 | 643775 |
| | 5629 | 5632 | 5635 | 5638 | 5641 | 5644 | 5647 | 5650 | 5653 | 5656 |
| 674.0 | 644340 | 644906 | 645473 | 646039 | 646606 | 647174 | 647741 | 648309 | 648877 | 649446 |
| | 5659 | 5662 | 5665 | 5668 | 5671 | 5674 | 5677 | 5680 | 5683 | 5686 |
| 675.0 | 650014 | 650583 | 651153 | 651722 | 652292 | 652863 | 653433 | 654004 | 654575 | 655147 |
| | 5689 | 5692 | 5695 | 5698 | 5701 | 5704 | 5707 | 5710 | 5713 | 5716 |
| 676.0 | 655718 | 656290 | 656863 | 657435 | 658008 | 658582 | 659155 | 659729 | 660303 | 660878 |
| | 5719 | 5722 | 5725 | 5728 | 5731 | 5734 | 5737 | 5740 | 5743 | 5746 |
| 677.0 | 661452 | 662028 | 662603 | 663179 | 663755 | 664331 | 664907 | 665484 | 666061 | 666639 |
| | 5749 | 5752 | 5755 | 5758 | 5761 | 5764 | 5767 | 5770 | 5773 | 5776 |
| 678.0 | 667217 | 667795 | 668373 | 668952 | 669531 | 670110 | 670690 | 671270 | 671850 | 672430 |
| | 5779 | 5782 | 5785 | 5788 | 5791 | 5794 | 5798 | 5801 | 5804 | 5807 |
| 679.0 | 673011 | 673592 | 674174 | 674755 | 675338 | 675920 | 676502 | 677085 | 677669 | 678252 |
| | 5810 | 5813 | 5816 | 5819 | 5822 | 5825 | 5828 | 5831 | 5834 | 5837 |

DON PEDRO LAKE, TUOLUMNE RIVER, CALIFORNIA - AREA AND CAPACITY TABLE AUG 1970

| ELEV FEET | CAP AREA .0 | CAP AREA .1 | CAP AREA .2 | CAP AREA .3 | CAP AREA .4 | CAP AREA .5 | CAP AREA .6 | CAP AREA .7 | CAP AREA .8 | CAP AREA .9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 680.0 | 678950 | 679535 | 680120 | 680705 | 681290 | 681875 | 682461 | 683047 | 683634 | 684221 |
| | 5840 | 5843 | 5847 | 5850 | 5853 | 5857 | 5860 | 5863 | 5867 | 5870 |
| 681.0 | 684808 | 685395 | 685983 | 686571 | 687160 | 687749 | 688338 | 688928 | 689517 | 690108 |
| | 5874 | 5877 | 5880 | 5884 | 5887 | 5890 | 5894 | 5897 | 5900 | 5904 |
| 682.0 | 690698 | 691289 | 691880 | 692472 | 693064 | 693656 | 694249 | 694842 | 695435 | 696028 |
| | 5907 | 5911 | 5914 | 5917 | 5921 | 5924 | 5927 | 5931 | 5934 | 5938 |
| 683.0 | 696622 | 697217 | 697811 | 698406 | 699001 | 699597 | 700193 | 700789 | 701386 | 701983 |
| | 5941 | 5944 | 5948 | 5951 | 5955 | 5958 | 5961 | 5965 | 5968 | 5971 |
| 684.0 | 702580 | 703178 | 703776 | 704374 | 704973 | 705572 | 706171 | 706771 | 707371 | 707971 |
| | 5975 | 5978 | 5982 | 5985 | 5988 | 5992 | 5995 | 5999 | 6002 | 6005 |
| 685.0 | 708572 | 709173 | 709774 | 710376 | 710978 | 711581 | 712183 | 712787 | 713390 | 713994 |
| | 6009 | 6012 | 6016 | 6019 | 6022 | 6026 | 6029 | 6033 | 6036 | 6039 |
| 686.0 | 714598 | 715202 | 715807 | 716412 | 717018 | 717624 | 718230 | 718836 | 719443 | 720050 |
| | 6043 | 6046 | 6050 | 6053 | 6056 | 6060 | 6063 | 6067 | 6070 | 6074 |
| 687.0 | 720658 | 721266 | 721874 | 722482 | 723091 | 723701 | 724310 | 724920 | 725530 | 726141 |
| | 6077 | 6080 | 6084 | 6087 | 6091 | 6094 | 6098 | 6101 | 6104 | 6108 |
| 688.0 | 726752 | 727363 | 727975 | 728587 | 729199 | 729812 | 730425 | 731038 | 731652 | 732266 |
| | 6111 | 6115 | 6118 | 6122 | 6125 | 6128 | 6132 | 6135 | 6139 | 6142 |
| 689.0 | 732880 | 733495 | 734110 | 734725 | 735341 | 735957 | 736574 | 737191 | 737808 | 738425 |
| | 6146 | 6149 | 6152 | 6156 | 6159 | 6163 | 6166 | 6170 | 6173 | 6177 |
| 690.0 | 738950 | 739661 | 740280 | 740899 | 741518 | 742137 | 742757 | 743378 | 743998 | 744619 |
| | 6180 | 6183 | 6187 | 6190 | 6194 | 6197 | 6201 | 6204 | 6208 | 6211 |
| 691.0 | 745240 | 745862 | 746484 | 747106 | 747729 | 748352 | 748975 | 749599 | 750223 | 750847 |
| | 6215 | 6218 | 6221 | 6225 | 6228 | 6232 | 6235 | 6239 | 6242 | 6246 |
| 692.0 | 751472 | 752097 | 752723 | 753349 | 753975 | 754601 | 755228 | 755855 | 756483 | 757111 |
| | 6249 | 6253 | 6256 | 6260 | 6263 | 6267 | 6270 | 6274 | 6277 | 6281 |
| 693.0 | 757739 | 758367 | 758996 | 759626 | 760255 | 760885 | 761515 | 762146 | 762777 | 763409 |
| | 6284 | 6287 | 6291 | 6294 | 6298 | 6301 | 6305 | 6308 | 6312 | 6315 |
| 694.0 | 764040 | 764672 | 765305 | 765937 | 766571 | 767204 | 767838 | 768472 | 769106 | 769741 |
| | 6319 | 6322 | 6326 | 6329 | 6333 | 6336 | 6340 | 6343 | 6347 | 6350 |
| 695.0 | 770377 | 771012 | 771648 | 772284 | 772921 | 773558 | 774195 | 774833 | 775471 | 776109 |
| | 6354 | 6357 | 6361 | 6364 | 6368 | 6371 | 6375 | 6378 | 6382 | 6385 |
| 696.0 | 776748 | 777387 | 778026 | 778666 | 779306 | 779947 | 780587 | 781229 | 781870 | 782512 |
| | 6389 | 6392 | 6396 | 6399 | 6403 | 6406 | 6410 | 6413 | 6417 | 6420 |
| 697.0 | 783154 | 783797 | 784440 | 785083 | 785727 | 786371 | 787015 | 787660 | 788305 | 788950 |
| | 6424 | 6428 | 6431 | 6435 | 6438 | 6442 | 6445 | 6449 | 6452 | 6456 |
| 698.0 | 789596 | 790242 | 790888 | 791535 | 792182 | 792830 | 793478 | 794126 | 794775 | 795423 |
| | 6459 | 6463 | 6466 | 6470 | 6473 | 6477 | 6480 | 6484 | 6487 | 6491 |
| 699.0 | 796073 | 796722 | 797372 | 798023 | 798673 | 799324 | 799976 | 800628 | 801280 | 801932 |
| | 6495 | 6498 | 6502 | 6505 | 6509 | 6512 | 6516 | 6519 | 6523 | 6526 |

DON PEDRO LAKE, TUOLUMNE RIVER, CALIFORNIA - AREA AND CAPACITY TABLE AUG 1970

| ELEV FEET | CAP AREA .0 | CAP AREA .1 | CAP AREA .2 | CAP AREA .3 | CAP AREA .4 | CAP AREA .5 | CAP AREA .6 | CAP AREA .7 | CAP AREA .8 | CAP AREA .9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 700.0 | 802500 | 803154 | 803807 | 804461 | 805116 | 805770 | 806425 | 807081 | 807736 | 808392 |
| | 6530 | 6534 | 6537 | 6541 | 6545 | 6548 | 6552 | 6556 | 6559 | 6563 |
| 701.0 | 809049 | 809706 | 810363 | 811021 | 811679 | 812337 | 812995 | 813655 | 814314 | 814974 |
| | 6567 | 6570 | 6574 | 6578 | 6581 | 6585 | 6589 | 6592 | 6596 | 6600 |
| 702.0 | 815634 | 816294 | 816955 | 817616 | 818278 | 818940 | 819602 | 820265 | 820928 | 821592 |
| | 6603 | 6607 | 6611 | 6614 | 6618 | 6622 | 6625 | 6629 | 6633 | 6636 |
| 703.0 | 822255 | 822920 | 823584 | 824249 | 824914 | 825580 | 826246 | 826912 | 827579 | 828246 |
| | 6640 | 6644 | 6647 | 6651 | 6655 | 6658 | 6662 | 6666 | 6669 | 6673 |
| 704.0 | 828914 | 829582 | 830250 | 830918 | 831587 | 832257 | 832926 | 833597 | 834267 | 834938 |
| | 6677 | 6680 | 6684 | 6688 | 6692 | 6695 | 6699 | 6703 | 6706 | 6710 |
| 705.0 | 835609 | 836281 | 836952 | 837625 | 838297 | 838970 | 839644 | 840318 | 840992 | 841666 |
| | 6714 | 6717 | 6721 | 6725 | 6729 | 6732 | 6736 | 6740 | 6743 | 6747 |
| 706.0 | 842341 | 843016 | 843692 | 844368 | 845044 | 845721 | 846398 | 847076 | 847754 | 848432 |
| | 6751 | 6754 | 6758 | 6762 | 6766 | 6769 | 6773 | 6777 | 6780 | 6784 |
| 707.0 | 849111 | 849790 | 850469 | 851149 | 851829 | 852509 | 853190 | 853871 | 854553 | 855235 |
| | 6788 | 6792 | 6795 | 6799 | 6803 | 6807 | 6810 | 6814 | 6818 | 6821 |
| 708.0 | 855917 | 856600 | 857283 | 857966 | 858650 | 859334 | 860019 | 860704 | 861389 | 862075 |
| | 6825 | 6829 | 6833 | 6836 | 6840 | 6844 | 6848 | 6851 | 6855 | 6859 |
| 709.0 | 862761 | 863447 | 864134 | 864821 | 865509 | 866197 | 866885 | 867574 | 868263 | 868952 |
| | 6863 | 6866 | 6870 | 6874 | 6878 | 6881 | 6885 | 6889 | 6893 | 6896 |
| 710.0 | 869700 | 870332 | 871023 | 871714 | 872405 | 873097 | 873789 | 874482 | 875175 | 875868 |
| | 6900 | 6904 | 6908 | 6912 | 6916 | 6920 | 6924 | 6928 | 6932 | 6936 |
| 711.0 | 876562 | 877256 | 877951 | 878646 | 879341 | 880037 | 880733 | 881429 | 882126 | 882824 |
| | 6939 | 6943 | 6947 | 6951 | 6955 | 6959 | 6963 | 6967 | 6971 | 6975 |
| 712.0 | 883521 | 884219 | 884918 | 885617 | 886316 | 887016 | 887716 | 888416 | 889117 | 889819 |
| | 6979 | 6983 | 6987 | 6991 | 6995 | 6999 | 7003 | 7007 | 7011 | 7015 |
| 713.0 | 890520 | 891222 | 891925 | 892628 | 893331 | 894035 | 894739 | 895443 | 896148 | 896853 |
| | 7019 | 7023 | 7027 | 7031 | 7035 | 7039 | 7043 | 7047 | 7051 | 7055 |
| 714.0 | 897559 | 898265 | 898971 | 899678 | 900386 | 901093 | 901801 | 902510 | 903219 | 903928 |
| | 7059 | 7063 | 7067 | 7071 | 7075 | 7079 | 7083 | 7087 | 7091 | 7095 |
| 715.0 | 904638 | 905348 | 906058 | 906769 | 907480 | 908192 | 908904 | 909616 | 910329 | 911042 |
| | 7099 | 7103 | 7107 | 7111 | 7115 | 7119 | 7123 | 7127 | 7131 | 7135 |
| 716.0 | 911756 | 912470 | 913185 | 913900 | 914615 | 915330 | 916047 | 916763 | 917480 | 918197 |
| | 7139 | 7143 | 7147 | 7151 | 7155 | 7159 | 7163 | 7167 | 7171 | 7175 |
| 717.0 | 918915 | 919633 | 920351 | 921070 | 921790 | 922509 | 923229 | 923950 | 924671 | 925392 |
| | 7179 | 7183 | 7187 | 7191 | 7195 | 7199 | 7203 | 7207 | 7211 | 7215 |
| 718.0 | 926114 | 926836 | 927558 | 928281 | 929005 | 929728 | 930453 | 931177 | 931902 | 932627 |
| | 7219 | 7223 | 7227 | 7231 | 7235 | 7239 | 7243 | 7247 | 7251 | 7255 |
| 719.0 | 933353 | 934079 | 934806 | 935533 | 936260 | 936988 | 937716 | 938445 | 939174 | 939903 |
| | 7259 | 7264 | 7268 | 7272 | 7276 | 7280 | 7284 | 7288 | 7292 | 7296 |

DON PEDRO LAKE, TUOLUMNE RIVER, CALIFORNIA - AREA AND CAPACITY TABLE AUG 1970

| ELEV FEET | CAP AREA .0 | CAP AREA .1 | CAP AREA .2 | CAP AREA .3 | CAP AREA .4 | CAP AREA .5 | CAP AREA .6 | CAP AREA .7 | CAP AREA .8 | CAP AREA .9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 720.0 | 940700 | 941431 | 942162 | 942893 | 943624 | 944356 | 945088 | 945821 | 946554 | 947287 |
| | 7300 | 7304 | 7308 | 7312 | 7316 | 7320 | 7324 | 7328 | 7332 | 7336 |
| 721.0 | 948021 | 948756 | 949490 | 950225 | 950961 | 951697 | 952433 | 953170 | 953907 | 954644 |
| | 7341 | 7345 | 7349 | 7353 | 7357 | 7361 | 7365 | 7369 | 7373 | 7377 |
| 722.0 | 955382 | 956120 | 956859 | 957598 | 958338 | 959078 | 959818 | 960559 | 961300 | 962042 |
| | 7381 | 7385 | 7389 | 7393 | 7397 | 7401 | 7406 | 7410 | 7414 | 7418 |
| 723.0 | 962784 | 963526 | 964269 | 965012 | 965756 | 966500 | 967244 | 967989 | 968734 | 969480 |
| | 7422 | 7426 | 7430 | 7434 | 7438 | 7442 | 7446 | 7450 | 7454 | 7459 |
| 724.0 | 970226 | 970972 | 971719 | 972466 | 973214 | 973962 | 974711 | 975460 | 976209 | 976959 |
| | 7463 | 7467 | 7471 | 7475 | 7479 | 7483 | 7487 | 7491 | 7495 | 7500 |
| 725.0 | 977709 | 978459 | 979210 | 979962 | 980714 | 981466 | 982218 | 982971 | 983725 | 984479 |
| | 7504 | 7508 | 7512 | 7516 | 7520 | 7524 | 7528 | 7532 | 7536 | 7541 |
| 726.0 | 985233 | 985988 | 986743 | 987498 | 988254 | 989010 | 989767 | 990524 | 991282 | 992040 |
| | 7545 | 7549 | 7553 | 7557 | 7561 | 7565 | 7569 | 7573 | 7578 | 7582 |
| 727.0 | 992798 | 993557 | 994316 | 995076 | 995836 | 996596 | 997357 | 998118 | 998880 | 999642 |
| | 7586 | 7590 | 7594 | 7598 | 7602 | 7606 | 7611 | 7615 | 7619 | 7623 |
| 728.0 | 1000405 | 1001168 | 1001931 | 1002695 | 1003459 | 1004223 | 1004988 | 1005754 | 1006520 | 1007286 |
| | 7627 | 7631 | 7635 | 7640 | 7644 | 7648 | 7652 | 7656 | 7660 | 7664 |
| 729.0 | 1008052 | 1008820 | 1009587 | 1010355 | 1011123 | 1011892 | 1012661 | 1013431 | 1014201 | 1014971 |
| | 7668 | 7673 | 7677 | 7681 | 7685 | 7689 | 7693 | 7698 | 7702 | 7706 |
| 730.0 | 1015700 | 1016513 | 1017285 | 1018057 | 1018829 | 1019602 | 1020375 | 1021149 | 1021923 | 1022698 |
| | 7710 | 7714 | 7718 | 7722 | 7727 | 7731 | 7735 | 7739 | 7743 | 7747 |
| 731.0 | 1023472 | 1024248 | 1025024 | 1025800 | 1026576 | 1027353 | 1028131 | 1028909 | 1029687 | 1030466 |
| | 7751 | 7756 | 7760 | 7764 | 7768 | 7772 | 7776 | 7781 | 7785 | 7789 |
| 732.0 | 1031245 | 1032024 | 1032804 | 1033585 | 1034365 | 1035147 | 1035928 | 1036710 | 1037493 | 1038275 |
| | 7793 | 7797 | 7801 | 7806 | 7810 | 7814 | 7818 | 7822 | 7826 | 7831 |
| 733.0 | 1039059 | 1039842 | 1040627 | 1041411 | 1042196 | 1042981 | 1043767 | 1044553 | 1045340 | 1046127 |
| | 7835 | 7839 | 7843 | 7847 | 7852 | 7856 | 7860 | 7864 | 7868 | 7872 |
| 734.0 | 1046914 | 1047702 | 1048491 | 1049279 | 1050068 | 1050858 | 1051648 | 1052438 | 1053229 | 1054020 |
| | 7877 | 7881 | 7885 | 7889 | 7893 | 7898 | 7902 | 7906 | 7910 | 7914 |
| 735.0 | 1054812 | 1055604 | 1056397 | 1057190 | 1057983 | 1058777 | 1059571 | 1060365 | 1061160 | 1061956 |
| | 7919 | 7923 | 7927 | 7931 | 7935 | 7940 | 7944 | 7948 | 7952 | 7956 |
| 736.0 | 1062752 | 1063548 | 1064345 | 1065142 | 1065939 | 1066737 | 1067536 | 1068334 | 1069134 | 1069933 |
| | 7961 | 7965 | 7969 | 7973 | 7978 | 7982 | 7986 | 7990 | 7994 | 7999 |
| 737.0 | 1070733 | 1071534 | 1072335 | 1073136 | 1073938 | 1074740 | 1075543 | 1076346 | 1077149 | 1077953 |
| | 8003 | 8007 | 8011 | 8016 | 8020 | 8024 | 8028 | 8032 | 8037 | 8041 |
| 738.0 | 1078757 | 1079562 | 1080367 | 1081173 | 1081979 | 1082785 | 1083592 | 1084399 | 1085207 | 1086015 |
| | 8045 | 8049 | 8054 | 8058 | 8062 | 8066 | 8071 | 8075 | 8079 | 8083 |
| 739.0 | 1086824 | 1087633 | 1088442 | 1089252 | 1090062 | 1090873 | 1091684 | 1092495 | 1093307 | 1094120 |
| | 8087 | 8092 | 8096 | 8100 | 8104 | 8109 | 8113 | 8117 | 8121 | 8126 |

| ELEV FEET | CAP AREA .0 | CAP AREA .1 | CAP AREA .2 | CAP AREA .3 | CAP AREA .4 | CAP AREA .5 | CAP AREA .6 | CAP AREA .7 | CAP AREA .8 | CAP AREA .9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 740.0 | 1094900 | 1095715 | 1096528 | 1097342 | 1098157 | 1098972 | 1099787 | 1100603 | 1101419 | 1102236 |
| | 8130 | 8134 | 8139 | 8143 | 8147 | 8152 | 8156 | 8160 | 8165 | 8169 |
| 741.0 | 1103053 | 1103871 | 1104689 | 1105507 | 1106326 | 1107145 | 1107965 | 1108785 | 1109606 | 1110427 |
| | 8173 | 8178 | 8182 | 8187 | 8191 | 8195 | 8200 | 8204 | 8208 | 8213 |
| 742.0 | 1111248 | 1112070 | 1112893 | 1113716 | 1114539 | 1115362 | 1116187 | 1117011 | 1117836 | 1118662 |
| | 8217 | 8221 | 8226 | 8230 | 8235 | 8239 | 8243 | 8248 | 8252 | 8256 |
| 743.0 | 1119487 | 1120314 | 1121140 | 1121968 | 1122795 | 1123623 | 1124452 | 1125281 | 1126110 | 1126940 |
| | 8261 | 8265 | 8270 | 8274 | 8278 | 8283 | 8287 | 8291 | 8296 | 8300 |
| 744.0 | 1127770 | 1128601 | 1129432 | 1130263 | 1131095 | 1131928 | 1132761 | 1133594 | 1134428 | 1135262 |
| | 8305 | 8309 | 8313 | 8318 | 8322 | 8327 | 8331 | 8335 | 8340 | 8344 |
| 745.0 | 1136097 | 1136932 | 1137767 | 1138603 | 1139440 | 1140276 | 1141114 | 1141951 | 1142790 | 1143628 |
| | 8349 | 8353 | 8357 | 8362 | 8366 | 8371 | 8375 | 8379 | 8384 | 8388 |
| 746.0 | 1144467 | 1145307 | 1146147 | 1146987 | 1147828 | 1148669 | 1149511 | 1150353 | 1151195 | 1152038 |
| | 8393 | 8397 | 8401 | 8406 | 8410 | 8415 | 8419 | 8424 | 8428 | 8432 |
| 747.0 | 1152882 | 1153726 | 1154570 | 1155415 | 1156260 | 1157106 | 1157952 | 1158799 | 1159646 | 1160493 |
| | 8437 | 8441 | 8446 | 8450 | 8454 | 8459 | 8463 | 8468 | 8472 | 8477 |
| 748.0 | 1161341 | 1162189 | 1163038 | 1163887 | 1164737 | 1165587 | 1166438 | 1167288 | 1168140 | 1168992 |
| | 8481 | 8486 | 8490 | 8494 | 8499 | 8503 | 8508 | 8512 | 8517 | 8521 |
| 749.0 | 1169844 | 1170697 | 1171550 | 1172404 | 1173258 | 1174112 | 1174967 | 1175823 | 1176679 | 1177535 |
| | 8525 | 8530 | 8534 | 8539 | 8543 | 8548 | 8552 | 8557 | 8561 | 8566 |
| 750.0 | 1178300 | 1179249 | 1180107 | 1180965 | 1181823 | 1182683 | 1183542 | 1184402 | 1185262 | 1186123 |
| | 8570 | 8575 | 8579 | 8584 | 8588 | 8593 | 8597 | 8602 | 8606 | 8611 |
| 751.0 | 1186985 | 1187846 | 1188709 | 1189571 | 1190434 | 1191298 | 1192162 | 1193027 | 1193892 | 1194757 |
| | 8615 | 8620 | 8625 | 8629 | 8634 | 8638 | 8643 | 8647 | 8652 | 8656 |
| 752.0 | 1195623 | 1196489 | 1197356 | 1198223 | 1199091 | 1199959 | 1200828 | 1201697 | 1202566 | 1203436 |
| | 8661 | 8666 | 8670 | 8675 | 8679 | 8684 | 8688 | 8693 | 8698 | 8702 |
| 753.0 | 1204307 | 1205178 | 1206049 | 1206921 | 1207793 | 1208666 | 1209539 | 1210413 | 1211287 | 1212161 |
| | 8707 | 8711 | 8716 | 8720 | 8725 | 8730 | 8734 | 8739 | 8743 | 8748 |
| 754.0 | 1213036 | 1213912 | 1214788 | 1215664 | 1216541 | 1217418 | 1218296 | 1219174 | 1220053 | 1220932 |
| | 8753 | 8757 | 8762 | 8766 | 8771 | 8776 | 8780 | 8785 | 8789 | 8794 |
| 755.0 | 1221812 | 1222692 | 1223572 | 1224453 | 1225335 | 1226217 | 1227099 | 1227982 | 1228865 | 1229749 |
| | 8798 | 8803 | 8808 | 8812 | 8817 | 8822 | 8826 | 8831 | 8835 | 8840 |
| 756.0 | 1230633 | 1231518 | 1232403 | 1233289 | 1234175 | 1235061 | 1235948 | 1236836 | 1237724 | 1238612 |
| | 8845 | 8849 | 8854 | 8858 | 8863 | 8868 | 8872 | 8877 | 8881 | 8886 |
| 757.0 | 1239501 | 1240390 | 1241280 | 1242170 | 1243061 | 1243952 | 1244844 | 1245736 | 1246628 | 1247521 |
| | 8891 | 8895 | 8900 | 8905 | 8909 | 8914 | 8919 | 8923 | 8928 | 8932 |
| 758.0 | 1248415 | 1249309 | 1250203 | 1251098 | 1251993 | 1252889 | 1253785 | 1254682 | 1255579 | 1256477 |
| | 8937 | 8942 | 8946 | 8951 | 8956 | 8960 | 8965 | 8970 | 8974 | 8979 |
| 759.0 | 1257375 | 1258274 | 1259173 | 1260072 | 1260972 | 1261873 | 1262774 | 1263675 | 1264577 | 1265479 |
| | 8983 | 8988 | 8993 | 8997 | 9002 | 9007 | 9011 | 9016 | 9021 | 9025 |

DON PEDRO LAKE, TUOLUMNE RIVER, CALIFORNIA - AREA AND CAPACITY TABLE AUG 1970

| ELEV FEET | CAP AREA .0 | CAP AREA .1 | CAP AREA .2 | CAP AREA .3 | CAP AREA .4 | CAP AREA .5 | CAP AREA .6 | CAP AREA .7 | CAP AREA .8 | CAP AREA .9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 760.0 | 1266400 | 1267304 | 1268208 | 1269112 | 1270017 | 1270922 | 1271828 | 1272734 | 1273641 | 1274548 |
| | 9030 | 9035 | 9040 | 9045 | 9050 | 9055 | 9060 | 9065 | 9070 | 9074 |
| 761.0 | 1275456 | 1276364 | 1277273 | 1278182 | 1279091 | 1280002 | 1280912 | 1281823 | 1282735 | 1283647 |
| | 9079 | 9084 | 9089 | 9094 | 9099 | 9104 | 9109 | 9114 | 9119 | 9124 |
| 762.0 | 1284560 | 1285473 | 1286387 | 1287301 | 1288215 | 1289131 | 1290046 | 1290962 | 1291879 | 1292796 |
| | 9129 | 9134 | 9139 | 9144 | 9149 | 9154 | 9159 | 9164 | 9169 | 9174 |
| 763.0 | 1293714 | 1294632 | 1295550 | 1296469 | 1297389 | 1298309 | 1299230 | 1300151 | 1301072 | 1301995 |
| | 9179 | 9184 | 9189 | 9194 | 9198 | 9203 | 9208 | 9213 | 9218 | 9223 |
| 764.0 | 1302917 | 1303840 | 1304764 | 1305688 | 1306612 | 1307538 | 1308463 | 1309389 | 1310316 | 1311243 |
| | 9228 | 9233 | 9238 | 9243 | 9248 | 9253 | 9258 | 9263 | 9268 | 9273 |
| 765.0 | 1312170 | 1313099 | 1314027 | 1314956 | 1315886 | 1316816 | 1317746 | 1318678 | 1319609 | 1320541 |
| | 9278 | 9283 | 9288 | 9293 | 9298 | 9303 | 9308 | 9313 | 9318 | 9323 |
| 766.0 | 1321474 | 1322407 | 1323340 | 1324275 | 1325209 | 1326144 | 1327080 | 1328016 | 1328953 | 1329890 |
| | 9328 | 9333 | 9338 | 9343 | 9348 | 9353 | 9358 | 9364 | 9369 | 9374 |
| 767.0 | 1330827 | 1331765 | 1332704 | 1333643 | 1334583 | 1335523 | 1336463 | 1337405 | 1338346 | 1339288 |
| | 9379 | 9384 | 9389 | 9394 | 9399 | 9404 | 9409 | 9414 | 9419 | 9424 |
| 768.0 | 1340231 | 1341174 | 1342118 | 1343062 | 1344007 | 1344952 | 1345897 | 1346844 | 1347790 | 1348737 |
| | 9429 | 9434 | 9439 | 9444 | 9449 | 9454 | 9459 | 9464 | 9469 | 9474 |
| 769.0 | 1349685 | 1350633 | 1351582 | 1352531 | 1353481 | 1354431 | 1355382 | 1356333 | 1357285 | 1358237 |
| | 9479 | 9484 | 9490 | 9495 | 9500 | 9505 | 9510 | 9515 | 9520 | 9525 |
| 770.0 | 1359200 | 1360143 | 1361097 | 1362051 | 1363006 | 1363961 | 1364917 | 1365873 | 1366830 | 1367788 |
| | 9530 | 9535 | 9540 | 9545 | 9551 | 9556 | 9561 | 9566 | 9571 | 9576 |
| 771.0 | 1368746 | 1369704 | 1370663 | 1371622 | 1372582 | 1373543 | 1374504 | 1375465 | 1376427 | 1377390 |
| | 9581 | 9587 | 9592 | 9597 | 9602 | 9607 | 9612 | 9617 | 9623 | 9628 |
| 772.0 | 1378353 | 1379316 | 1380280 | 1381245 | 1382210 | 1383176 | 1384142 | 1385108 | 1386075 | 1387043 |
| | 9633 | 9638 | 9643 | 9648 | 9654 | 9659 | 9664 | 9669 | 9674 | 9679 |
| 773.0 | 1388011 | 1388980 | 1389949 | 1390919 | 1391889 | 1392860 | 1393831 | 1394803 | 1395776 | 1396748 |
| | 9685 | 9690 | 9695 | 9700 | 9705 | 9710 | 9716 | 9721 | 9726 | 9731 |
| 774.0 | 1397722 | 1398696 | 1399670 | 1400645 | 1401620 | 1402596 | 1403573 | 1404550 | 1405527 | 1406506 |
| | 9736 | 9742 | 9747 | 9752 | 9757 | 9762 | 9767 | 9773 | 9778 | 9783 |
| 775.0 | 1407484 | 1408463 | 1409443 | 1410423 | 1411404 | 1412385 | 1413366 | 1414349 | 1415331 | 1416315 |
| | 9788 | 9793 | 9799 | 9804 | 9809 | 9814 | 9819 | 9825 | 9830 | 9835 |
| 776.0 | 1417298 | 1418283 | 1419267 | 1420253 | 1421239 | 1422225 | 1423212 | 1424199 | 1425187 | 1426176 |
| | 9840 | 9846 | 9851 | 9856 | 9861 | 9866 | 9872 | 9877 | 9882 | 9887 |
| 777.0 | 1427165 | 1428154 | 1429144 | 1430135 | 1431126 | 1432118 | 1433110 | 1434102 | 1435096 | 1436089 |
| | 9893 | 9898 | 9903 | 9908 | 9913 | 9919 | 9924 | 9929 | 9934 | 9940 |
| 778.0 | 1437084 | 1438078 | 1439074 | 1440069 | 1441066 | 1442063 | 1443060 | 1444058 | 1445056 | 1446055 |
| | 9945 | 9950 | 9955 | 9961 | 9966 | 9971 | 9976 | 9982 | 9987 | 9992 |
| 779.0 | 1447055 | 1448055 | 1449055 | 1450056 | 1451058 | 1452060 | 1453063 | 1454066 | 1455069 | 1456074 |
| | 9997 | 10003 | 10008 | 10013 | 10018 | 10024 | 10029 | 10034 | 10039 | 10045 |

DON PEDRO LAKE, TUOLUMNE RIVER, CALIFORNIA - AREA AND CAPACITY TABLE AUG 1970

| ELEV FEET | CAP AREA .0 | CAP AREA .1 | CAP AREA .2 | CAP AREA .3 | CAP AREA .4 | CAP AREA .5 | CAP AREA .6 | CAP AREA .7 | CAP AREA .8 | CAP AREA .9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 780.0 | 1457100 | 1458106 | 1459111 | 1460118 | 1461125 | 1462132 | 1463140 | 1464148 | 1465157 | 1466167 |
| | 10050 | 10055 | 10061 | 10066 | 10071 | 10077 | 10082 | 10087 | 10093 | 10098 |
| 781.0 | 1467177 | 1468188 | 1469199 | 1470210 | 1471223 | 1472235 | 1473249 | 1474263 | 1475277 | 1476292 |
| | 10103 | 10109 | 10114 | 10119 | 10125 | 10130 | 10135 | 10141 | 10146 | 10152 |
| 782.0 | 1477307 | 1478323 | 1479340 | 1480357 | 1481374 | 1482392 | 1483411 | 1484430 | 1485450 | 1486470 |
| | 10157 | 10162 | 10168 | 10173 | 10178 | 10184 | 10189 | 10194 | 10200 | 10205 |
| 783.0 | 1487491 | 1488512 | 1489534 | 1490556 | 1491579 | 1492603 | 1493627 | 1494651 | 1495676 | 1496702 |
| | 10211 | 10216 | 10221 | 10227 | 10232 | 10237 | 10243 | 10248 | 10254 | 10259 |
| 784.0 | 1497728 | 1498755 | 1499782 | 1500810 | 1501838 | 1502867 | 1503897 | 1504926 | 1505957 | 1506988 |
| | 10264 | 10270 | 10275 | 10280 | 10286 | 10291 | 10297 | 10302 | 10307 | 10313 |
| 785.0 | 1508020 | 1509052 | 1510084 | 1511117 | 1512151 | 1513185 | 1514220 | 1515256 | 1516291 | 1517328 |
| | 10318 | 10324 | 10329 | 10334 | 10340 | 10345 | 10351 | 10356 | 10361 | 10367 |
| 786.0 | 1518365 | 1519402 | 1520440 | 1521479 | 1522518 | 1523558 | 1524598 | 1525639 | 1526680 | 1527722 |
| | 10372 | 10378 | 10383 | 10389 | 10394 | 10399 | 10405 | 10410 | 10416 | 10421 |
| 787.0 | 1528764 | 1529807 | 1530851 | 1531895 | 1532939 | 1533984 | 1535030 | 1536076 | 1537123 | 1538170 |
| | 10427 | 10432 | 10437 | 10443 | 10448 | 10454 | 10459 | 10465 | 10470 | 10475 |
| 788.0 | 1539218 | 1540266 | 1541315 | 1542365 | 1543415 | 1544465 | 1545516 | 1546568 | 1547620 | 1548673 |
| | 10481 | 10486 | 10492 | 10497 | 10503 | 10508 | 10514 | 10519 | 10524 | 10530 |
| 789.0 | 1549726 | 1550780 | 1551834 | 1552889 | 1553944 | 1555000 | 1556057 | 1557114 | 1558172 | 1559230 |
| | 10535 | 10541 | 10546 | 10552 | 10557 | 10563 | 10568 | 10574 | 10579 | 10585 |
| 790.0 | 1560300 | 1561348 | 1562408 | 1563468 | 1564529 | 1565591 | 1566653 | 1567715 | 1568778 | 1569842 |
| | 10590 | 10596 | 10601 | 10607 | 10612 | 10618 | 10623 | 10629 | 10634 | 10640 |
| 791.0 | 1570906 | 1571971 | 1573036 | 1574102 | 1575169 | 1576236 | 1577303 | 1578372 | 1579440 | 1580510 |
| | 10645 | 10651 | 10656 | 10662 | 10668 | 10673 | 10679 | 10684 | 10690 | 10695 |
| 792.0 | 1581579 | 1582650 | 1583721 | 1584792 | 1585864 | 1586937 | 1588010 | 1589084 | 1590158 | 1591233 |
| | 10701 | 10706 | 10712 | 10718 | 10723 | 10729 | 10734 | 10740 | 10745 | 10751 |
| 793.0 | 1592308 | 1593384 | 1594460 | 1595537 | 1596615 | 1597693 | 1598772 | 1599851 | 1600931 | 1602011 |
| | 10756 | 10762 | 10768 | 10773 | 10779 | 10784 | 10790 | 10796 | 10801 | 10807 |
| 794.0 | 1603092 | 1604174 | 1605256 | 1606339 | 1607422 | 1608506 | 1609590 | 1610675 | 1611760 | 1612846 |
| | 10812 | 10818 | 10823 | 10829 | 10835 | 10840 | 10846 | 10851 | 10857 | 10863 |
| 795.0 | 1613933 | 1615020 | 1616107 | 1617196 | 1618284 | 1619374 | 1620464 | 1621554 | 1622645 | 1623737 |
| | 10868 | 10874 | 10879 | 10885 | 10891 | 10896 | 10902 | 10907 | 10913 | 10919 |
| 796.0 | 1624829 | 1625922 | 1627015 | 1628109 | 1629203 | 1630298 | 1631394 | 1632490 | 1633586 | 1634683 |
| | 10924 | 10930 | 10936 | 10941 | 10947 | 10952 | 10958 | 10964 | 10969 | 10975 |
| 797.0 | 1635781 | 1636880 | 1637978 | 1639078 | 1640178 | 1641278 | 1642380 | 1643481 | 1644584 | 1645686 |
| | 10980 | 10986 | 10992 | 10997 | 11003 | 11009 | 11014 | 11020 | 11026 | 11031 |
| 798.0 | 1646790 | 1647894 | 1648998 | 1650103 | 1651209 | 1652315 | 1653422 | 1654529 | 1655637 | 1656746 |
| | 11037 | 11042 | 11048 | 11054 | 11059 | 11065 | 11071 | 11076 | 11082 | 11088 |
| 799.0 | 1657855 | 1658965 | 1660075 | 1661185 | 1662297 | 1663409 | 1664521 | 1665634 | 1666748 | 1667862 |
| | 11093 | 11099 | 11105 | 11110 | 11116 | 11122 | 11127 | 11133 | 11139 | 11144 |



Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G

DON PEDRO LAKE, TUOLUMNE RIVER, CALIFORNIA - AREA AND CAPACITY TABLE AUG 1970

| ELEV FEET | CAP AREA .0 | CAP AREA .1 | CAP AREA .2 | CAP AREA .3 | CAP AREA .4 | CAP AREA .5 | CAP AREA .6 | CAP AREA .7 | CAP AREA .8 | CAP AREA .9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 800.0 | 1669000 | 1670118 | 1671234 | 1672350 | 1673467 | 1674585 | 1675703 | 1676822 | 1677941 | 1679061 |
| | 11150 | 11156 | 11161 | 11167 | 11173 | 11178 | 11184 | 11189 | 11195 | 11201 |
| 801.0 | 1680181 | 1681302 | 1682423 | 1683545 | 1684668 | 1685791 | 1686915 | 1688039 | 1689164 | 1690290 |
| | 11206 | 11212 | 11218 | 11223 | 11229 | 11235 | 11240 | 11246 | 11252 | 11257 |
| 802.0 | 1691416 | 1692542 | 1693669 | 1694797 | 1695925 | 1697054 | 1698184 | 1699313 | 1700444 | 1701575 |
| | 11263 | 11269 | 11274 | 11280 | 11286 | 11291 | 11297 | 11303 | 11308 | 11314 |
| 803.0 | 1702707 | 1703839 | 1704972 | 1706105 | 1707239 | 1708374 | 1709509 | 1710644 | 1711781 | 1712917 |
| | 11320 | 11325 | 11331 | 11337 | 11342 | 11348 | 11354 | 11359 | 11365 | 11371 |
| 804.0 | 1714055 | 1715193 | 1716331 | 1717470 | 1718610 | 1719750 | 1720891 | 1722032 | 1723174 | 1724316 |
| | 11376 | 11382 | 11388 | 11393 | 11399 | 11405 | 11410 | 11416 | 11422 | 11428 |
| 805.0 | 1725459 | 1726603 | 1727747 | 1728892 | 1730037 | 1731183 | 1732330 | 1733477 | 1734624 | 1735772 |
| | 11433 | 11439 | 11445 | 11450 | 11456 | 11462 | 11467 | 11473 | 11479 | 11485 |
| 806.0 | 1736921 | 1738071 | 1739220 | 1740371 | 1741522 | 1742674 | 1743826 | 1744978 | 1746132 | 1747286 |
| | 11490 | 11496 | 11502 | 11507 | 11513 | 11519 | 11525 | 11530 | 11536 | 11542 |
| 807.0 | 1748440 | 1749595 | 1750751 | 1751907 | 1753064 | 1754221 | 1755379 | 1756537 | 1757696 | 1758856 |
| | 11548 | 11553 | 11559 | 11565 | 11570 | 11576 | 11582 | 11588 | 11593 | 11599 |
| 808.0 | 1760016 | 1761177 | 1762338 | 1763500 | 1764663 | 1765826 | 1766990 | 1768154 | 1769319 | 1770484 |
| | 11605 | 11611 | 11616 | 11622 | 11628 | 11634 | 11639 | 11645 | 11651 | 11657 |
| 809.0 | 1771650 | 1772816 | 1773984 | 1775151 | 1776319 | 1777488 | 1778658 | 1779828 | 1780998 | 1782169 |
| | 11662 | 11668 | 11674 | 11680 | 11685 | 11691 | 11697 | 11703 | 11708 | 11714 |
| 810.0 | 1783300 | 1784513 | 1785686 | 1786860 | 1788034 | 1789209 | 1790384 | 1791560 | 1792736 | 1793913 |
| | 11720 | 11726 | 11732 | 11738 | 11744 | 11750 | 11756 | 11762 | 11768 | 11774 |
| 811.0 | 1795091 | 1796270 | 1797448 | 1798628 | 1799808 | 1800989 | 1802170 | 1803352 | 1804535 | 1805718 |
| | 11780 | 11786 | 11792 | 11798 | 11804 | 11811 | 11817 | 11823 | 11829 | 11835 |
| 812.0 | 1806902 | 1808086 | 1809271 | 1810457 | 1811643 | 1812830 | 1814017 | 1815205 | 1816394 | 1817583 |
| | 11841 | 11847 | 11853 | 11859 | 11865 | 11871 | 11877 | 11883 | 11889 | 11895 |
| 813.0 | 1818773 | 1819963 | 1821154 | 1822346 | 1823538 | 1824731 | 1825925 | 1827119 | 1828313 | 1829509 |
| | 11901 | 11907 | 11914 | 11920 | 11926 | 11932 | 11938 | 11944 | 11950 | 11956 |
| 814.0 | 1830705 | 1831901 | 1833098 | 1834296 | 1835494 | 1836693 | 1837893 | 1839093 | 1840294 | 1841495 |
| | 11962 | 11968 | 11974 | 11980 | 11986 | 11993 | 11999 | 12005 | 12011 | 12017 |
| 815.0 | 1842697 | 1843900 | 1845103 | 1846307 | 1847511 | 1848716 | 1849922 | 1851128 | 1852335 | 1853543 |
| | 12023 | 12029 | 12035 | 12041 | 12047 | 12054 | 12060 | 12066 | 12072 | 12078 |
| 816.0 | 1854751 | 1855959 | 1857169 | 1858379 | 1859589 | 1860800 | 1862012 | 1863225 | 1864438 | 1865651 |
| | 12084 | 12090 | 12096 | 12102 | 12109 | 12115 | 12121 | 12127 | 12133 | 12139 |
| 817.0 | 1866865 | 1868080 | 1869296 | 1870512 | 1871729 | 1872946 | 1874164 | 1875382 | 1876601 | 1877821 |
| | 12145 | 12152 | 12158 | 12164 | 12170 | 12176 | 12182 | 12188 | 12194 | 12201 |
| 818.0 | 1879042 | 1880262 | 1881484 | 1882706 | 1883929 | 1885153 | 1886377 | 1887601 | 1888827 | 1890053 |
| | 12207 | 12213 | 12219 | 12225 | 12231 | 12238 | 12244 | 12250 | 12256 | 12262 |
| 819.0 | 1891279 | 1892506 | 1893734 | 1894962 | 1896191 | 1897421 | 1898651 | 1899882 | 1901113 | 1902345 |
| | 12268 | 12274 | 12281 | 12287 | 12293 | 12299 | 12305 | 12311 | 12318 | 12324 |



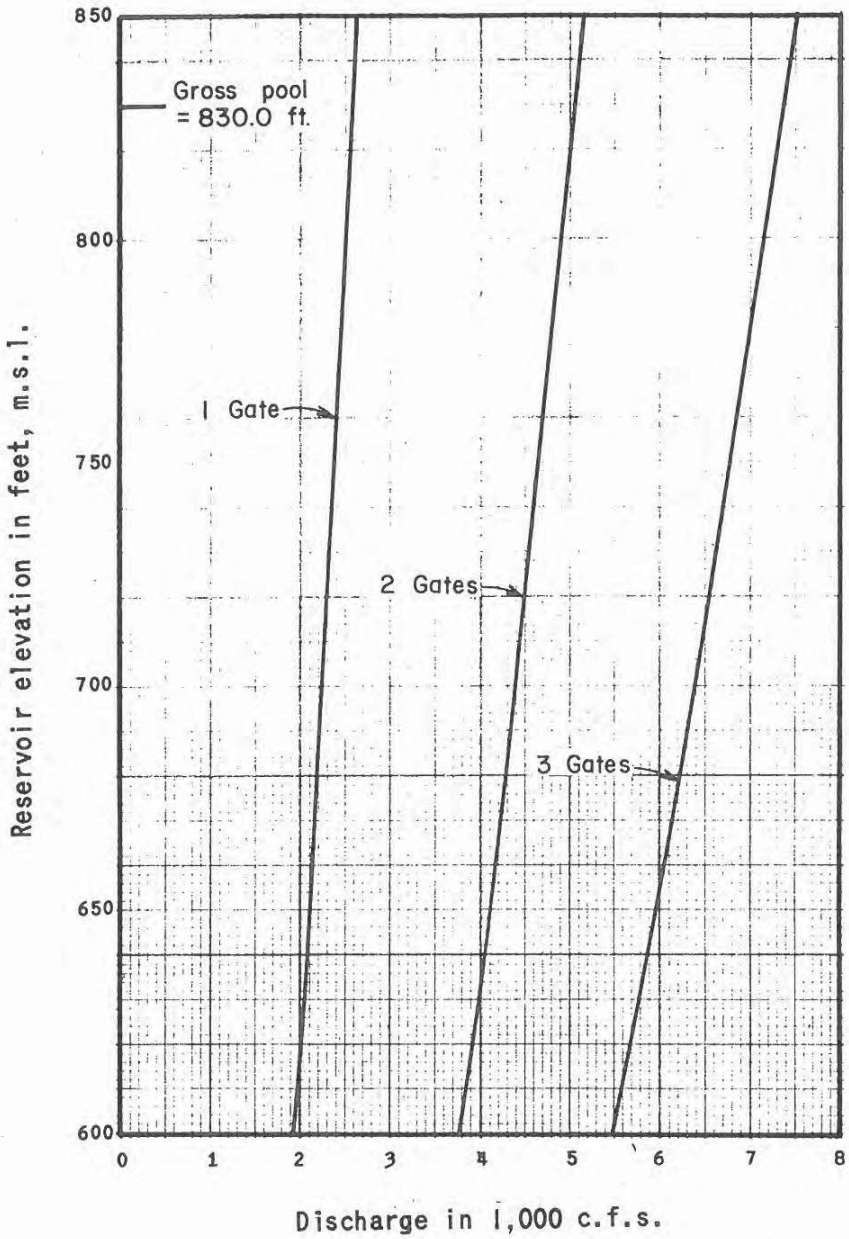
Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G

DON PEDRO LAKE, TUOLUMNE RIVER, CALIFORNIA - AREA AND CAPACITY TABLE AUG 1970

| ELEV FEET | CAP AREA .0 | CAP AREA .1 | CAP AREA .2 | CAP AREA .3 | CAP AREA .4 | CAP AREA .5 | CAP AREA .6 | CAP AREA .7 | CAP AREA .8 | CAP AREA .9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 820.0 | 1903600 | 1904834 | 1906068 | 1907302 | 1908538 | 1909773 | 1911010 | 1912247 | 1913484 | 1914723 |
| | 12330 | 12336 | 12342 | 12349 | 12355 | 12361 | 12367 | 12374 | 12380 | 12386 |
| 821.0 | 1915962 | 1917201 | 1918441 | 1919682 | 1920924 | 1922166 | 1923408 | 1924652 | 1925895 | 1927140 |
| | 12392 | 12399 | 12405 | 12411 | 12417 | 12424 | 12430 | 12436 | 12442 | 12448 |
| 822.0 | 1928385 | 1929631 | 1930877 | 1932124 | 1933372 | 1934620 | 1935869 | 1937119 | 1938369 | 1939620 |
| | 12455 | 12461 | 12467 | 12474 | 12480 | 12486 | 12492 | 12499 | 12505 | 12511 |
| 823.0 | 1940871 | 1942123 | 1943376 | 1944629 | 1945883 | 1947138 | 1948393 | 1949649 | 1950905 | 1952162 |
| | 12517 | 12524 | 12530 | 12536 | 12542 | 12549 | 12555 | 12561 | 12568 | 12574 |
| 824.0 | 1953420 | 1954678 | 1955937 | 1957197 | 1958457 | 1959718 | 1960979 | 1962241 | 1963504 | 1964768 |
| | 12580 | 12586 | 12593 | 12599 | 12605 | 12612 | 12618 | 12624 | 12630 | 12637 |
| 825.0 | 1966032 | 1967296 | 1968561 | 1969827 | 1971094 | 1972361 | 1973629 | 1974897 | 1976166 | 1977436 |
| | 12643 | 12649 | 12656 | 12662 | 12668 | 12675 | 12681 | 12687 | 12693 | 12700 |
| 826.0 | 1978706 | 1979977 | 1981249 | 1982521 | 1983794 | 1985067 | 1986341 | 1987616 | 1988891 | 1990167 |
| | 12706 | 12712 | 12719 | 12725 | 12731 | 12738 | 12744 | 12750 | 12757 | 12763 |
| 827.0 | 1991444 | 1992721 | 1993999 | 1995277 | 1996557 | 1997836 | 1999117 | 2000398 | 2001680 | 2002962 |
| | 12769 | 12776 | 12782 | 12788 | 12795 | 12801 | 12807 | 12814 | 12820 | 12826 |
| 828.0 | 2004245 | 2005528 | 2006813 | 2008098 | 2009383 | 2010669 | 2011956 | 2013243 | 2014531 | 2015820 |
| | 12833 | 12839 | 12845 | 12852 | 12858 | 12864 | 12871 | 12877 | 12884 | 12890 |
| 829.0 | 2017109 | 2018399 | 2019690 | 2020981 | 2022273 | 2023565 | 2024859 | 2026152 | 2027447 | 2028742 |
| | 12896 | 12903 | 12909 | 12915 | 12922 | 12928 | 12934 | 12941 | 12947 | 12954 |
| 830.0 | 2030000 | 2031334 | 2032631 | 2033928 | 2035226 | 2036525 | 2037825 | 2039125 | 2040425 | 2041727 |
| | 12960 | 12966 | 12972 | 12979 | 12985 | 12991 | 12997 | 13004 | 13010 | 13016 |
| 831.0 | 2043029 | 2044331 | 2045634 | 2046938 | 2048243 | 2049548 | 2050853 | 2052160 | 2053466 | 2054774 |
| | 13022 | 13029 | 13035 | 13041 | 13047 | 13054 | 13060 | 13066 | 13072 | 13079 |
| 832.0 | 2056082 | 2057391 | 2058700 | 2060010 | 2061321 | 2062632 | 2063944 | 2065257 | 2066570 | 2067884 |
| | 13085 | 13091 | 13097 | 13104 | 13110 | 13116 | 13122 | 13129 | 13135 | 13141 |
| 833.0 | 2069198 | 2070513 | 2071829 | 2073145 | 2074462 | 2075780 | 2077098 | 2078417 | 2079736 | 2081056 |
| | 13147 | 13154 | 13160 | 13166 | 13173 | 13179 | 13185 | 13191 | 13198 | 13204 |
| 834.0 | 2082377 | 2083698 | 2085020 | 2086343 | 2087666 | 2088990 | 2090315 | 2091640 | 2092965 | 2094292 |
| | 13210 | 13216 | 13223 | 13229 | 13235 | 13242 | 13248 | 13254 | 13261 | 13267 |
| 835.0 | 2095619 | 2096946 | 2098275 | 2099604 | 2100933 | 2102263 | 2103594 | 2104925 | 2106257 | 2107590 |
| | 13273 | 13279 | 13286 | 13292 | 13298 | 13305 | 13311 | 13317 | 13324 | 13330 |
| 836.0 | 2108923 | 2110257 | 2111592 | 2112927 | 2114263 | 2115599 | 2116937 | 2118274 | 2119613 | 2120952 |
| | 13336 | 13343 | 13349 | 13355 | 13361 | 13368 | 13374 | 13380 | 13387 | 13393 |
| 837.0 | 2122291 | 2123631 | 2124972 | 2126314 | 2127656 | 2128999 | 2130342 | 2131686 | 2133031 | 2134376 |
| | 13399 | 13406 | 13412 | 13418 | 13425 | 13431 | 13437 | 13444 | 13450 | 13456 |
| 838.0 | 2135722 | 2137069 | 2138416 | 2139764 | 2141113 | 2142462 | 2143811 | 2145162 | 2146513 | 2147865 |
| | 13463 | 13469 | 13475 | 13482 | 13488 | 13495 | 13501 | 13507 | 13514 | 13520 |
| 839.0 | 2149217 | 2150570 | 2151923 | 2153278 | 2154632 | 2155988 | 2157344 | 2158701 | 2160058 | 2161416 |
| | 13526 | 13533 | 13539 | 13545 | 13552 | 13558 | 13565 | 13571 | 13577 | 13584 |



Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G




NOTES:

Outlet controls: 3 parallel outlets, each with two 4'x5' slide gates in tandem.

Curves based on data furnished by Modesto and Turlock Irrigation Districts.

Revised title 26 May 1971

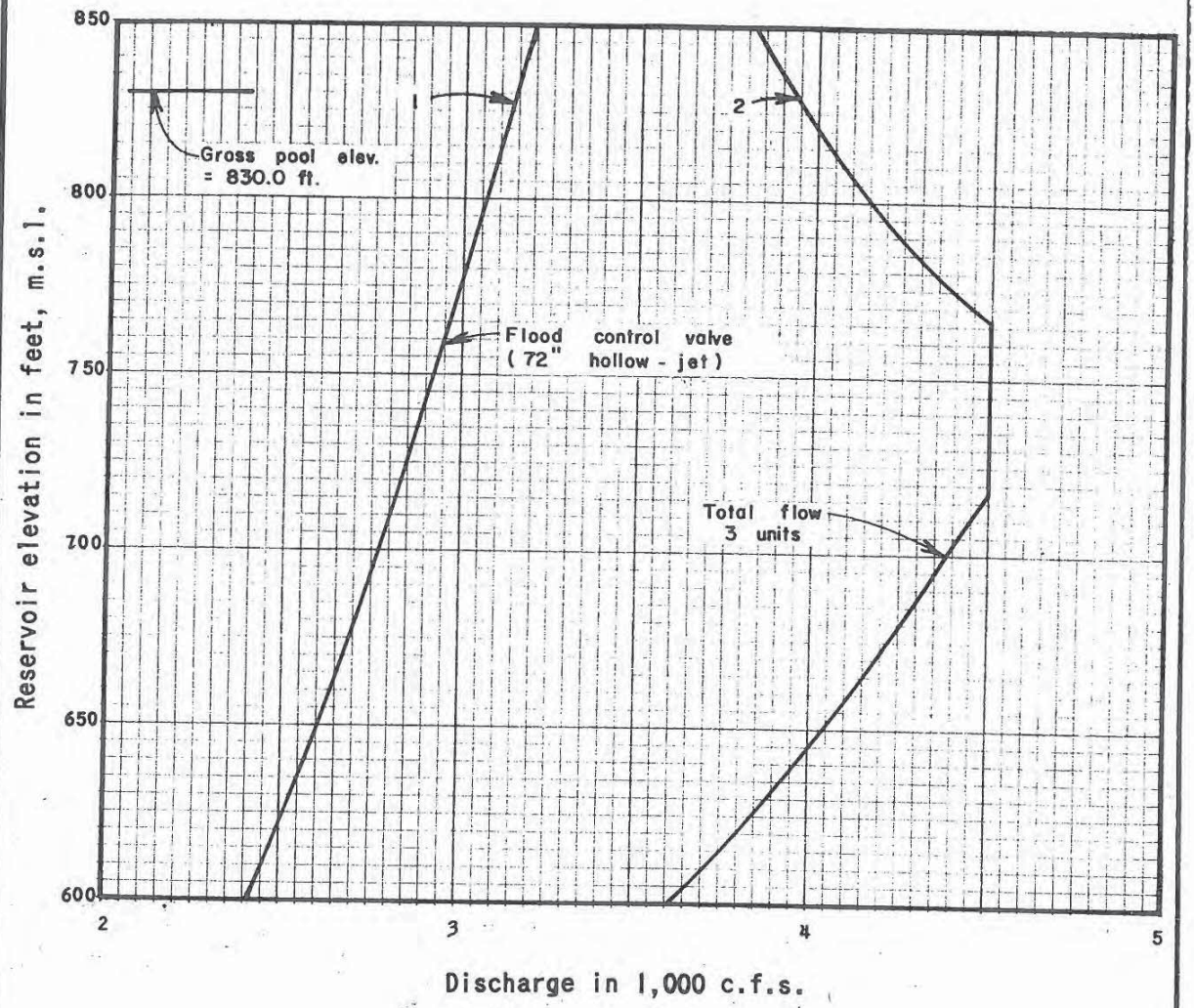
DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

DISCHARGE RATING CURVES
(Through river outlet works)

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: D.D.D.
Drawn: R.E.Y.&S.K.N.
Date: August 1970

CHART A-3




NOTE:

Curves furnished by Modesto and Turlock Irrigation Districts.

LEGEND

1. Discharge through flood control valve, with no releases through the turbines.
2. Total discharge through all 3 units, with no discharge through flood control valve.

Revised title 26 May 1971

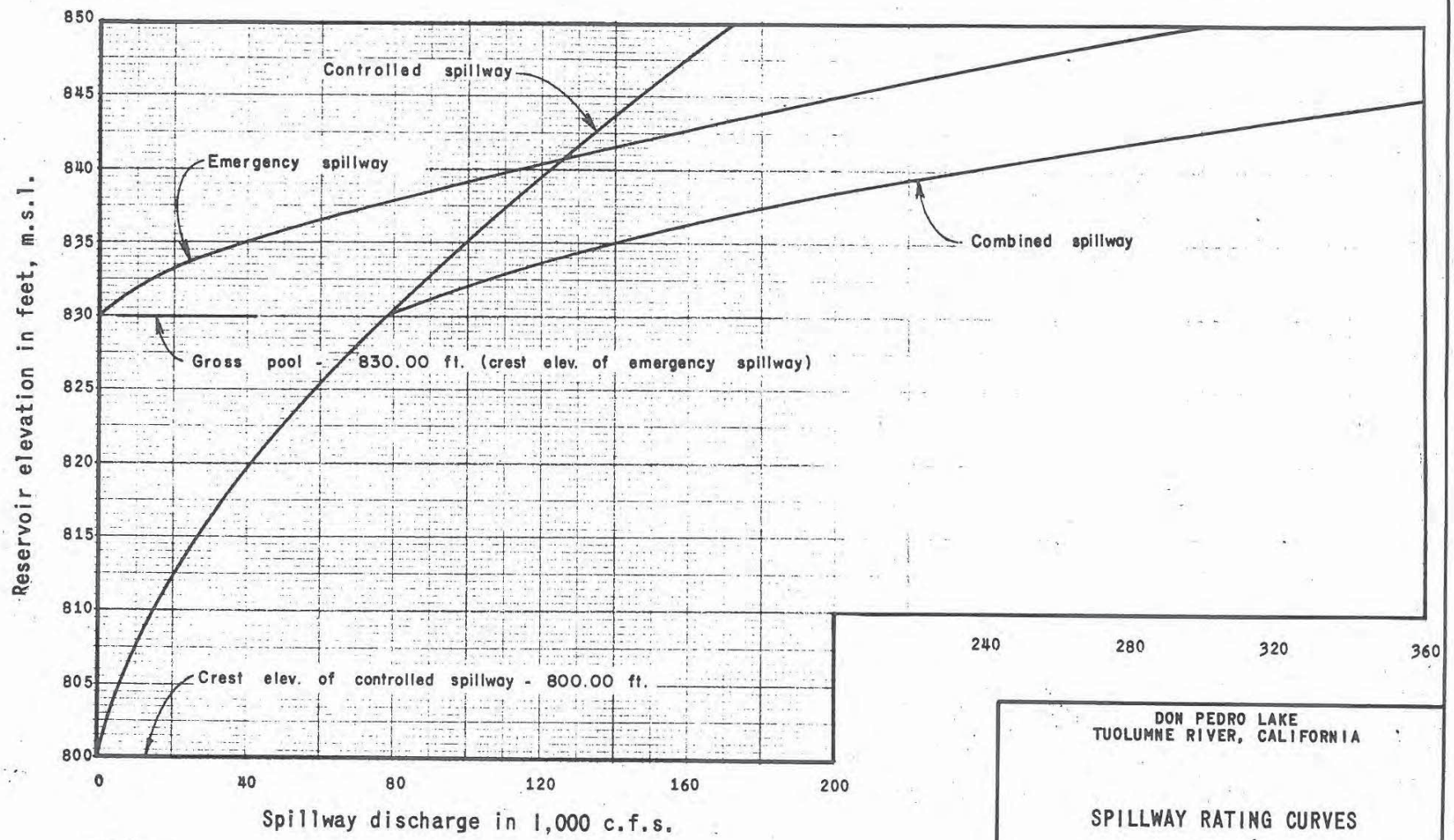
DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

DISCHARGE RATING CURVES
(FLOOD CONTROL VALVE AND TURBINES)

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: D.D.D.
Drawn: R.E.Y. & S.K.N.
Date: August 1970

CHART A-4




NOTES:

1. Controlled spillway - 135.0 ft. (3-45 ft. x 30 ft. radial gates)
2. Curves based on data furnished by Modesto and Turlock Irrigation Districts.

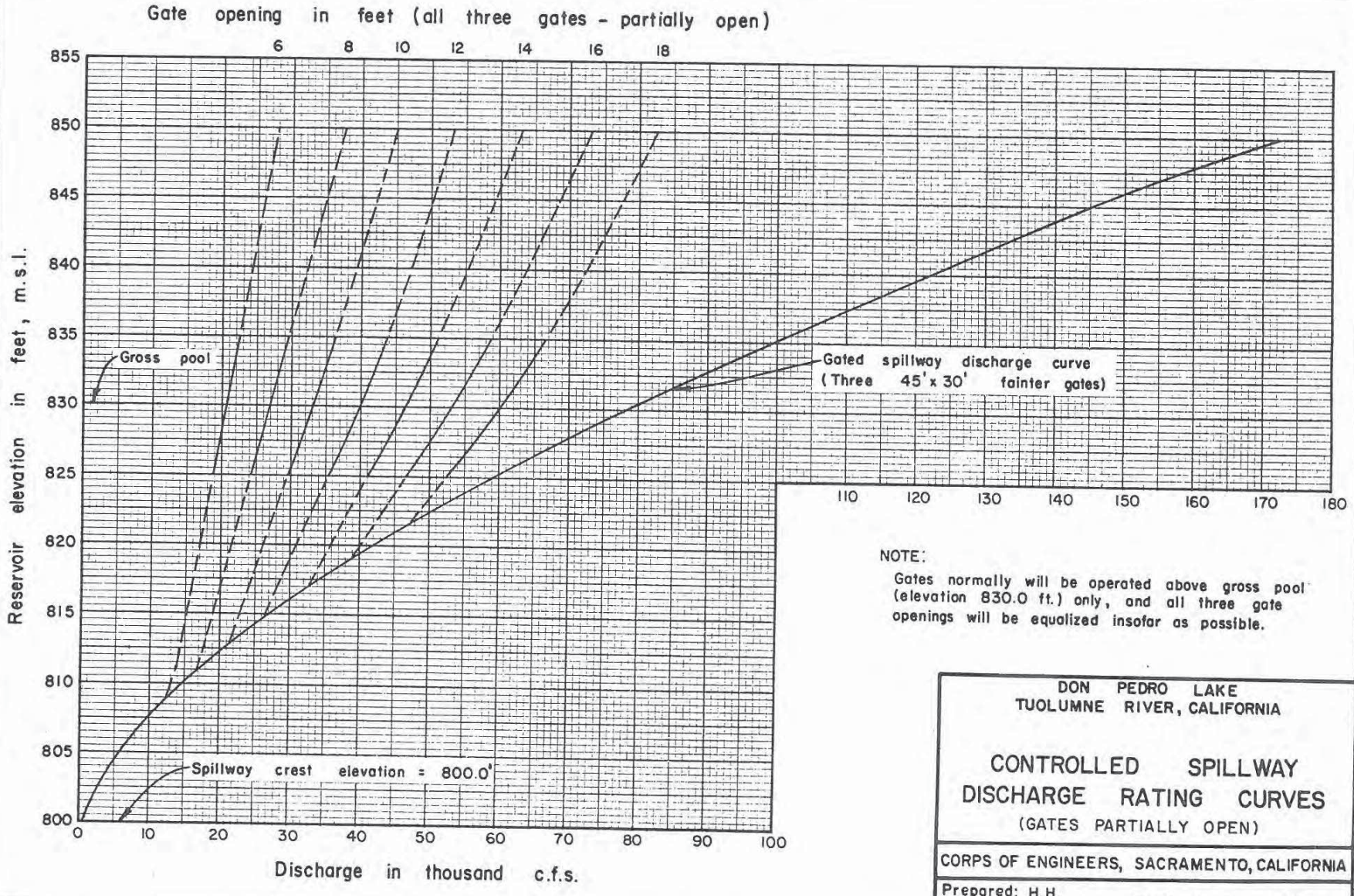
DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

SPILLWAY RATING CURVES
(GATES FULLY OPEN)

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: D.D.D.
Drawn: R.E.Y. & S.K.N.
Date: August 1970

CHART A-5




NOTE:

Gates normally will be operated above gross pool (elevation 830.0 ft.) only, and all three gate openings will be equalized insofar as possible.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

CONTROLLED SPILLWAY DISCHARGE RATING CURVES
(GATES PARTIALLY OPEN)

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: H.H.
Drawn: T.G.K.
Date: APRIL 1972

CHART A-6

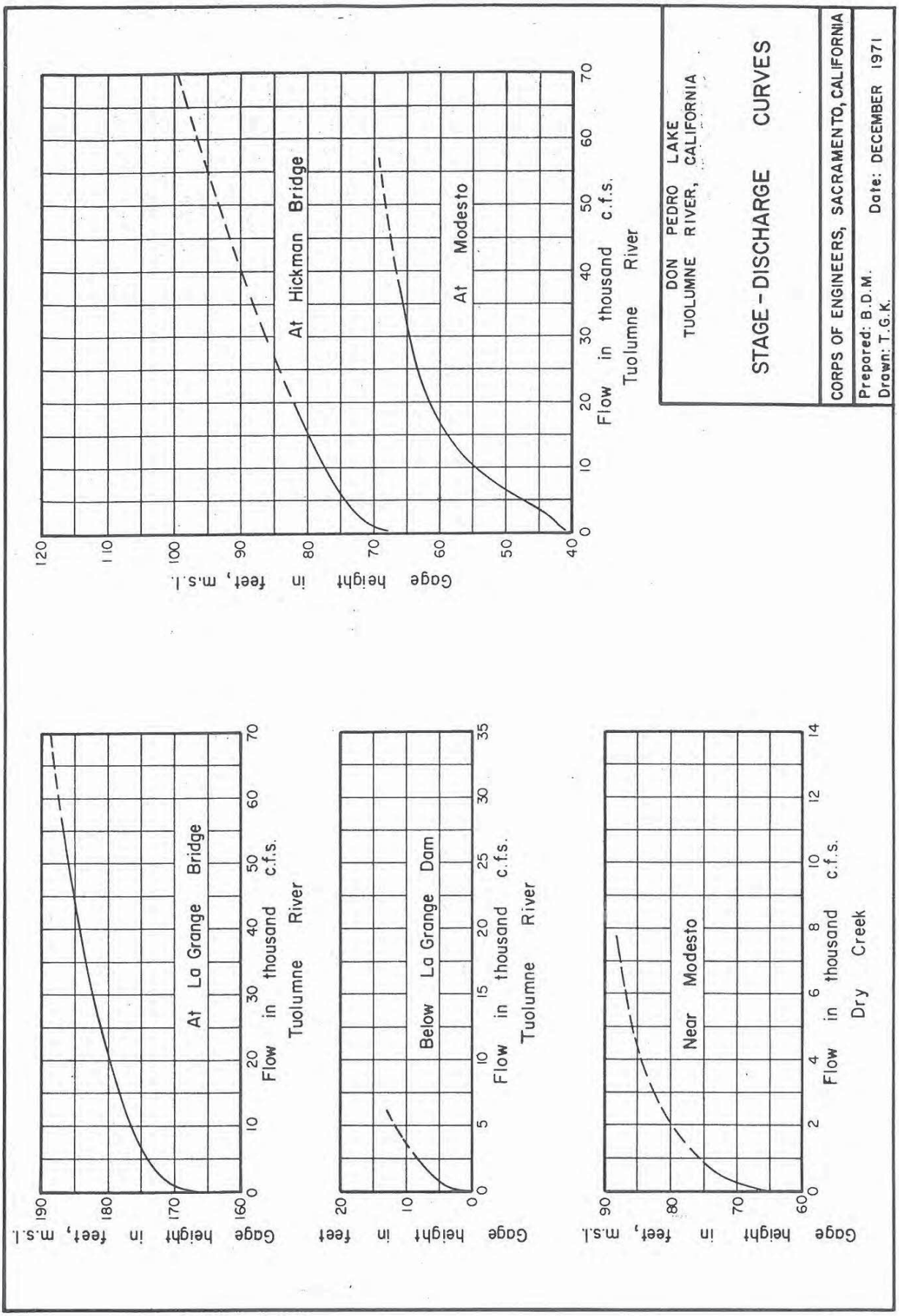
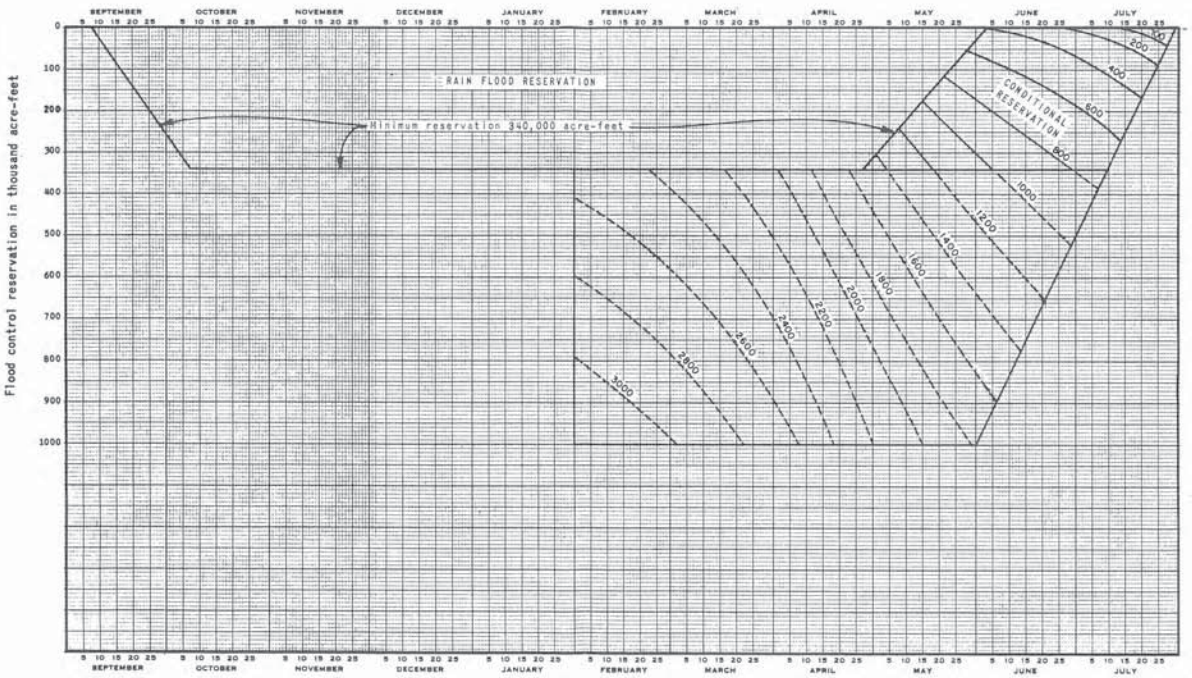

At Hickman Bridge
At Modesto
Gage height in feet, m.s.l.
Flow in thousand c.f.s.
Tuolumne River
At La Grange Bridge
Below La Grange Dam
Near Modesto
Gage height in feet
Dry Creek
DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA
STAGE - DISCHARGE CURVES
CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA
Prepared: B.D.M.
Drawn: T.G.K.
Date: DECEMBER 1971

CHART A




NOTES

1. Don Pedro Lake shall be operated for flood control in accordance with this flood control diagram and the accompanying emergency spillway release diagram. Reservoir releases shall be made in accordance with the diagram requiring greater release.

2. Flood control reservation increases uniformly at a rate of 11,700 acre-feet per day from zero requirement on 8 September to the maximum reservation of 340,000 acre-feet by 7 October. The reservation is maintained at 340,000 acre-feet through 27 April after which, unless additional reservation is indicated by the snowmelt parameters, it will decrease uniformly at a rate of 9,200 acre-feet per day to zero requirement by 3 June.

3. Snowmelt parameter value is the forecasted natural runoff in thousand acre-feet of Tuolumne River inflow to Don Pedro Lake between the given date and 31 July. Dash line parameter extensions below maximum reservation line are used for computation purposes to define gross reservation requirement (before reduction for empty space in upstream reservoirs.)

4. The flood control reservation in Don Pedro Lake determined from snowmelt parameters may be decreased by 80 percent of the available empty space in each of Hetch Hetchy and Cherry Valley Reservoirs, respectively, but no reduction will be permitted below 50,000 acre-feet or the rain flood reservation value, and not more than 70% of the creditable portion of the requirement may be allowed for empty space in Hetch Hetchy Reservoir nor more than 30% for empty space in Cherry Valley Reservoir.

5. When space available for flood control is less than that indicated by the diagram (after allowing credit for empty space in upstream reservoirs), water shall be released as rapidly as possible without causing flows in Tuolumne River below Dry Creek to exceed 9,000 c.f.s.

6. Releases shall not be increased more than 2,000 c.f.s. or decreased more than 1,000 c.f.s. in any 2-hour period.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

FLOOD CONTROL DIAGRAM

Prepared Pursuant to Flood Control Regulations for Don Pedro Dam and Lake

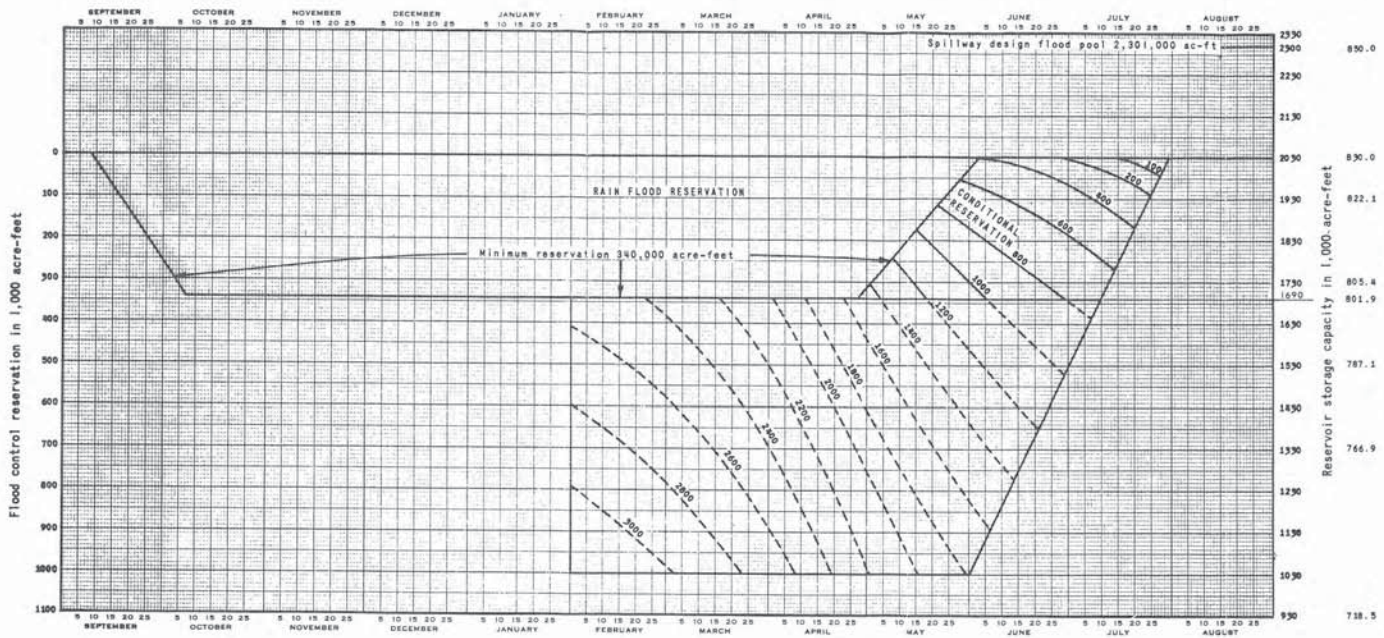
APPROVED: _____
Major General, USA, Director of Civil Works

APPROVED: _____
Chief Engineer, Modesto Irrigation District

APPROVED: _____
Chief Engineer, Turlock Irrigation District

Effective Date: _____ File No: TU-1-19-9

CHART A-8




NOTES

1. Don Pedro Lake shall be operated for flood control in accordance with this Flood Control Diagram and the accompanying Emergency Spillway Release Diagram. Reservoir releases shall be made in accordance with the diagram requiring greater release.

2. Flood control reservation increases uniformly at a rate of 11,700 acre-feet per day from zero requirement on 8 September to the maximum reservation of 340,000 acre-feet by 7 October. The reservation is maintained at 340,000 acre-feet through 27 April after which, unless additional reservation is indicated by the snowmelt parameters, it will decrease uniformly at a rate of 9,200 acre-feet per day to zero requirement by 3 June.

3. Snowmelt parameter value is the forecasted natural runoff in thousand acre-feet of Tuolumne River inflow to Don Pedro Lake between the given date and 31 July. Dash line parameter extensions below maximum reservation line are used for computation purposes to define gross reservation requirement (before reduction for empty space in upstream reservoirs).

4. The flood control reservation in Don Pedro Lake determined from snowmelt parameters may be decreased by 80 percent of the available empty space in each of Hetch Hetchy and Cherry Valley Reservoirs, respectively, but no reduction will be permitted below 50,000 acre-feet or the rain flood reservation value, and not more than 70% of the creditable portion of the requirement may be allowed for empty space in Hetch Hetchy Reservoir nor more than 30% for empty space in Cherry Valley Reservoir.

5. When space available for flood control is less than that indicated by the diagram (after allowing credit for empty space in upstream reservoirs), water shall be released as rapidly as possible without causing flows in Tuolumne River below Dry Creek to exceed 9,000 c.f.s.

6. Releases shall not be increased more than 2,000 c.f.s. or decreased more than 1,000 c.f.s. in any 2-hour period except as required by the Emergency Spillway Release Diagram.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

FLOOD CONTROL DIAGRAM
Prepared Pursuant to Flood Control Regulations for Don Pedro Dam and Lake in accordance with the Code of Federal Regulations Title 33 Part 208.11

APPROVED: _____
Guwen, USA, Division Engineer, South Pacific Division

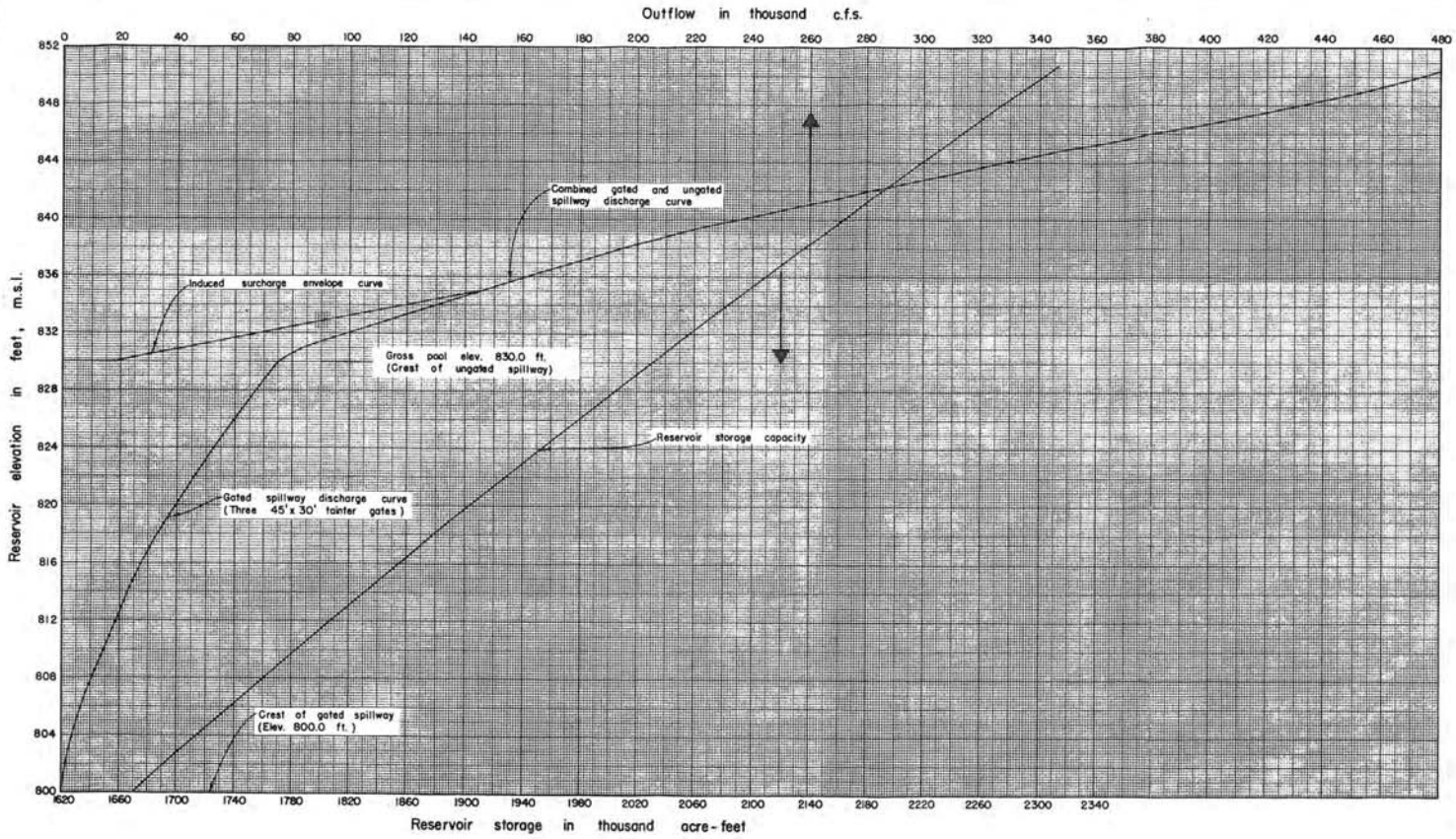
APPROVED: M. N. Bennett
Chief, Administrative Officer, Modesto Irrigation District

APPROVED: _____
Manager, Turlock Irrigation District

Effective Date: 27 JUL 1978 File No. TU-1-19-9

CHART 4-A

Modesto Irrigation District/Turlock Irrigation District
Joint Comments on Draft SED - Appendix G




OPERATING INSTRUCTIONS

1. Follow regular flood control regulation schedule until gross pool elevation 830.0 feet has been reached.

2. Above elevation 830.0 feet, minimum permissible releases are those indicated by the induced surcharge envelope curve. Gate openings (all three gates) shall be adjusted at least once each hour in order for the reservoir elevation to conform with the induced surcharge envelope curve as closely as possible.

3. When the reservoir water surface is dropping, maintain current gate openings until the water surface has reached elevation 830.0 feet (gross pool). Once the pool has dropped below elevation 830.0 feet releases should be reduced each hour by 0.3 of the difference between inflow and outflow until releases are reduced to rates required by the flood control diagram.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

**EMERGENCY SPILLWAY RELEASE DIAGRAM**

Prepared Pursuant to Flood Control Regulations for Don Pedro Dam and Lake

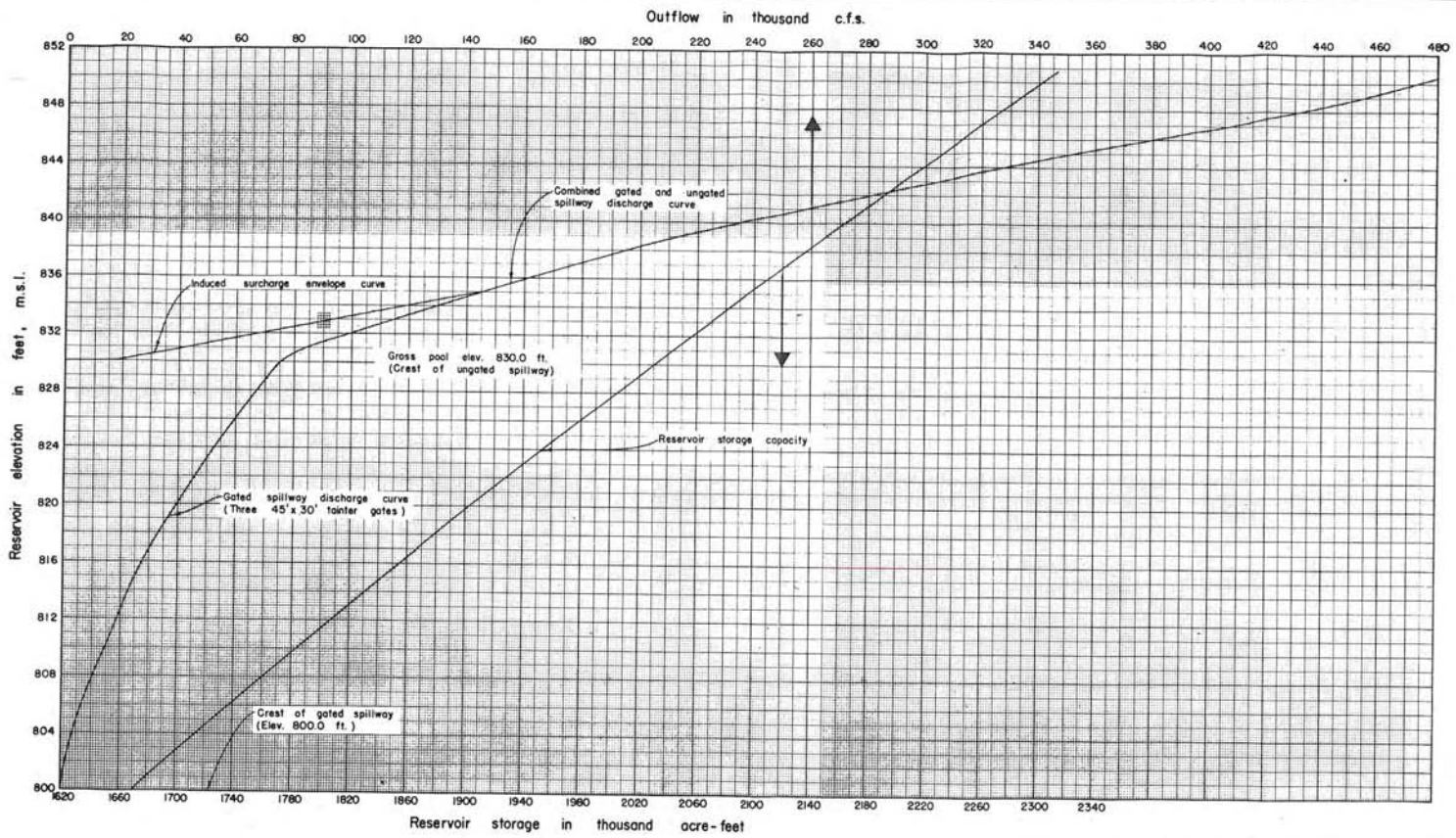
APPROVED: _____
MAJOR GENERAL, USA, DIRECTOR OF CIVIL WORKS

APPROVED: _____
CHIEF ENGINEER, MODESTO IRRIGATION DISTRICT

APPROVED: _____
CHIEF ENGINEER, TURLOCK IRRIGATION DISTRICT

Effective Date: _____ File No: TU-I-13-11

CHART A-9




OPERATING INSTRUCTIONS

1. Follow regular flood control regulation schedule until gross pool elevation 830.0 feet has been reached.

2. Above elevation 830.0 feet, minimum permissible releases are those indicated by the induced surcharge envelope curve. Gate openings (all three gates) shall be adjusted at least once each hour in order for the reservoir elevation to conform with the induced surcharge envelope curve as closely as possible.

3. When the reservoir water surface is dropping, maintain current gate openings until the water surface has reached elevation 830.0 feet (gross pool). Once the pool has dropped below elevation 830.0 feet releases should be reduced each hour by 0.3 of the difference between inflow and outflow until releases are reduced to rates required by the flood control diagram.

DON PEDRO LAKE
TUOLUMNE RIVER, CALIFORNIA

## EMERGENCY SPILLWAY RELEASE DIAGRAM

Prepared Pursuant to Flood Control Regulations for Don Pedro Dam and Lake in accordance with the Code of Federal Regulations Title 33 Part 208.11

APPROVED: William C. Gadsby
Colonel, USA, Division Engineer, South Pacific Division

APPROVED: M. N. Bennett
Chief, Administrative Officer, Modesto Irrigation District

APPROVED: [illegible]
Manager, Turlock Irrigation District

Effective Date 27 JUL 1978 File No. TU-1-13-11

CHART A-2

FIELD WORKING AGREEMENT
BETWEEN
THE MODESTO AND TURLOCK IRRIGATION DISTRICTS
AND
DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS
FOR
FLOOD CONTROL OPERATION
OF
DON PEDRO DAM AND LAKE
ON
TUOLOMNE RIVER, CALIFORNIA

THIS agreement, made and entered into this 11th day of July, 1978, between the Modesto Irrigation District, and the Turlock Irrigation District hereinafter referred to as Irrigation Districts, and the Department of the Army, Corps of Engineers, hereinafter referred to as the Corps of Engineers.

WITNESSETH THAT:

WHEREAS, under the terms of contract number DA-04-167-eng-38 entered into 29 August 1949, and amended by Supplemental Agreement No. 1 dated 12 June 1967, by the United States of America, the Irrigation Districts and the City and County of San Francisco, the Irrigation Districts agreed to provide 340,000 acre-feet of flood space in Don Pedro Lake, and

WHEREAS, the Irrigation Districts, as owners and operators are responsible for the normal operation and structural safety of Don Pedro Dam and Lake, and

WHEREAS, the Department of the Army, acting through the Corps of Engineers, represented by its appropriate District and Division Engineers, is responsible for the flood control operation plan of said dam and lake in accordance with Section 7 of the 1944 Flood Control Act (33 U.S.C. 709) and as promulgated in Code of Federal Regulations, Title 33, Part 208.11, 15 May 1976, and

WHEREAS, there is a need for a working agreement to insure a clear understanding of the flood control regulations and information exchange required.

NOW, THEREFORE, it is mutually understood and agreed by and between the parties hereto that the Don Pedro Dam and Lake will be operated in accordance with the following criteria:

(a) Conservation operations shall be in accordance with the Irrigation Districts criteria.

(b) Storage space in the Don Pedro Dam and Lake Shall be made available on a seasonal basis and operated for flood control in accordance with the Flood Control Diagram currently in force.

(c) Emergency operations shall be in accordance with the procedure set forth on the Emergency Spillway Realease Diagram or procedures currently in force.

(d) The Irrigation Districts are responsible for the safety of the dam and appurtenant facilities and for regulation of the Don Pedro Dam and Lake during surcharge storage utilization. Emphasis upon the safety of the dam is especially important in the event surcharge storage is utilized, which results when the total storage space reserved for flood control is exceeded. Any assistance provided by the Corps of Engineers concerning surcharge regulation is to be utilized at the discretion of the Irrigation Districts, and does not relieve the Irrigation Districts of the responsibility for safety of the Don Pedro Dam and Lake.

(e) Revisions of the Flood Control or Emergency Spillway Release Diagrams and procedures may be developed as necessary by parties of this agreement. Each such revision shall be effective on the date specified.

(f) Except as necessary in order to comply with Emergency Operation procedures, the flood control regulations shall not be construed to require dangerously rapid changes in magnitude of releases. Releases will be made in a manner consistent with requirements for protecting the dam, lake and appurtenances from major damages.

(g) Any water impounded in the flood control space defined by the Flood Control Diagram shall be evacuated as rapidly as can be safely accomplished without causing downstream flows to exceed the controlling rates; i.e., releases from the reservoir shall be restricted insofar as practicable to quantities which, in conjunction with uncontrolled runoff downstream of the dam, will not cause water levels to exceed the controlling stages currently in force. Although conflicts may arise with other purposes, such as hydropower, the plan or regulation may require releases to be completely curtailed in the interest of flood control or safety of the project.

(h) The Irrigation Districts shall procure such current basic hydrologic data and make such current determinations of required flood control space and releases at the reservoir as are required to accomplish the flood control objectives.

(i) The Irrigation Districts shall keep the District Engineer advised of such currently available hydrometeorlogical reservoir operating data as the District Engineer may request. The minimum data required is reservoir storage, inflow, releases and streamflow at control points designated by the Flood Control Diagram on a daily basis.

(j) The flood control regulations are subject to temporary modification by the Corps of Engineers if found necessary in time of emergency. Requests for and action on such modifications may be made by the fastest

means of communication available. The action taken shall be confirmed in writing the same day to the offices of the Irrigation Districts and shall include justification for the action.

(k) The Irrigation Districts may temporarily deviate from the flood control regulations in the event an immediate short-term departure is deemed necessary for emergency reasons to protect the safety of the dam, or to avoid other serious hazards. Such actions shall be immediately reported by the fastest means of communication available. Actions shall be confirmed in writing the same day to the Corps of Engineers and shall include justification for the action. Continuation of the deviation will require the express approval of the Division Engineer.

IN WITNESS WHEREOF, the parties hereto have caused this memorandum of agreement to be executed as the day and date first above written.

CORPS OF ENGINEERS

By: William E. Vandenberg
Division Engineer
South Pacific Division

MODESTO IRRIGATION DISTRICT

By: M. N. Bennett
Chief, Administrative Officer

TURLOCK IRRIGATION DISTRICT

By: Ernest Bell
General Manager