RECLAMATION
Managing Water in the West

Auburn-Folsom South Unit Special Report

Technical Memorandum Water Supply, Power Generation, and Water Temperature Analysis

Central Valley Project, California
Mid-Pacific Region

U.S. Department of the Interior
Bureau of Reclamation
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Sacramento, California

July 2006

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Introduction

This technical memorandum details the hydrologic and temperature modeling tools used for the technical analysis performed for the Auburn-Folsom South Unit Special Report. The DWR/Reclamation Joint CALSIM II planning model was used to simulate the Central Valley Project (CVP) and the State Water Project (SWP) on a monthly time step from water year 1922 to 1994. The modeling assumptions regarding CVP and SWP operations, the temperature modeling tool, and model limitations, are discussed in succeeding paragraphs.

The purpose of this analysis is to evaluate the potential impacts of a multi-purpose dam near Auburn on water resources in the American River Basin, as well as the CVP and SWP systems. The evaluation considers the impact of a new dam on water supply, delivery, reliability, power generation, and flood control.

The proposed dam near Auburn is located on the North and Middle Forks of the American River, upstream of Folsom Lake. At present, Folsom Lake is the largest storage facility in the American River watershed. Its storage capacity is 0.977 million acre-feet (MAF). The proposed dam would provide a new storage facility with a capacity of 2.326 MAF. The CALSIM II model tool was modified to evaluate these water resource system changes by incorporating the new storage facility into the Central Valley Project.

CALSIM II Modeling Methodology

CALSIM II is a computer model that simulates the major water resource systems and their operation in California’s Central Valley and Sacramento-San Joaquin Delta region. The focus of the CALSIM II representation is primarily on the Central Valley Project and State Water Project systems. The model was developed jointly by the California Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (Reclamation). Its purpose is to provide quantitative hydrologic information related to scenario-based CVP-SWP operations and assumptions related to climate, water demands, and the regulatory environment. As the official planning model of both agencies, CALSIM II is used extensively to support a variety of studies describing comparative effects of alternative scenarios varying by infrastructure, operational rules, regulations, water demands, and/or climate.

Study Application of CALSIM II

For this report, two CALSIM II model studies were used to estimate changes to the American River system. Both "with" and "without" project models were developed to compare results representing future levels of development (2020 LOD). The version of CALSIM II that implements Water Right Decision 1641 was used for this analysis. Policy-oriented operation and coordination of the 800 TAF of dedicated CVPIA 3406 (B)(2) water and the CALFED Environmental Water Account was not implemented in either without-project or with-project alternatives. The coordination (fishery agencies, operation offices, and others) required to define and model (B)(2) operation and EWA assets for the with-project alternative is beyond the scope of this analysis. Similarly, estimating climate change impacts to the American River system, including the assessment of synthetic hydrology, is also beyond the scope of this analysis.

The "without-project" study has the following characteristics:

- This Base Study represents conditions anticipated in the future, such as demand on the water supply system, storage and conveyance infrastructure, and regulations, but does not include a dam near Auburn. This study was previously developed by DWR and Reclamation staff for the purpose of creating a CALSIM II study that is to be used as a basis for comparing project alternatives. Specific assumptions are discussed later.

The "with-project" study has the following characteristics:

- This study represents the same conditions anticipated in the future, such as demand on the water supply system, storage and conveyance infrastructure, regulations, and also includes a storage facility near Auburn.

CALSIM II Study Assumptions

The CALSIM II study models are used to simulate a 73-year period approximating future conditions under assumptions of future levels of development and historic climate conditions. Table 1 outlines the hydrologic and operational assumptions included in this analysis. Greater detail regarding the general model representation of the Central Valley water resources system and quantitative methods are described in DWR (2002), and Draper et al (2004). The modifications implemented in the model to represent the with-project scenario, along with summary results, are described in the following sections.

The with-project CALSIM II study is a modified version of the model last publicly released as part of the CALFED Bay-Delta Program Surface Storage Investigations Progress Report (May 2005).

Table 1: CALSIM II Model Assumptions

	Future Without-Project	**Future With-Project**
Period of Simulation	73 years (1922-1994)	Same
HYDROLOGY		
Level of Development (Land Use)	2020 Level, DWR Bulletin 160-98	Same
Demands		
North of Delta (exc. American R)		
CVP	Land Use based, Limited by Full Contract	Same
SWP (FRSA)	Land Use based, Limited by Full Contract	Same
Non-Project	Land Use based	Same
CVP Refuges	Firm Level 2[a]	Same
American River Basin		
Water rights	2020[b]	Same
CVP	2020 [b]	Same
San Joaquin River Basin		
Friant Unit	Regression of historical	Same
Lower Basin	Fixed annual demands	Same
Stanislaus River Basin	New Melones Interim Operations Plan	Same
South of Delta		
CVP	Full Contract	Same
CVP Refuges	Firm Level 2[a]	Same
CCWD	195 taf/yr	Same
SWP (w/ North Bay Aqueduct)	3.9-4.1 MAF/yr (MWD demand at Table A)	Same
SWP Article 21 Demand	MWDSC up to 100 taf/month, Dec-Mar, others up to 84 taf/month	Same
FACILITIES		
System-wide	Existing plus others as noted	Same
Upper American River	PCWA Diversion	Same
Auburn Dam	None	2.326 Million af reservoir implemented

	Future Without-Project	Future With-Project
Freeport Regional Water Project	Included (includes modified EBMUD operations on the Mokelumne River)	Same
Delta Export Conveyance		
SWP Banks Pumping Capacity	8500 cfs	Same
Tracy Pumping Capacity	4600 cfs (with implementation of CA-DMC Intertie)	Same
REGULATORY STANDARDS		
Trinity River		
Minimum Flow below Lewiston Dam	Trinity EIS Preferred Alternative (369 -815 taf/yr)	Same
Trinity Reservoir End-of-September Minimum Storage	Trinity export-to-inflows Preferred Alternative (600 taf as able)	Same
Clear Creek		
Minimum Flow below Whiskeytown Dam	Downstream water rights, 1963 USBR Proposal to USFWS and NPS	Same
Upper Sacramento River		
Shasta Lake End-of-September Minimum Storage	SWRCB WR 1993 Winter-run Biological Opinion (1.9 Million af)	Same
Minimum Flow below Keswick Dam	Flows for SWRCB WR 90-5 and 1993 Winter-run Biological Opinion temperature control	Same
Feather River		
Minimum Flow below Thermalito Diversion Dam	1983 DWR, DFG Agreement (600 CFS)	Same
Minimum Flow below Thermalito Afterbay outlet	1983 DWR, DFG Agreement (750–1700 CFS)	Same
American River		
Minimum Flow below Nimbus Dam	SWRCB D-893	SWRCB D-1400
Minimum Flow at H Street Bridge	SWRCB D-893	SWRCB D-1400
Lower Sacramento River		
Minimum Flow near Rio Vista	SWRCB D-1641	Same
Mokelumne River		
Minimum Flow below Camanche Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (100–325 CFS)	Same
Minimum Flow below Woodbridge Diversion Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (25 – 300 CFS)	Same

	Future Without-Project	Future With-Project
Stanislaus River		
Minimum Flow below Goodwin Dam	1987 USBR, DFG agreement	Same
Minimum Dissolved Oxygen	SWRCB D-1422	Same
Merced River		
Minimum Flow below Crocker-Huffman Diversion Dam	Davis-Grunsky (180 – 220 CFS, Nov – Mar), and Cowell Agreement	Same
Tuolumne River		
Minimum Flow at Lagrange Bridge	FERC 2299-024, 1995 (Settlement Agreement 94,000 – 301,000 af/yr)	Same
San Joaquin River		
Maximum Salinity near Vernalis	SWRCB D-1641	Same
Minimum Flow near Vernalis	SWRCB D-1641, and Vernalis Adaptive Management Program per San Joaquin River Agreement	Same
Sacramento River-San Joaquin River Delta		
Delta Outflow Index (Flow and Salinity)	SWRCB D-1641	Same
Delta Cross Channel Gate Operation	SWRCB D-1641	Same
Delta Exports	SWRCB D-1641	Same
OPERATIONS CRITERIA		
Subsystem		
Upper Sacramento River		
Flow Objective for Navigation (Wilkins Slough)	3,250 – 5,000 CFS based on Lake Shasta storage condition	Same
American River		
Auburn Dam Flood Control	None (not implemented)	Maximum flood control space of 450 taf Nov 1 – May 1 [f]
Folsom Dam Flood Control	SAFCA, Interim-Reoperation of Folsom Dam, Variable 400/670 (without outlet modifications)	Maximum flood control space of 200 taf Nov 1 – May 1 [f]
Flow below Nimbus Dam	Operations criteria corresponding to SWRCB D-893 required minimum flow [g]	Same
Stanislaus River		

	Future Without-Project	**Future With-Project**
Flow below Goodwin Dam	1997 New Melones Interim Operations Plan	Same
System-wide		
CVP Water Allocation		
CVP Settlement and Exchange	100% (75% in Shasta Critical years)	Same
CVP Refuges	100% (75% in Shasta Critical years)	Same
CVP Agriculture	100% - 0% based on supply	Same
CVP Municipal & Industrial	100% - 50% based on supply	Same
SWP Water Allocation		
North of Delta (FRSA)	Contract specific	Same
South of Delta	Based on supply; Monterey Agreement	Same
CVP/SWP Coordinated Operations		
Sharing of Responsibility for In-Basin-Use	1986 Coordinated Operations Agreement	Same
Sharing of Surplus Flows	1986 Coordinated Operations Agreement	Same
Sharing of Restricted Export Capacity	Equal sharing of export capacity under SWRCB D-1641	Same
Dedicated CVP Conveyance at Banks	SWP to convey 100 taf/yr of Level 2 refuge water at Banks P.P. (Jul and Aug)	Same
North of Delta Accounting Adjustments	CVP to provide the SWP a maximum of 75 taf to meet in-basin requirements through adjustments in COA accounting (released from Shasta)	Same
Sharing of Export Capacity for lesser Priority and Wheeling Related Pumping	Cross Valley Canal wheeling (max of 128 taf/yr), CALFED ROD defined Joint-Point-of-Diversion	Same
San Luis Low Point	San Luis Reservoir is allowed to operate to a minimum storage of 100 taf	Same
Transfers	None (not implemented at this time)	Same
Dry Year Program	None	Same
Phase 8	None	Same
Water Forum Analyses Water transfers /Mitigation Water	None	Same
MWDSC/CVP Settlement Contractors	None	Same

	Future Without-Project	Future With-Project
CVPIA 3406(b)(2)	Not Modeled. No CVPIA 3406(b)(2) operations are included at this time; per Department of the Interior 2003 Decision (600 taf/yr in 40-30-30 Critical Year, 700 taf/yr in 40-30-30 Dry years, and 800 taf/yr in all other year types).	Same
CALFED Environmental Water Account	Not Modeled. No EWA operations are included at this time; dedicated export capacity of 500 cfs is reserved in Banks P.P. in the months of July, August, and September (Banks pumping of SWP and CVP water limited to 8,000 cfs in these months).	Same

Notes:
[a] It is assumed that Level 4 supplies are obtained through water transfers and are not part of the basic operating demands in CALSIM II.
[b] Sacramento Water Forum 2025 Level Demands are defined in Sacramento Water Forum's EIR.
[c] The Placer County Water Agency pumping facility upstream of Folsom Lake is just about to begin construction.
[d] D1644 in some form will be modeled in the future when SWRCB and YCWA resolve the Decision.
[e] This is implemented only in the PCWA Middle Fork Project releases used in defining the CALSIM II inflows into Folsom Lake.
[f] Flood control and conservation space was determined from previous studies of Auburn Dam by the U.S. Bureau of Reclamation in 1977.
[g] The Proposed Sacramento Area Water Forum Lower American River Flow Management Standard is not included in these assumptions. Reclamation has agreed in principle to the Flow Management Standard, but flow specifications are not yet available for modeling purposes. This assumption will be revisited as part of future model development.

Water Supply, Power Generation and Water Temperature

Water Supply Modeling

For the water supply analysis, CALSIM II implementation of a dam near Auburn (with-project alternative) included the following modifications:

1. Define a new reservoir in the CALSIM network at an existing North Fork American River flow arc upstream of Folsom Lake. The new reservoir incorporates the physical specifications of the CG-3 design.
2. Modify CALSIM II logic to integrate the new storage facility as a component of the CVP (e.g., CVP reservoir balancing, San Luis storage target calculation, export based rule for CVP south-of-Delta deliveries, water supply and delivery indices, etc.).

3. Define seasonal flood control storage for both a new storage facility and Folsom Lake. The seasonal storage defined is consistent with storage allocation presented in the 1977 report.
4. Implement minimum flow requirements within the lower American River per SWRCB D-1400.

Sensitivity and Limitations of CALSIM II Modeling

Model sensitivity measures the relationship between input parameters and results. This type of analysis builds confidence in results and reveals how input changes directly affect the results. A sensitivity investigation of CALSIM-II model inputs by DWR (October 2005) identified input parameters which have relative sensitivity to SWP and CVP operations. Study results show a high sensitivity index of American River inflows to some operations in the Delta but moderate to low sensitivity index for all other parameters measured.

The monthly time-step is a major limitation for operations that occur on a smaller timescale, such as flood and hydropower operations. Daily fluctuations in operation, deliveries, and hydrologic inputs to the system are not captured in the CALSIM II model. In addition, several issues were not addressed in this analysis because of limited study scope. These issues may impact water supply and project storage because they deal with conveyance and operational constraints. They represent both operational agreements and additional facilities, and include:

1. Modifications to the existing CVP-SWP Coordinated Operating Agreement (COA), highly likely if a new large storage facility is constructed.
2. Completion of the Folsom South Canal which would provide an additional conveyance facility for water stored in the Auburn-Folsom reservoir complex.
3. Potential new water demands for a new water supply facility.
4. Implementation of CVPIA 3406 (B)(2) or the CALFED Environmental Water Account.

Despite these limitations, the monthly CALSIM II model results remain useful for comparative purposes. It is important to differentiate between “absolute or “predictive” modeling applications and “comparative” applications. In “absolute” applications the model is run once to predict a future outcome; and errors or assumptions in formulation, system representation, data, operational criteria, etc. all contribute to total error or uncertainty in model results. In “comparative” applications the model is run twice; once to represent a base condition (no project) and a second time with a specific change (project) to assess the ***change*** in the outcome due to the input change. In this mode (the mode used in this application), the difference between the two simulations is of principal importance. Potential errors or uncertainties that exist in the “no project” simulation are also present in the “project” simulation such that the effects are reduced when assessing the change in outcomes.

CALSIM II Model Results

Table 2 contains a summary of CALSIM II results for both without-project and with-project alternatives. CVP and SWP deliveries were selected as the metric for evaluating water supply benefits of new storage, although any portion of the new supply could be dedicated to environmental actions. However, the coordination required to define these actions is beyond the scope of this analysis. The aggregate benefits of increased storage within the coordinated CVP and SWP system may allow for enhanced flexibility in delivery allocations and the results shown in Table 2 present one possible allocation distribution. As shown, a new reservoir near Auburn can provide an additional 343 TAF of annual deliveries to the CVP and SWP during dry and critically dry year-types. The average increase in deliveries for the 73-year study period is about 208 TAF.

Table 2: CALSIM II Water Supply Summary

Future (2020) Level of Development (Period of Simulation, 1922-1994)				
	Without Project (TAF)	**With Project (TAF)**	**Change (TAF)**	**Percent Change**
STORAGE (End of September)				
Auburn	--	1,260	--	--
Folsom	510	594	84	17%
Oroville	1,958	1,968	10	0%
Shasta	2,549	2,547	(2)	0%
Trinity	1,299	1,305	6	0%
FLOW				
Below Nimbus Dam	2,316	2,281	(35)	-1%
Below Auburn Dam	--	1,266	--	--
Surplus Delta Outflow	8,112	7,854	(258)	-3%
Required Delta Outflow	5,632	5,649	17	0%
DELIVERY SUMMARY				
American River Deliveries	643	664	21	3%
CVP Total Deliveries	5,296	5,434	138	3%
SWP Total Deliveries	4,317	4,387	70	2%
CVP Dry and Critical Year Deliveries	4,596	4,825	229	5%
SWP Dry and Critical Year Deliveries	3,235	3,349	114	4%

A new storage facility near Auburn increases the frequency of filling Folsom Lake, as shown in Figure 1, End-of-May storage exceedence. A corresponding increase in Folsom Lake end-of-September carryover storage, Figure 2, can also be achieved. However, increased deliveries (Table 2) and D-1400 minimum flow requirements may result in low Folsom Lake storage during dry and critically dry years. Depending on the operating criteria, storage at Auburn can be used to increase Folsom Lake storage during these periods. Figures 3 and 4 contain representative end-of-May and end-of-September storage exceedence plots for a new storage facility near Auburn.

Additional storage in the basin results in reduced (stored) flood flows in the lower American River during the peak flood season. Figure 5 is an exceedence plot of December through February flows below Nimbus Dam for both alternatives. As shown on Figure 5, the frequency of flows above 5,000 cfs is reduced from about 30% to 15%; while D-1400 provides higher sustained minimum flows.

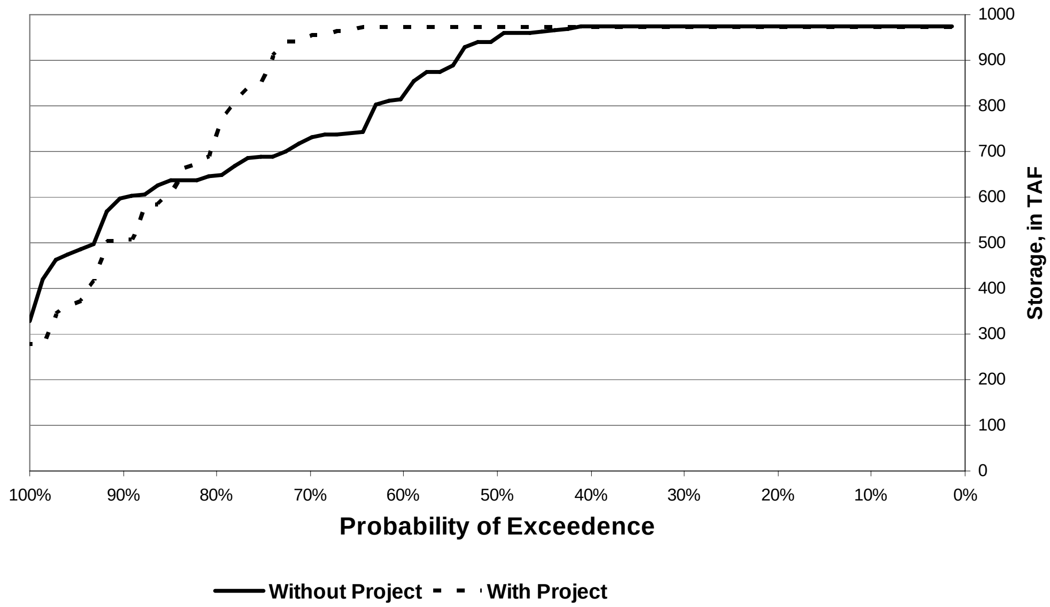

Figure 1. Folsom Lake End-of-May Storage

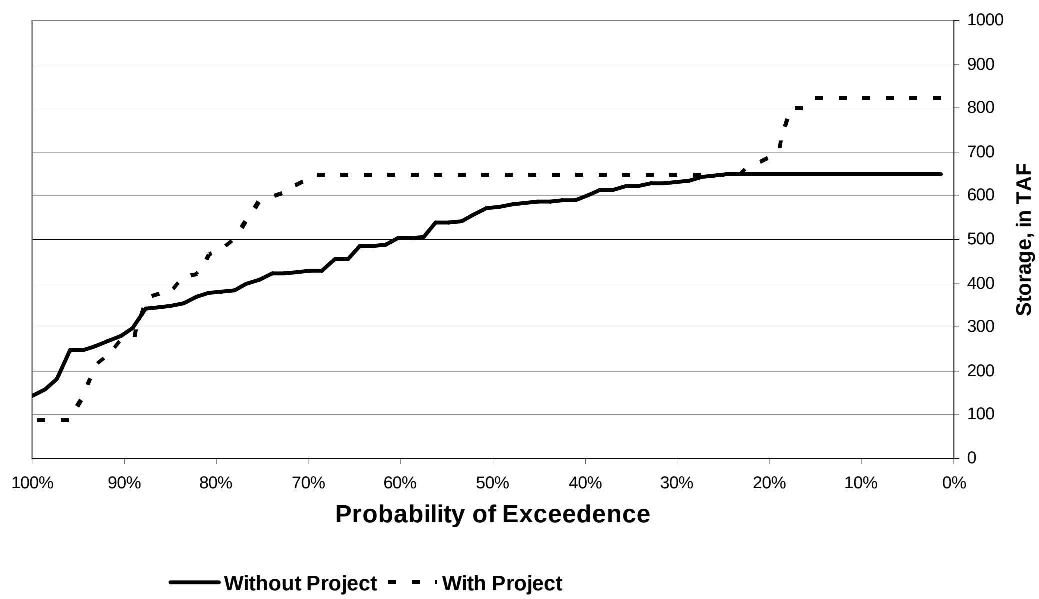

Figure 2. Folsom Lake End-of-September Storage

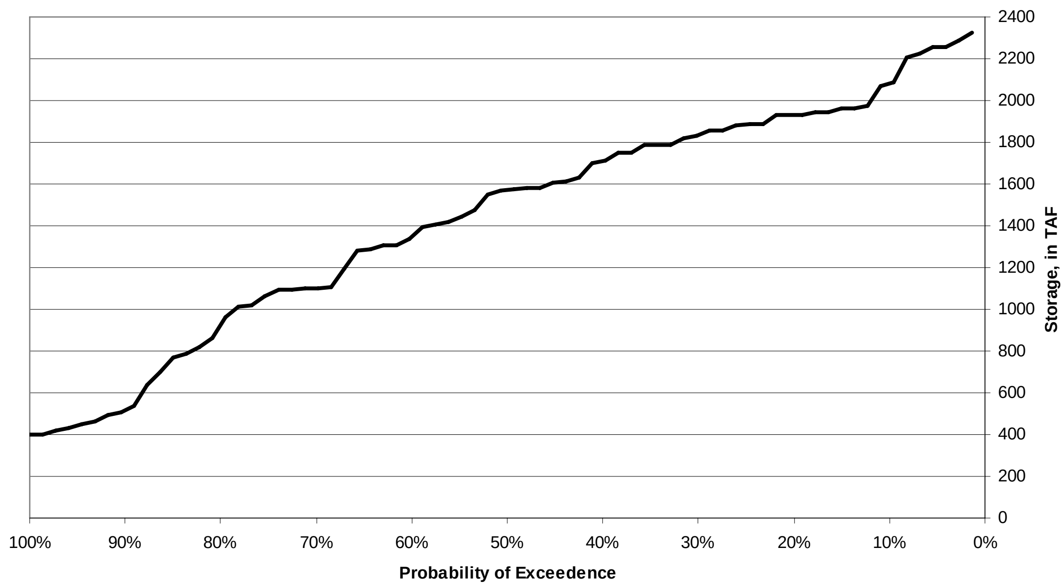

Figure 3. Auburn Lake End-of-May Storage

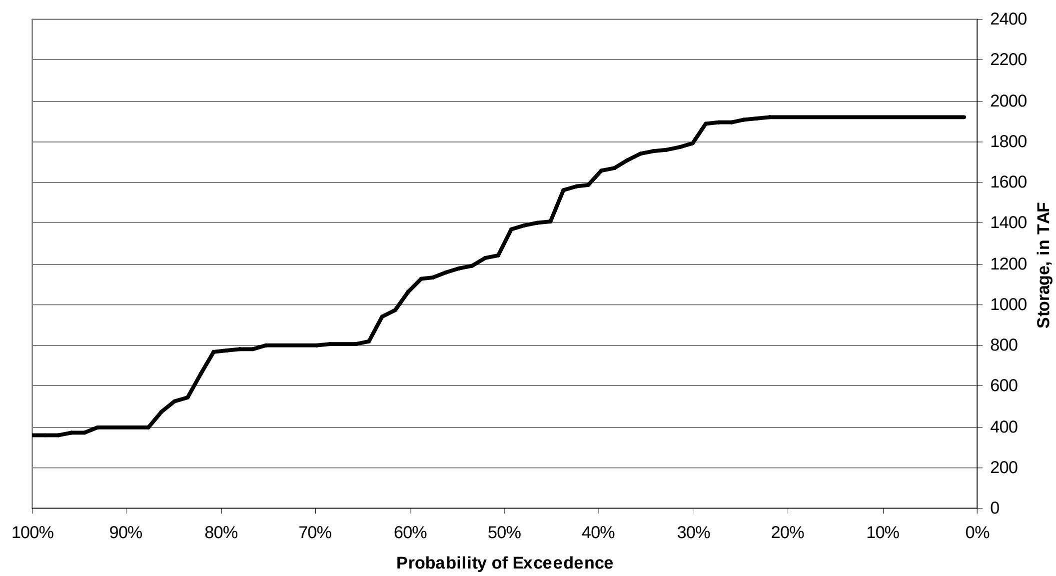

Figure 4. Auburn Lake End-of-September Storage

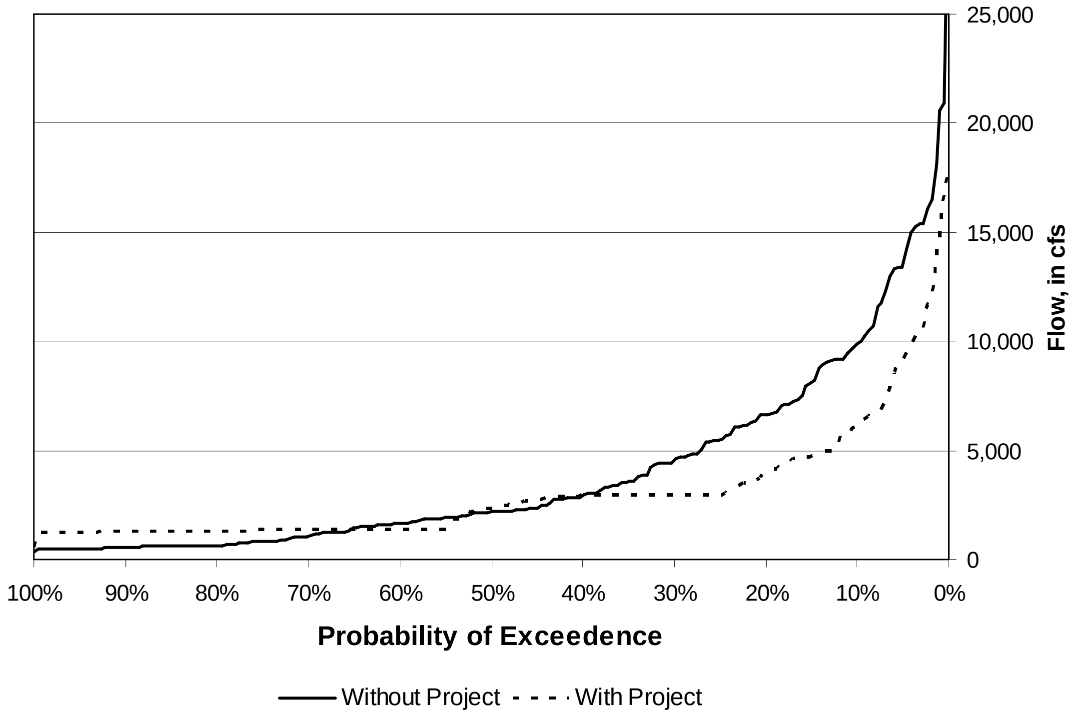

Figure 5. Nimbus Dam Release (December through February)

Hydropower Generation Estimates

The purpose of this analysis was to estimate the power generation capabilities of the Auburn Dam, and provide a range of power generation scenarios in relation to existing output estimates of the CVP hydropower system.

Power Generation at Auburn Dam - Basic Assumptions

The proposed Auburn Dam has two penstock intake elevations of 625 and 800 feet MSL providing flexibility for hydropower operations under variable water surface elevations within the reservoir. The proposed power plant consists of four, Francis type, 200MW units. Each unit has a maximum rated discharge of 5,760 cfs (the theoretical maximum release is 23,040 cfs).

For this analysis, the upper penstock elevation was exclusively used for the power calculation. Conservatively, gross head is calculated from the 625-foot elevation and higher. The aggregate turbine discharge for the four and two unit power plants were scaled based on water surface elevation in the Auburn reservoir

Two methodologies were used to estimate power generation. The first method was based on a generalized power model. The second method utilized an efficiency regression based on operational data for the New Melones power plant, estimating the Auburn power plant as twice the capacity of New Melones. The two-unit Auburn estimate utilized the generalized power model.

Limitations of the Power Generation Estimates

The modeled operation of Auburn Reservoir, as an enhanced filling component for Folsom Lake, may not allow storage levels in Auburn to be high enough for full utilization of the proposed 800MW capacity power plant. In comparison to Shasta-Keswick yearly and gross monthly output, the two unit facility may provide a more reasonable estimate of the Auburn powerplant and project operation. Due to the aggregate monthly estimate of water levels provided by the CALSIM II output, the power estimate does not include any peaking or flood flow operations.

Power Generation Results

Estimated monthly average power generation in Gigawatt-hours (GWH) over the 1922-1994 period including the corresponding Shasta-Keswick estimated output, is presented in Table 3 below.

Table 3: Estimated Monthly Average Power Generation (GWH)

	4-Unit Auburn	2-Unit Auburn	Shasta/Keswick	2XMelones
October	189.7	114.8	149.8	243.5
November	173.0	106.0	122.3	221.8
December	195.3	117.8	150.2	250.4
January	215.5	128.5	170.2	276.3
February	250.6	147.1	189.0	321.2
March	278.1	161.7	187.4	356.3
April	303.7	175.2	199.5	389.2
May	275.2	160.1	245.6	352.7
June	290.0	167.8	289.9	371.6
July	230.3	136.4	339.3	295.1
August	215.2	128.2	274.2	275.9
September	206.1	123.4	163.5	264.1

The estimated monthly power generation results indicate that hydropower generation, as a function of simulated Auburn reservoir levels, is more variable than the modeled Shasta/Keswick power production and can be attributed to the modeled water supply specific operations of the Auburn dam Since the Auburn estimates of energy production are based on simulated end of month storage values, operations specific to hydropower optimization are not presented in these results and are beyond the scope of this analysis.

Water Temperature Modeling

This analysis was performed to assess the potential impacts of a multi-purpose dam near Auburn on water temperatures in the lower American River. Water temperature operations in the lower American River are affected by many factors and operational tradeoffs. These factors include available cold-water resources, Nimbus Dam release schedules, annual hydrology, Folsom power penstock shutter management flexibility, and Folsom Dam urban water supply management.

The existing Reclamation temperature model was used to estimate temperatures in the American River. In general, the objective of the temperature model is to assist in the fisheries impact evaluations of alternative operation scenarios. Flow inputs into the temperature model were derived from the CALSIM II studies for the without-project and with-project alternatives. Because of the complex structure of CALSIM II, flow arcs were combined at appropriate nodes to insure compatibility with the temperature model.

Temperature Model Description

The Reclamation temperature models for tributaries of the Sacramento River, including the American River, are documented in a USBR report (Rowell, 1990). The models are also described in Appendix IX of the USBR Draft CVPIA-PEIS (CVPIA, 1997). They were applied in the Biological Assessment for the CVP-OCAP (OCAP, 2004). Each temperature model consists of a reservoir and river component. On the American River, the reservoir temperature model simulates monthly vertical temperature profiles and release temperatures for Folsom Lake based on hydrologic and climatic input data. The temperature shutter system on the power penstocks at Folsom Dam can selectively withdraw water from several reservoir levels to provide downstream temperature control. The shutters are generally operated to conserve cold water for the summer and fall months when river temperatures become critical for fisheries. The model simulates shutter operation by making upper pool level releases in the winter and spring, mid-level releases in the late spring and summer, and low level releases in the late summer and fall.

Temperature changes in Lake Natoma are computed from equilibrium temperature decay equations in the reservoir models. These equations are similarly applied in the river model. In addition, the river temperature model outputs temperature at nine locations on the American River, from Nimbus Dam to the mouth, and includes the temperature compliance location at Watt Avenue. The river temperature calculations are based on regulating reservoir release temperatures, river flows, and climatic data. Mean monthly historical air temperatures for the study period, as well as other long-term average climatic data, for Folsom and Sacramento were obtained from National Weather Service records. They were used to represent climatic conditions in the American River basin.

Model Modifications for a Reservoir near Auburn

The reservoir temperature model, described in the previous paragraph, was modified to incorporate a reservoir on the North Fork American River near Auburn, upstream of Folsom Lake. The modified reservoir temperature model simulates monthly vertical temperature profiles and release temperatures for Auburn Lake, as well as Folsom Lake. Generalized calibration coefficients for the energy exchange functions were assumed for the reservoir near Auburn. These coefficients are similar to those generated in previous studies for Shasta, New Melones and Oroville Reservoirs. Auburn mean monthly air temperature records were applied at the new reservoir. In addition, North Fork (Auburn) and South Fork (Folsom) reservoir inflow temperatures were developed as described in the 1990 Sacramento River report (Rowell, 1990).

Multi-level penstock intakes at elevation 625 and 800 feet were assumed for the reservoir near Auburn. These intakes were operated so that upper level releases occurred from January through August, with low level releases occurring during the remainder of the year. From previous studies and designs, diversions to the Placer County Water Agency were assumed to be released through an intake at elevation 715 feet.

Inflow (temperature and volume) into Folsom Lake is represented as the combination of Auburn Dam release and South Fork flow. No additional modifications were made to the Folsom Lake component of the reservoir temperature model.

Temperature Model Limitations

The main limitation of the temperature model is the time-step. Mean monthly flows and temperatures do not define daily variations that could occur in the rivers due to dynamic flow and climatic conditions. The temperature models are also unable to accurately simulate certain aspects of the actual operations strategies used when attempting to meet temperature objectives. There is also uncertainty regarding performance of the selective withdrawal structures (temperature shutters, TCD, etc.). However, a monthly model still functions as a useful tool for general comparison of alternatives.

Temperature Model Results

Temperature model simulations were performed for both the without-project and with-project alternatives. Table 4 contains a comparison of mean monthly temperature at Watt Avenue for average conditions, and dry and critically dry year-types. For the with-project alternative, higher Folsom Lake levels and the existence of a seasonal cold-water pool at Auburn resulted in somewhat cooler temperatures at Watt Avenue during most of the temperature operation season, primarily late May through early November. However, it should be noted that no attempt was made to operate the American River system for optimum temperature conditions for either alternative. Similar Folsom Dam tail-water temperature targets were used for both alternatives. Also, water temperature was the only parameter considered in this analysis. Additional water quality parameters that should be considered in future studies include turbidity, dissolved oxygen, and heavy metals.

Table 4: American River at Watt Avenue
Mean Monthly Water Temperature (˚F)

	Average											
	Oct	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
wo/Project	60.0	56.1	48.4	45.9	48.6	53.3	58.1	62.7	66.7	68.8	70.5	67.9
w/Project	59.1	55.4	49.3	46.6	49.4	53.0	57.1	61.2	65.2	67.2	68.9	65.8
Difference	-0.9	-0.7	+0.9	+0.7	+0.8	-0.3	-1.0	-1.5	-1.5	-1.6	-1.6	-2.1
	Dry & Critically Dry Water Years											
wo/Project	60.6	56.3	47.6	45.5	49.7	54.5	59.9	64.9	68.8	70.1	71.4	69.0
w/Project	60.0	55.9	48.9	46.1	50.2	54.5	59.7	62.8	66.7	67.7	69.4	66.8
Difference	-0.6	-0.4	+1.3	+0.6	+0.5	+0.0	-0.2	-2.1	-2.1	-2.4	-2.0	-2.2

Conclusion

This memorandum documents the results of a water supply, power generation, and temperature analysis performed for the Auburn-Folsom South Unit Special Report. The results represent a reevaluation, without project reformulation, of the potential impacts of a 2.326 MAF storage facility near Auburn, and reflect only one of many possible operation scenarios. The report does not provide recommendations on a new storage facility or its operation.

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