power systems, but, under existing conditions of operation, an average range is from a maximum of about 20 percent above to a minimum of 20 percent below the average monthly use during the year. For hydraulic mining, the period of use during the year varies with conditions of water supply and climate, but may be continuous throughout the year with a comparatively uniform rate of use from month to month if the above conditions permit. In all of the foregoing uses there also are wide variations in the rate of use from day to day during the month and at different hours of the day.

About 1,000,000 acres in the Sacramento and San Joaquin Valleys are irrigated wholly or in part by water pumped from wells, of which there are about 31,000. The estimated total usable capacities of the ground-water reservoirs in the various sections of the Valley are shown in Table 4. Within some of these areas a greater depth of water table loweringthan 50 feet, on the average, would be desirable and probably economically warranted at the end of a long dry period.

TABLE 4

USABLE UNDERGROUND STORAGE CAPACITY

Section	Capacity in Acre-feet		
	Between depth of 10 feet below ground surface and ground water levels of 1929	Between depths of 10 and 50 feet below ground surface	Between depth of 10 feet below ground surface and assumed limit of economic pumping
Upper San Joaquin Valley	9,000,000	14,000,000	20,000,000
Lower San Joaquin Valley	160,000	3,000,000	
Sacramento Valley		3,000,000	
Total		20,000,000	

Navigation. The Sacramento and San Joaquin Rivers form natural waterways which play an important part in the commercial activities of this region. Projects for the maintenance and improvement of navigation on both of these rivers have been approved by congressional enactment. On the Sacramento River from 1,000,000 to nearly 2,000,000 tons have been handled each year for the past 10 years, and on the lower San Joaquin River, nearly 1,000,000 tons. Large investments have been made in terminal facilities utilized by nearly 100 individuals or companies operating freight and passenger vessels.

Improvement of the navigation facilities on the lower sections of the rivers is now in progress. On the San Joaquin River, a ship channel with a depth of 26 feet has been constructed from upper San Francisco Bay to Stockton. From the mouth of the Sacramento River to the city of Sacramento, a navigable depth of 10 feet is being maintained by dredging and other means. Above Sacramento the navigation condition should be improved. In the low-water season of each year, navigation is greatly impaired from Sacramento to the present head of navigation at Chico Landing, a distance of 138 miles. On the San Joaquin River above Stockton, navigation has been practically abandoned.

Power. Hydro plants built on Central Basin streams have a total installed capacity of 1,500,000 kw and supply three-quarters of the electric power used in northern and central California.

METHOD OF DEVELOPMENT

Ultimate Development. The ultimate development of the water resources of the Central Valley Basin will be accomplished by the construction of the 24 surface storage reservoirs listed in table 5 and the seven conveyance units listed in table 6. The storage created by these reservoirs, one of which is located on every major stream in the basin, will insure the maximum practical utilization of the water resources of the area. The storage reservoirs projected for the ultimate plan have a combined capacity of almost 15,000,000 acre-feet, of which 2,700,000 acre-feet are reserved for flood control. Provision will be made for installation of 1,600,000 kva of electrical generating equipment. The water supply of the Central Valley will be augmented by the diversion of almost 800,000 acre-feet of water annually from the Trinity River, which is located in the North Pacific Basin in a region of excessive water resources.

TABLE NO. 5

MAJOR STORAGE UNITS OF ULTIMATE PLAN OF DEVELOPMENT

OF THE WATER RESOURCES OF THE GREAT CENTRAL VALLEY

Reservoir	River	Drainage Area Sq. Mi.	Aver. Annual Runoff Acre Feet	Height of Dam Above Low Water	Reservoir Capacity Acre Feet	Aver. Seasonal Irrigation Yield - Ac.Ft.	Space Reserved for Flood Control - Ac.Ft.	Flood Storage in Inches of Runoff	Installed Power Capacity KVA	Annual Power Yield 1000 KWH	Est. Cost Complete Unit
Sacramento River Basin											
##Shasta	Sacramento	6,649	6,149,000	420	2,940,000	4,340,000	512,000	1.4	325,000	1,373,000	$ 97,200,000
*(Shasta)	(Sacramento)	(6,649)	(6,149,000)	(480)	(4,500,000)	(Not known)	(512,000)	(1.4)	(400,000)	(1,500,000)	(Not known)
Oroville	Feather	3,613	5,201,000	580	1,705,000	2,480,000	521,000	2.7	314,000	1,172,000	147,700,000
Narrows	Yuba	1,108	2,553,000	530	853,000	975,000	272,000	4.6	160,000	528,000	53,000,000
**Camp Far West	Bear	282	402,000	130	151,000	192,000	50,000	3.3	--	--	6,500,000
Folsom	American	1,875	3,049,000	190	355,000)		175,000	3.0	125,000)		19,500,000
Auburn	American	(1) (965)	(1)(1,830,000)	440	831,000)	1,790,000	90,000	(1) --	110,000)	899,000	30,600,000
Coloma	American	(1) (708)	(1)(1,054,000)	345	766,000)		35,000	(1) --	60,000)		18,400,000
Fairview (Trinity River Diversion)		667	(2) 796,000	365	1,436,000	796,000	--	--	193,000	1,064,000	62,000,000
Millsite	Stoney Creek	597	432,000	135	115,000	92,000	--	--	--	--	3,200,000
Capax	Cache Creek	396	762,000	170	378,000	155,000	--	--	--	--	5,500,000
Montecello	Putah Creek	620	420,000	150	130,000	96,000	--	--	--	--	2,600,000
#Total Sacramento Basin		16,407	19,764,000		9,660,000	10,916,000	1,655,000	1.91	1,287,000	5,036,000	$446,200,000
San Joaquin River Basin											
Nashville	Cosumnes	435	290,000	270	281,000	163,000	56,000	2.4	--	--	$ 7,400,000
Ione	Dry Creek	270	(3) 348,000	120	610,000	150,000	121,000	8.4	--	--	8,600,000
#Pardee	Mokelumne	575	820,000	343	222,000	294,000	--	--	18,750	100,000	11,000,000
Valley Springs	Calaveras	363	189,000	200	325,000	98,000	165,000	8.5	--	--	7,600,000
**Melones	Stanislaus	900	1,239,000	460	1,090,000	387,000	204,000	4.3	68,000	240,000	26,200,000
**Don Pedro	Tuolumne	1,536	1,634,000	455	1,000,000	1,303,000	214,000	2.6	120,000	365,000	32,500,000
#Exchequer	Merced	1,034	989,000	307	279,000	728,000	59,000	1.1	31,250	150,000	10,700,000
Buchanan	Chowchilla	238	70,900	147	84,000	53,000	--	--	--	--	2,600,000
Windy Gap	Fresno	102	55,200	206	62,000	45,000	--	--	--	--	3,300,000
##Friant	San Joaquin	1,631	1,993,000	252	(4) 400,000	1,726,000	75,000	0.9	--	--	14,300,000
*(Friant)	(San Joaquin)	(1,631)	(1,993,000)	(277)	(520,000)	(Not known)	(75,000)	(0.9)	--	--	(Not known)
Pine Flat	Kings	1,544	1,389,000	274	400,000	1,764,000	80,000	1.0	40,000	100,000	11,600,000
Pleasant Valley	Tule	264	99,700	125	39,000	128,000	--	--	--	--	2,900,000
Isabella	Kern	2,080	714,000	190	383,000	670,000	67,000	0.6	--	--	5,700,000
#Total San Joaquin Basin		10,972	10,051,500		5,175,000	8,009,000	1,041,000	1.8	288,000	978,000	$144,400,000
#Total Central Valley		27,379	29,915,500		14,835,000	18,925,000	2,696,000	1.86	1,565,000	5,991,000	$590,600,000

* Under Construction in initial plan by Bureau of Reclamation.

** Proposed development floods out existing reservoir of same name.

\# Constructed.

Original State Engineer's plan.

Note: Data given in this table were assembled from reports by the State Engineer of California from 1930 through 1932 and except for the completed projects and projects now under construction, is subject to considerable change as more comprehensive studies are made. Cost estimates include all parts of one complete unit; for instance, the Shasta Unit includes Shasta dam and reservoir, Shasta power plant, Keswick afterbay dam and reservoir, Keswick power plant, and Shasta to Antioch transmission line. Figures in parenthesis are not included in totals.

(1) Amounts in Auburn and Coloma reservoirs are included with those for Folsom.

(2) Amount to be diverted from Trinity River is 796,000 acre-feet per year. The mean annual full natural flow at Fairview Dam Site is 1,201,000 acre-feet.

(3) Includes 280,000 acre-feet spilled from Pardee.

(4) Effective capacity 270,000 acre-feet. (390,000 acre-feet).

TABLE NO. 6

MAJOR CONVEYANCE UNITS - ULTIMATE PLAN

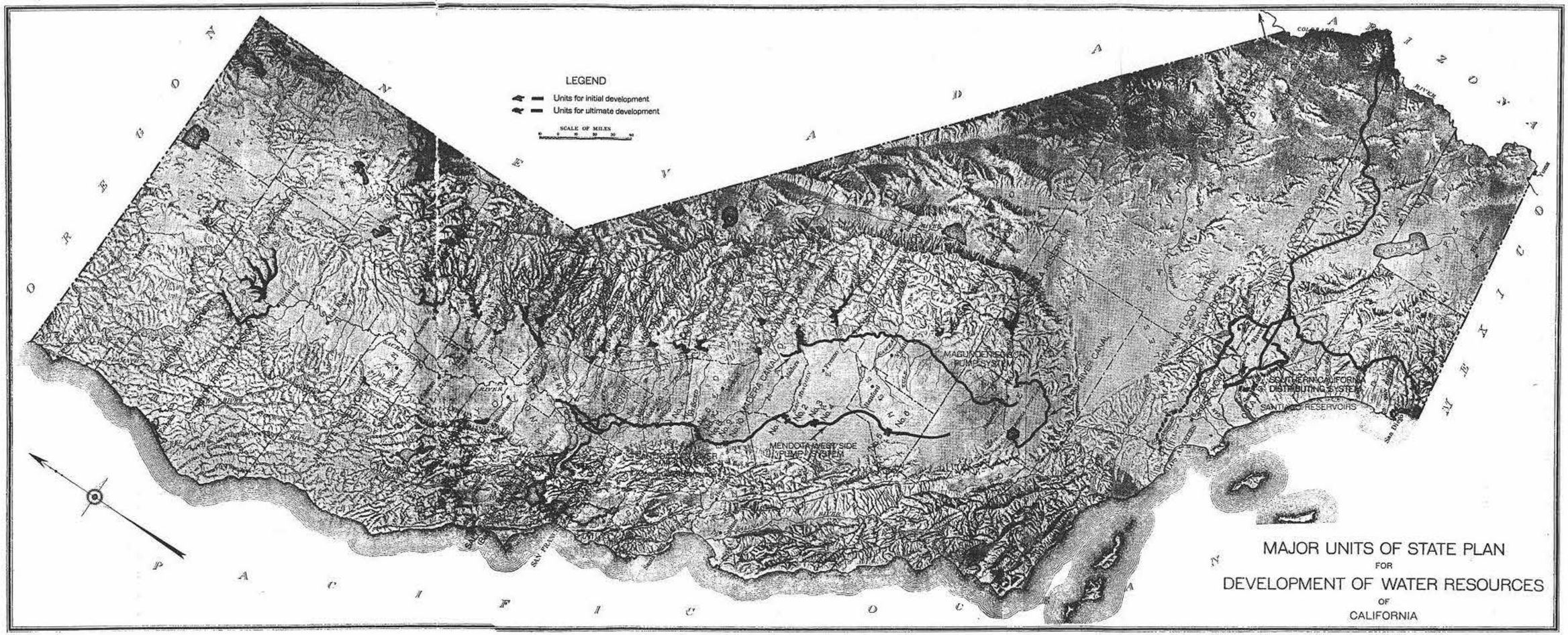
Unit	Maximum Capacity C.F.S.	Length Miles	No. of Pumping Plants	Elevation of Diversion##	Elevation of Terminus##	Maximum Pumping Lift--Ft.	Estimated Cost
**Contra Costa Canal	350	46	4	0	65	136	$ 2,500,000
**Sacramento-San Joaquin Delta Cross Channel	10,000	24	0	3	1	0	4,000,000
**San Joaquin Pumping System	*8,000	107	5	0	159	226	28,500,000
**Madera Canal	1,500	35	0	415	370	0	3,200,000
**Friant-Kern Canal	3,000	157	0	467	358	0	26,000,000
Kern River Canal	1,500	75	0	680	591	0	9,000,000
Mendota West Side Pumping System	4,500	100	6	159	250	150	16,000,000
Totals	28,850	544	15	-	-	512	$89,200,000

* Initial Capacity 3000 C.F.S.
** Under construction in initial plan.
U.S.G.S. Datum.

NOTE: Data in this table were assembled from reports by the State Engineer of California.

EXHIBIT 5

PLATE XXVI



MAJOR UNITS OF STATE PLAN
FOR
DEVELOPMENT OF WATER RESOURCES
OF
CALIFORNIA

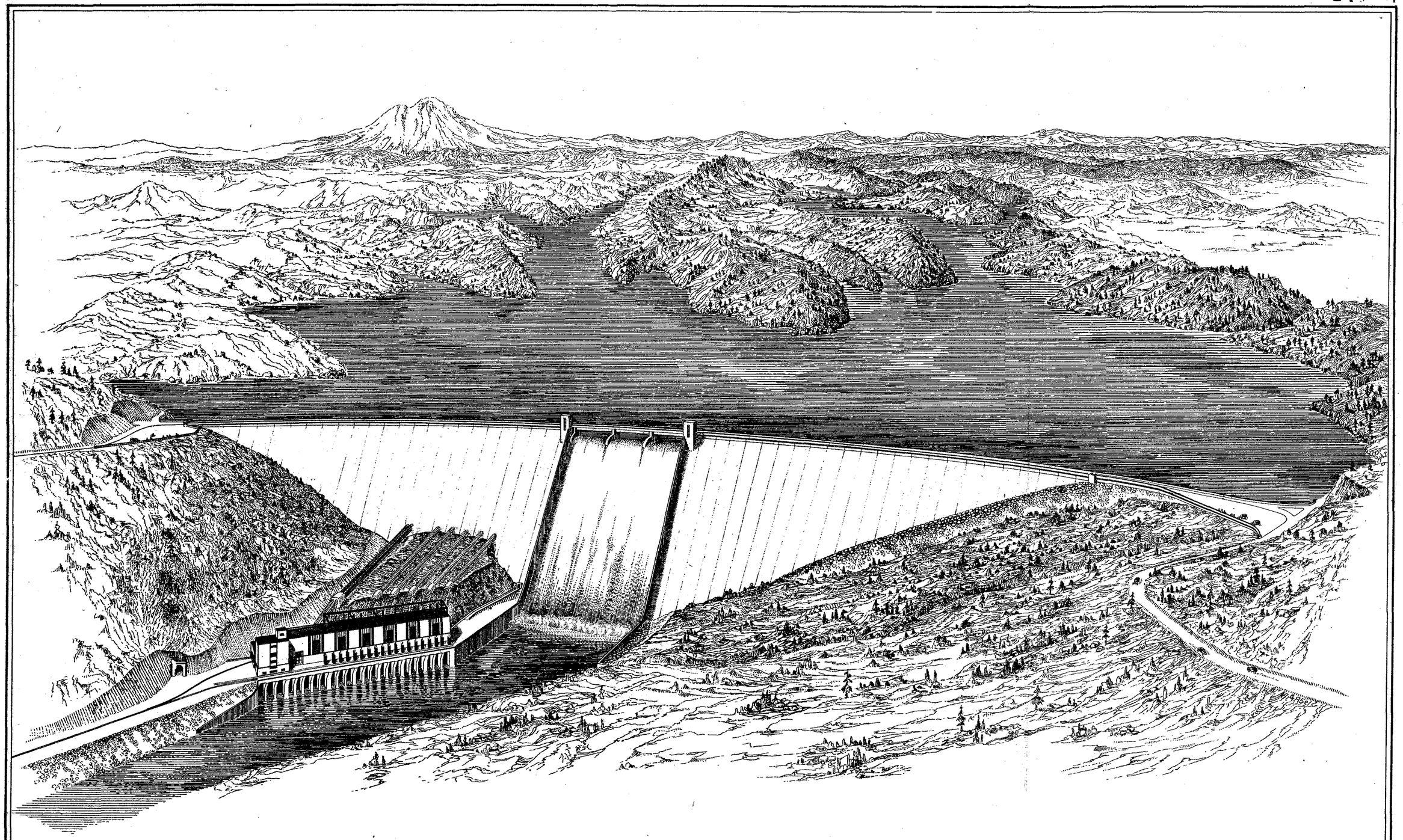
Initial Development. The two most serious problems, which are largely responsible for advancing the immediate program of water conservation and development in the Central Valley are the serious water supply deficiency in the southern section of the San Joaquin Valley and the encroachment of salt water into the upper section of San Francisco Bay and the adjacent delta areas. For the initial stage of construction it is proposed to build the units for which there is the most pressing demand: namely, Shasta and Friant Dams, the Delta Cross Channel, the Contra Costa Canal, the San Joaquin Pumping System, the Kern County Canal, and the Madera Canal. These are also the units of greatest economic value. They will bring no new land under cultivation, but will merely augment and insure the water supply of existing developments. As the population increases and the demand for new land grows, other storage and conveyance units of the ultimate plan will be constructed when they are needed and are economically justified. As new units are built and included in the system, each will tend to augment the benefits of the others. Eventually, when all proposed units are constructed and operated as a system, the ultimate use of the entire water resources of the area will be possible. Actual delivery of water to the land will be by distribution facilities constructed by local interests.

Shasta Dam. This unit is under construction by the Bureau of Reclamation and comprises Shasta Dam, reservoir and power plant, Kesweck afterbay dam, reservoir and power plant, and the Shasta transmission line, including a substation at Antioch. Shasta Dam is located on the Sacramento River near Redding, about 250 miles upstream from Sacramento. It will be a gravity concrete structure curved slightly in plan and rising 480 feet above low tail water and 560 feet above the low point of the foundation. It will be 480 feet thick at the base and 3500 feet long at the crest and contains 5,600,000 cu yd of concrete. The reservoir will store 4,500,000 acre-feet of water and flood 30,000 acres of land. Shasta power plant, located at the foot of the dam, will have an initial installation of five units, each having a capacity of 70,000 kva, or a total of 350,000 kva. Kesweck afterbay dam, located about nine miles downstream from Shasta Dam, will re-regulate to a uniform flow the irregular discharges from Shasta power plant. It will be a concrete gravity dam 95 feet high, with provision for future installation of 50,000 kva of power.

The original State Engineer's plan contemplated a dam on this site having a height of 420 feet above low tail water and a reservoir having a capacity of 2,940,000 acre-feet. It was planned to install 325,000 kva power capacity.

Friant Dam. This unit is now under construction by the Bureau of Reclamation and will consist of the dam, reservoir, and irrigation outlets. Friant Dam is located on the San Joaquin River near Friant, about 240 miles upstream from the confluence of the Sacramento and the San Joaquin Rivers. It will be a gravity concrete structure 210 feet thick at the base, 3400 feet long at the crest, rising 277 feet above low tail water, and containing 1,800,000 cu yd of concrete. The reservoir will

EXHIBIT 6



THE SHASTA DAM AND POWER PLANT

214-D-1309

have a capacity of 520,000 acre-feet, of which 390,000 acre-feet will be above the outlet of the Friant-Kern Canal. The reservoir will flood 4500 acres of land. No provision will be made for the generation of power.

The original State Engineer's plan contemplated a dam on this site having a height of 252 feet above low tail water and a reservoir having a capacity of 400,000 acre-feet.

Contra Costa County Canal. This concrete-lined canal, 46 miles long, begins at a point about four miles east of Oakley. It will have a capacity of 350 cfs at the diversion point and within the first three miles will have four pumping plants which will lift the water from sea level to a point about 125 feet above sea level. The water will then flow by gravity in a westerly direction, the canal passing near the towns of Antioch, Pittsburg, Fort Chicago, Concord, Walnut Creek, and terminating in a reservoir near Martinez. The Contra Costa Canal is designed to relieve the effects of salt water intrusion in a highly developed area of the Upper San Francisco Bay region and adjacent delta areas, and water will be delivered to municipalities, industries, and agricultural lands.

Sacramento-San Joaquin Delta Cross Channel. The Delta Cross Channel connects the Sacramento and the San Joaquin Rivers and will be used to deliver Sacramento River waters to the San Joaquin Pumping System. The water will either be pumped, or diverted by means of a dam, into a dredged channel which will follow natural drainage into one of the branches of the Mokelumne River, and thence down this improved channel to the San Joaquin River to a point near the Mossdale Bridge, where the San Joaquin Pumping System begins.

San Joaquin Pumping System. Original plans to pump the water up the San Joaquin River by creating a series of pools in the river with low collapsible dams and lift plants at each pool have been abandoned. More detailed studies disclosed that the quantity of soluble salts would be so greatly increased by this method as to impair the water's usefulness. For this reason, an alternative high line location on the west side of the Valley was adopted. The canal begins at a point near Mossdale Bridge at sea level, and the water is lifted by a series of pumping plants to a point about 198 feet above sea level, whence it flows by gravity a distance of 99 miles southeasterly to the existing Mendota Pond which is 160 feet above sea level, the diversion point for a number of existing canals.

Friant-Kern Canal. This canal, 157 miles long, will divert water southerly from Friant Reservoir to irrigated and producing lands in Fresno, Tulare, Kings and Kern Counties, now suffering from a lack of adequate water supplies. It will be, for the most part, a concrete-lined canal having a maximum capacity of 3000 second-feet. An auxiliary pumping system will serve a small developed area east of the canal, too high to be served by gravity. During the portion of the year when irrigation water is not in demand, this canal will be used to replenish the supply of underground storage basins.

OREGON

NEVADA

ARIZONA

MEXICO

PACIFIC OCEAN

Crescent City

Klamath River

Klamath River

Trinity River

Eel River

Eureka

Ukiah

Russian River

Santa Rosa

San Rafael

Martinez

Antioch

SAN FRANCISCO

OAKLAND

San Jose

Santa Cruz

Monterey

Salinas

San Luis Obispo

Santa Maria River

Sisquoc River

Santa Ynez River

Santa Barbara

Ventura

Los Angeles

Mt. Shasta

Dunsmuir

McCloud River

Pit River

Redding

Relocated Railroad

POWER PLANT

Red Bluff

Stony Creek

Willows

Colusa

Clear Lake

Cache Creek

Putah Creek

Davis

Woodland

Knights Landing

Oroville

Feather River

Yuba River

Marysville

Bear River

American River

SACRAMENTO

Cosumnes River

Mokelumne River

Calaveras

STOCKTON

Stanislaus River

Tuolumne River

Modesto

Turlock

Merced River

Merced

Hills Ferry

San Joaquin River

Chowchilla River

Fresno River

Madera

Mendota

FRESNO

Kings River

Kaweah River

Hanford

Visalia

Tulare

Tulare Lake Basin

Tule River

Porterville

Kern River

BAKERSFIELD

Mono Lake

Lake Tahoe

Goose Lake

Upper Lake

Eagle Lake

Honey Lake

Lake Almanor

MT. WHITNEY

Owens Lake

S.P.R.R.

W.P.R.R.

N.W.P.R.R.

C.W.&P.N.Co.

A.T.&S.F.R.R.

McCLOUD R.R.

SHASTA RESERVOIR
will be operated to reduce flood flows and to furnish water for irrigation, the restoration of navigation, the control of salinity in the delta, and to generate electric energy.

SACRAMENTO RIVER
Will convey water from Shasta Reservoir for all uses and will have navigable depths restored to Red Bluff

KENNETT TRANSMISSION LINE
Will convey electric energy from Shasta Dam unit to load center

Areas under irrigation which will receive Sacramento River water

Fresh water maintained in all river and delta channels to lower end of delta

DELTA CROSS CHANNEL
Will convey Sacramento River water across head of delta for irrigation use in delta, for salinity control, and for supplies to Contra Costa Conduit and San Joaquin Pumping System.

CONTRA COSTA CONDUIT
Will convey fresh water supplies maintained by Shasta Reservoir to the cities, industries and agricultural lands along Suisun Bay.

SAN JOAQUIN PUMPING SYSTEM
Will convey surplus water and water made available by Shasta Reservoir to lower San Joaquin Valley irrigated lands where exchanges will be made for present San Joaquin River supplies which will be stored in and diverted at Friant Reservoir.

Irrigated lands to be furnished a substitutional water supply by San Joaquin Pumping System

Irrigated lands to be furnished a supplemental water supply from San Joaquin River

Irrigated lands presently supplied by pumping from lower San Joaquin River

MADERA CANAL
will convey supplemental water supply to lands in Madera County

FRIANT RESERVOIR
Will be operated to store San Joaquin River water for diversion into the Friant - Kern and Madera Canals

FRIANT-KERN CANAL
Will convey supplemental water supply to irrigated lands in Fresno, Kings, Tulare and Kern Counties

LEGEND

- Pumping plants
- Sacramento River Water
- San Joaquin River Water
- Direction of flow
- Boundary of Central Valley drainage basin
- Transmission Line

LOCATION MAP

OREGON
NEVADA
PACIFIC OCEAN
CENTRAL VALLEY
SAN FRANCISCO
Sacramento
Stockton
Bakersfield
LOS ANGELES
MEXICO

WATER PROJECT AUTHORITY
OF THE
STATE OF CALIFORNIA

CENTRAL VALLEY PROJECT
OF
CALIFORNIA

Scale of Miles

1939

Madera Canal. The Madera Canal will divert water northerly from Friant Reservoir and deliver it by gravity to irrigated and producing lands in Madera County which now have a deficient water supply. The canal will be concrete-lined, have a maximum capacity of 1500 second-feet, and will extend from Friant Dam to the Chowchilla River, a distance of 35 miles. During the portion of the year when irrigation water is not in demand, this canal will be used to replenish the supply of underground basins.

OPERATION

Ultimate Plan. The amount of water estimated to be available for storage and regulation was obtained by deducting from the total natural run-off of the streams entering the Valley an estimated net allowance of 2,283,000 acre-feet per season to ultimately supply 1,439,000 acres of irrigable mountain valley and foothill lands lying at elevations too high to be irrigated by gravity from the major reservoirs. An allowance of 448,000 acre-feet per year was also deducted from the Tuolumne River flow to supply the City of San Francisco, while 224,000 acre-feet per year was deducted from the East Bay region from water regulated in Pardee Reservoir on the Mokelumne River.

Reservoir storage space for controlling floods will be provided in the reservoirs listed in table 7. The amount of this space and the regulated flow to which floods on each stream will be controlled also are shown.

Stored water will be drawn from the major surface reservoirs and underground basins in such amounts and at such times as to supplement unregulated flows and return waters to:

(a) Provide 9,033,000 acre-feet per season, gross allowance without deficiency, for irrigation of 2,640,000 acres of irrigable lands of all classes[1] in the Sacramento Valley floor.

(b) Provide 1,200,000 acre-feet per season, without deficiency, for irrigation of 392,000 acres in the Sacramento-San Joaquin delta.

(c) Improve navigation on the Sacramento River to Red Bluff.

---

1. Class 1 lands are defined as lands where the texture of soil, alkali, or topography do not limit the crop yield or the feasibility of irrigation. Class 2 lands are lands of medium ability to carry costs for irrigation water. Class 3 lands are those which do not at present justify irrigation with regulated water supplies, but which may eventually come into Class 2 through improvements. Class 4 lands are those suitable only for pasture. Class 5 lands can be considered permanently non-irrigable by any reasonable standards.

TABLE NO. 7

RESERVOIR SPACE REQUIRED FOR CONTROLLING

WINTER FLOODS TO CERTAIN SPECIFIED FLOWS*

ULTIMATE PLAN

Reservoir	Stream	Point of Control	Maximum Reservoir Space Req'd.	Controlled Flow in Sec. Ft.	Number of Times Controlled Flow Would Be Exceeded - Average
Shasta	Sacramento	Red Bluff	512,000	(2) 125,000	Once in 14 years
Oroville	Feather	Oroville	521,000	100,000	" " 100 "
Narrows	Yuba	Smartsville	272,000	70,000	" " 100 "
Camp Far West	Bear	Wheatland	50,000	20,000	" " 100 "
Folsom, Auburn, & Coloma	American	Fairoaks	300,000	(3) 80,000	" " 250 "
Nashville	Cosumnes	Michigan Bar	56,000	15,000	" " 100 "
Ione	Dry Creek	Galt	(1) 121,000	5,000	" " 100 "
Pardee	Mokelumne	Clements	(1) 0	10,000	" " 100 "
Valley Springs	Calaveras	Jenny Lind	165,000	25,000	" " 100 "
Melones	Stanislaus	Knights Ferry	204,000	(4) 15,000	" " 100 "
Don Pedro	Tuolumne	La Grange	214,000	(4) 15,000	" " 100 "
Exchequer	Merced	Exchequer	59,000	(4) 25,000	" " 100 "
Friant	San Joaquin	Friant	75,000	(4) 15,000	" " 100 "
Pene Flat	Kings	Piedra	80,000	(4) 15,000	" " 100 "
Isabella	Kern	Bakersfield	67,000	(4) 7,500	" " 100 "

* From State Engineer's plan.

(1) Floods which would cause flows in excess of 10,000 s.f. in the Mokelumne River would be diverted from Pardee Reservoir and stored in Ione.

(2) Floods would be controlled to 125,000 c.f.s. maximum flow exceeded once in 100 years except when this amount is exceeded by uncontrolled flow between Shasta and Red Bluff. Flows greater than 125,000 c.f.s. would be of short duration.

(3) Folsom Reservoir alone would control flow at Fairoaks to a maximum of 100,000 c.f.s. exceeded once in 100 years by employing 175,000 acre feet of space in the reservoir for flood control.

(4) Amounts shown are controlled flows during winter floods. During summer floods the flows would be controlled to amounts not exceeding those shown by combining some reservoir regulation with diversions from the stream for irrigation and underground storage. The control would not be at the points shown for winter floods but would be at points downstream where control is desired to protect lands subject to inundation.

TABLE NO. 8

WINTER FLOODS IN THE CENTRAL VALLEY

WITH AND WITHOUT RESERVOIR CONTROL*

ULTIMATE PLAN

Stream	Maximum Mean Daily Flow in Second Feet		Number of Times Flow would be Exceeded - Average
	Without Control	With Control	
Sacramento River at Red Bluff	303,000	(1) 187,000	Once in 100 years
Sacramento River at Red Bluff	218,000	(1) 125,000	" " 14 "
Sacramento River and Sutter-Butte Bypass opposite Colusa	370,000	250,000	" " 100 "
Sacramento River and Sutter-Butte Bypass opposite Colusa	254,000	170,000	" " 14 "
Sacramento River at Sacramento and Yolo Bypass at Lisbon	670,000	535,000	" " 100 "
Feather River below confluence with Yuba River	400,000	201,000	" " 100 "
Feather River below confluence with Bear River	430,000	226,000	" " 100 "
American River at Fairoaks	185,000	80,000	" " 250 "
San Joaquin River below confluence with Merced River	70,000	50,000	" " 100 "
San Joaquin River below confluence with Tuolumne River	103,000	64,000	" " 100 "
San Joaquin River below confluence with Stanislaus	135,000	82,000	" " 100 "
Sacramento and San Joaquin Rivers at confluence	780,000	596,000	" " 100 "

* State Engineer's plan.

(1) Floods would be controlled to 125,000 sec. ft. maximum, exceeded once in 100 years, except when this amount is exceeded by uncontrolled run-off between Shasta and Red Bluff. Flows greater than 125,000 sec. ft. would be of short duration.

(d) Provide a fresh water flow past Antioch into Suisun Bay of not less than 3,300 second-feet, which will control salinity to the lower end of the Sacramento-San Joaquin delta.

(e) Provide 5,342,000 acre-feet per season, gross allowance with a maximum seasonal deficiency of 35 percent, for irrigation of 1,810,000 acres of all classes of land in the lower San Joaquin Valley, including 134,000 acres of foothills on the eastern side of the Valley below the major reservoirs.

(f) Provide 4,700,000 acre-feet per season, without deficiency, for irrigation of 2,350,000* acres of Class 1 and Class 2 lands on the eastern and southern slopes of the upper San Joaquin Valley. This will be accomplished by utilization of underground storage in conjunction with the major reservoir and conveyance units.

(g) Provide 1,570,000 acre-feet per season, with a maximum seasonal deficiency of 35 percent, for irrigation of 785,000* acres of Class 1 and Class 2 lands lying chiefly on the western slope of the upper San Joaquin Valley.

(h) Provide 403,000 acre-feet per season for use in the San Francisco Bay basin. This allowance, together with the supply which can be provided by full practicable development of local resources and annual importations of 224,000 acre-feet from the Mokelumne River and 448,000 acre-feet from the Tuolumne River, and an importation from the Eel River, will be adequate for the ultimate development of this basin. (There would have been a deficiency of 35 percent in the driest year (1924) in the 323,000 acre-foot portion of this supply alloted for irrigation).

(i) Generate an average of almost six billion kilowatt hours of electric energy annually.

Initial Plan.

Shasta Dam Unit.** This unit will be operated to:

(a) Supply the irrigation demands along the Sacramento River up to 6,000 cfs maximum draft in July.

(b) Supply the full present irrigation requirements of the lands in the entire Sacramento-San Joaquin delta.

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* No provision is made for a water supply for 500,000 acres of Class 3, 4, and 5 lands in the San Joaquin Valley.

** State Engineer's plan.

(c) Furnish sufficient water to maintain a fresh water flow of not less than 3,300 cfs past Antioch into Suisun Bay for salinity control.

(d) Maintain a navigable depth of five to six feet in the Sacramento River from Sacramento to Chico Landing and substantially improve depths above that point to Red Bluff.

(e) Make available a water supply for the developed agricultural and industrial area along the south shore of Suisun Bay.

(f) Make available an irrigation supply sufficient in amount for the crop lands now being served from the San Joaquin River above the mouth of the Merced River. This water will be conveyed to these lands by the San Joaquin pumping system and will make possible the exportation of all the available supply at Friant Dam, if the "grass land" rights on the San Joaquin River above the mouth of the Merced River are purchased.

(g) Reduce floods to a maximum of 125,000 cfs at Red Bluff, exceeded only once in 100 years, except when the run-off from the area between Shasta Dam and Red Bluff exceeds 125,000 cfs.

(h) Produce an annual average of 1,373,000,000 kwh of hydroelectric energy.

Shasta reservoir would have an annual total yield of 4,340,000 acre-feet of water for irrigation, and an annual yield of 2,850,000 acre-feet of new water, if operated solely for irrigation and flood control. However, under this method of operation, a large block of low-value secondary power would be generated. By spilling through the generators a small quantity of water which would otherwise be stored during the few months when no irrigation water is released, the value of the power output could be greatly increased with only a small loss of irrigation water. If operated purely for power generation and flood control, with irrigation incidental, the reservoir would yield only 2,085,000 acre-feet of water for irrigation, of which only 595,000 acre-feet would be new water.

The value of Shasta for controlling flood flows at Red Bluff is not as great as it would be were it located nearer Red Bluff. However, it will have an important effect in reducing flood flows in the Valley as is indicated by the study which is summarized in table 8.

The flood control rule for the reservoir has been established as follows: some space will be held in reserve for flood control from November 1 to May 1 whenever the total precipitation up to any date in that period is more than 50 percent of normal to that date. The flood-control reserve will be increased at a uniform rate from zero on November 1

to 512,000 acre-feet on December 1. This space will be held in reserve from December 1 to April 1, (except during control of flood flows) and then decreased at a uniform rate to zero on May 1.

Friant Dam Unit.* This unit will be operated to:

(a) Provide the fullest practicable regulation of the available run-off of the San Joaquin River at Friant.

(b) Serve as a diversion works for the Friant-Kern Canal and the Madera Canal.

(c) Reduce flood flows immediately below the dam to 15,000 cfs, exceeded once in 100 years.

During the season when no irrigation water is required, the canals of the Friant Dam unit will be operated to supply water for underground storage, from which the water will be pumped when needed. The storage capacity of this unit was established to give the lowest total cost of water considering the cost of reservoir, conveyance units, and pumping charges.

There is no provision for power at Friant Dam, since the entire controllable flow of the San Joaquin River is to be diverted into the Friant-Kern and Madera Canals.

After providing for a primary supply of 138,000 acre-feet for surface irrigation, the reservoir will be operated to deliver as much water as possible for both direct application and ground water storage. In addition to the surface irrigation supply, water will be delivered to the Madera Canal up to the maximum capacity of 1,500 cfs for ground water storage when Friant is spilling, and during the months of March, April, and May in seasons of above-normal run-off. After supplying the Madera Canal, the remainder of the water will be delivered to the areas south of the river up to the maximum 3000 cfs capacity of the Friant-Kern Canal during the months of March to October inclusive, and at a rate of 2300 second-feet during the remaining months. Under this plan of operation, Friant reservoir will produce an average of 1,700,000 acre-feet of irrigation water annually.

The flood control rule for Friant reservoir has been established as follows: Some space will be held in reserve for flood control from November 1 to May 1 whenever the total precipitation up to any date in that period is more than 50 percent of normal to that date. The flood control reserve will be increased from zero on November 1 to 75,000 acre-feet on December 1. This space will be held in reserve from December 1 to April 1 (except during control of flood flows), and then decreased at a uniform rate to zero on May 1, except as follows: When snow surveys indicate that flows after April 1 will exceed the sum of controlled releases for irrigation and underground storage, space for flood control will be reserved during such periods and in such amounts as to obtain the desired flow.

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* State Engineer's plan.