4. EXISTING CONDITIONS, THRESHOLDS OF SIGNIFICANCE, WATER FORUM AGREEMENT IMPACTS, AND MITIGATION MEASURES

4.1 ENVIRONMENTAL IMPACT REPORT FOCUS

4.1.1 CONTENTS OF ENVIRONMENTAL ANALYSIS SECTIONS

The sections in Chapter 4 of this Program EIR contain a discussion of the existing conditions, thresholds of significance, environmental impacts, mitigation measures, and level of significance after mitigation. Issues evaluated in these sections consist of potential environmental issues that need to be addressed in a program-level analysis and were originally identified for review in the Notice of Preparation (NOP) of the Draft Environmental Impact Report. The complete NOP is contained in Appendix A. Chapter 4 sections are organized into the following major components:

1. **Existing Conditions:** This subsection describes the existing regional and local environmental conditions, in accordance with the State CEQA Guidelines §15125. The discussions of existing conditions focus on information relevant to the affected study areas described in Section 3.1 to establish the pertinent base conditions for impact analysis. Applicable regulatory framework, plans, and policies, if any, under which the WFP would be implemented are also discussed in the Existing Conditions component of each section.

   Existing hydrologic conditions represent conditions within the CVP/SWP before the WFP is implemented. These conditions were modeled for each year in the 70-year hydrologic record from 1922 - 1991, providing data on the effects of current levels of diversions and operating rules in a variety of water-year types (i.e., varying levels of precipitation).

2. **Thresholds of Significance:** This subsection presents the criteria and thresholds that define significant effects on the environment in the impact analysis, consistent with Public Resources Code (PRC) §21082.2, State CEQA Guidelines §§15064 and 15065. The criteria define the circumstances that would lead to a significant effect on the environment, as defined by PRC §21068 and State CEQA Guidelines §§15002(g) and 15382. Thresholds are presented and explained to help apply the significance criteria to the impact analysis where quantitative or qualitative measures, agency standards, or legislative or regulatory requirements are relevant to the impact analysis. The thresholds of significance provide the basis for the EIR's conclusions as to whether impacts will be significant.

3. **Environmental Impacts:** Environmental impacts are numbered sequentially in each section throughout the chapter. For instance, impacts in Section 4.3 are numbered Impact 4.3-1, Impact 4.3-2, Impact 4.3-3, etc. A brief impact statement precedes the

discussion of each impact and provides the summary conclusion of each impact analysis and the effect's level of significance before mitigation. The discussion that follows the impact statement describes the substantial evidence upon which a conclusion is made as to whether the impact would be significant or less than significant.

Environmental effects are analyzed based on the results of modeling simulations. The USBR operations model PROSIM was used with refinements (see Section 4.1.4). Impacts are assessed by comparing model results for the existing condition with the existing condition with the WFP. The EIR thus identifies adverse changes in the existing physical conditions of the area affected (Public Resources Code §§ 21060.5 and 21068).

4. **Mitigation Measures:** This subsection provides mitigation measures to reduce significant effects to the extent feasible, in accordance with State CEQA Guidelines §§15002(a)(3), 15021(a)(2), and 15091(a)(1). State CEQA Guidelines §15370 defines mitigation as:

   a. avoiding the impact altogether by not taking a certain action or parts of an action;
   b. minimizing impacts by limiting the degree or magnitude of the action and its implementation;
   c. rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
   d. reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
   e. compensating for the impact by replacing or providing substitute resources or environments.

   The mitigation measures are registered numerically, corresponding to the impact being addressed. For example, Impact 4.3-1 would be mitigated with Mitigation 4.3-1.

5. **Level of Significance After Mitigation:** This subsection describes whether any significant effects are considered significant and unavoidable, or whether all effects are less than significant after the application of mitigation. If mitigation is proposed in the impact analysis, the conclusion will consider whether the mitigation measures would or would not reduce impacts to a less-than-significant level. This section is presented in accordance with State CEQA Guidelines §15126(b), which requires identification of significant unavoidable effects on the environment. If significant unavoidable effects remain, an agency may approve a project, if it finds, pursuant to PRC §21081, that there are no feasible mitigation measures or alternatives for the effects and that overriding benefits of the project outweigh the significant effects.

4.1.2 PROGRAM-LEVEL ANALYSIS

In the context of CEQA compliance, the WFP is a "program," that is appropriately addressed by a "program EIR." Consistent with State CEQA Guidelines §15168, the WFP consists of a "series of actions that can be characterized as one project" and it would involve "rules, regulations, plans, or other criteria to govern the conduct of a continuing program." The water supply and environmental protection objectives of the WFP relate to a continuing plan and program intended to be in effect between now and 2030.

PROGRAM-LEVEL ANALYSIS

As a "program EIR," this EIR serves as a "first tier" environmental document intended "to examine the overall effects of the proposed course of action and to take steps to avoid unnecessary adverse environmental effects," as described in the "Discussion" supporting §15168 of the State CEQA Guidelines. The level of analysis in this EIR is intended to comply with the requirements of a first-tier, program-level document. PRC §21068.5 describes "tiering" as:

> "the coverage of general matters and environmental effects in a [first-tier] environmental impact report prepared for a policy, plan, program, or ordinance followed by narrower or site-specific [second-tier] environmental impact reports ...."

For the WFP the relevant "overall effects of the proposed course of action" and "general matters and environmental effects" relate to the impacts of the overall water management approaches set forth in the WFP regarding the diversion of surface water, extraction of groundwater, protection of instream flows, and management of instream water temperatures and flow schedules. The program-level focus of the EIR analysis will, therefore, be on the overall environmental effects related to the WFP's water resources management provisions, such as proposed amounts of diversions and rules surrounding surface water diversions from the American River, related surface water releases from other reservoirs necessitated by the WFP, groundwater extraction from the regional basins, water conservation, water use in the service areas of the participating water purveyors, and the management of water release schedules and temperatures to the Lower American River.

Consequently, this EIR discussion focuses on the potential environmental effects to water resources and the beneficial uses of the affected water resources. Examples of overall effects that warrant detailed consideration in this program-level analysis are hydrologic regime changes to surface and ground water, effects on fishery resources related to river flows and water temperatures, or changes in recreation opportunities related to river flows and lake levels.

SUBSEQUENT PROJECT-LEVEL ENVIRONMENTAL REVIEW

This program EIR does not evaluate the specific environmental effects of construction of facilities necessary to implement the WFP. Facility construction projects will be addressed in separate "second tier," or "project-level," environmental documents. Site-specific issues related to construction and operation of facilities must be deferred to other environmental documents, because the lead agency may be different from the WFP's, planning and design of the specific facilities require separate processes and approvals by water agencies and others, and sufficient information about the precise nature of the facilities is not yet available for many facilities.

This approach is consistent with CEQA requirements. State CEQA Guidelines §15168(d) specifically allows for use of the program EIR "to simplify the task of preparing environmental documents on later parts of the program." For instance, a second-tier, project EIR can incorporate the program EIR by reference "to deal with regional influences, secondary effects, cumulative impacts, broad alternatives, and other factors that apply to the program as a whole."

4.1.3 WATER SERVICE AREA-WIDE EFFECTS

In addition to assessing the effects of the WFP on water resources and their beneficial uses, the program EIR addresses relevant environmental effects of development in the service area that is supplied water by the implementation of the WFP. The water service study area addressed in this EIR is defined in Section 3.1, Project Location.

The water service area-wide effects are a secondary impact caused by urban development in the communities within the boundaries of the water agencies receiving water supply from the resources covered in the WFP. These agencies are located in Sacramento County, western El Dorado County, and South Placer County. In keeping with its program-level analysis, overall service area effects in these counties are discussed in limited detail in this EIR when relevant. Additional information contained in appropriate general plans, EIRs, and other reports has been incorporated by reference.

4.1.4 IMPACT ASSESSMENT FRAMEWORK AND METHODOLOGY

FRAMEWORK FOR IMPACTS ANALYSIS

The framework for quantified analysis is based on a set of specific model simulations. Each simulation, defining a specific hydrologic condition (e.g., Base Condition, Future Cumulative Condition, etc.) was characterized by a set of modeling assumptions. For impacts analysis, model-generated output was compared between various simulations (depicting different hydrologic and environmental conditions). Within this framework, the incremental impacts due to increased diversions under the WFP, and cumulative future impacts, relative to existing conditions could be determined. A brief description of each condition assessed as part of the quantified impacts analysis provided below.

Base Condition

The "Base Condition" (sometimes referred to as the "existing condition") represents existing hydrologic conditions within the CVP/SWP before the WFP is implemented. It includes existing surface water diversions and operating practices/policies (e.g., minimum instream flows, flood control, Delta water quality standards, etc.) of the CVP/SWP. The CVP/SWP modeling includes certain assumptions associated with accretions and depletions from the system which incorporates the exercise of water rights by non-SWP/CVP water users. Modeling was conducted to quantitatively simulate the Base Condition.

For purposes of CEQA, the Base Condition is "the baseline physical conditions by which a lead agency determines whether an impact is significant," in compliance with Section 15125(a) of the State CEQA Guidelines.

Water Forum Proposal Added to the Base Condition

For impact assessment purposes, the additional surface water diversions associated with the WFP are represented by adding the additional diversion amounts negotiated as part of the Draft WFP to the Base Condition (i.e., Base w/WFP). Although the additional WFP diversions assessed would occur gradually over time until approximately the year 2030, analyzing these additional diversion amounts against existing conditions substantially reduces modeling uncertainty and, therefore, provides the best estimate of the incremental impacts that could occur as a result of the additional WFP diversions. Modeling was conducted to quantitatively simulate the increased diversions under the WFP.

FUTURE CUMULATIVE CONDITION

The simulation of the Future Cumulative Condition represents "probable future projects" considering the time frame of the WFP (i.e., 2030), including the WFP, consistent with the State CEQA Guidelines direction for discussion of cumulative impacts in Section 15130(b). The Future Cumulative Condition includes the additional diversion amounts under the WFP together with all other potential future system-wide actions (e.g., 2030 out-of-basin CVP/SWP demands and increased Sacramento Valley demands). Modeling was conducted to quantitatively simulate the Future Cumulative Condition.

No-Project - Constrained Surface Water and Groundwater

The No-Project Alternative—Constrained Surface Water and Groundwater represents a condition at 2030 that could occur if diversions by Water Forum purveyors were constrained by the lesser of future demands, existing capacity, or existing water entitlements (see Section 5.1, Introduction to Alternatives). All other assumptions (e.g., 2030 out-of-basin CVP/SWP demands and increased Sacramento Valley demands) were set at the same levels established for the Future Cumulative Condition. Modeling was conducted to quantitatively simulate this alternative.

Each of the simulations identified above were based on a defined set of modeling assumptions. Appendix G (Water Forum Proposal Technical Memorandum —Hydrologic Modeling) describes PROSIM, the CVP and SWP facilities represented in the hydrologic modeling simulations and includes the hydrologic, operational, and environmental regulatory assumptions defined for each simulation. A summary of the key modeling assumptions and differences between the various model simulations is provided in Table 4.1-1.

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TABLE 4.1-1. WATER FORUM MODELING ASSUMPTIONS

	BASE CONDITION	BASE w/WFP	FUTURE CUMULATIVE CONDITION	NO-PROJECT CONSTRAINED
SWP Demands	Variable 3.6 MAF	Variable 3.6 MAF	Variable 4.2 MAF	Variable 4.2 MAF
CVP Demands				
North of Delta	Based on '95 Land Use & Max Historic Use	Based on '95 Land Use & Max Historic Use	Based on 2020 Land Use & Max Historic Use	Based on 2020 Land Use & Max Historic Use
American River	WF Current Use Estimate	WFA	WFA	Based on Existing Facilities
EBMUD @ I-5	0	0	EBMUD 8/3/98 Proposal	EBMUD 8/3/98 Proposal
South of Delta	3.1 MAF	3.1 MAF	About 3.1 MAF	About 3.1 MAF
CVP Water Allocation				
CVP Settlement / Exchange *	100% - 75% Based on Shasta Index	100% - 75% Based on Shasta Index	100% - 75% Based on Shasta Index	100% - 75% Based on Shasta Index
CVP Ag	100% - 10% Based on Supply	100% - 10% Based on Supply	100% - 10% Based on Supply	100% - 10% Based on Supply
CVP M&I	100% - 50% Based on Supply	100% - 50% Based on Supply	100% - 50% Based on Supply	100% - 50% Based on Supply
Refuge	100% - 50% Based on Supply	100% - 50% Based on Supply	100% - 50% Based on Supply	100% - 50% Based on Supply
Instream Flow Requirements				
Trinity River	340 TAF	340 TAF	390 - 750 TAF	390 - 750 TAF
Sacramento River	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP
Clear Creek	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP
American River	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP
Delta Requirements	Delta Accord	Delta Accord	Delta Accord	Delta Accord
Delta (b)(2) Actions				
Action 1 - VAMP	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP
Action 2 - Old River Barrier	Not Modeled	Not Modeled	Not Modeled	Not Modeled
Action 3 - Additional X2 Days	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP
Action 4 - Freeport Pulse	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP
Action 5 - Ramping SJR	November 20, 1997 (exports only)	November 20, 1997 (exports only)	November 20, 1997 (exports only)	November 20, 1997 (exports only)
Action 6 - XCG closure	Delta Accord	Delta Accord	Delta Accord	Delta Accord
Action 7 - July Flows and Export	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP	November 20, 1997 AFRP
Action 8 - Smolt Evaluation	Not Modeled	Not Modeled	Not Modeled	Not Modeled
Toolbox				
Joint Point of Diversion	Not Modeled	Not Modeled	Not Modeled	Not Modeled
Land Retirement	Not Modeled	Not Modeled	Not Modeled	Not Modeled
(b)(3) - Water Purchase	Not Modeled	Not Modeled	Not Modeled	Not Modeled
Reserve Account	Not Modeled	Not Modeled	Not Modeled	Not Modeled
GW Storage	Not Modeled	Not Modeled	Not Modeled	Not Modeled
Time Shifting	Not Modeled	Not Modeled	Not Modeled	Not Modeled
Temperature Modeling	Delta Accord	Delta Accord	Delta Accord	Delta Accord
Optimal Cold Water Pool Management	Yes	Yes	Yes	Yes
Folsom Lake TCD	No	Yes	Yes	Yes
Flood Control at Folsom	400/670	400/670	400/670	400/670
Hydrology	160-98	160-98	160-98	160-98

* USBR policies are to provide at least a 75% delivery to Settlement and Exchange contractors.
It is also recognized that under some conditions the model might indicate there is an over allocation of CVP resources.

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For the diversions from the American River, Table 4.1-2 illustrates the maximum surface water diversions by each purveyor on the American River system for each of the simulations performed.

Model Simulations

As indicated above, the following quantitative PROSIM model simulations were performed for the DEIR:

- Base Condition
- Water Forum Proposal Added to on the Base Condition
- Future Cumulative Condition
- No-Project —Constrained Surface Water and Groundwater

All other alternatives (as described in Section 5.1) were analyzed qualitatively.

USBR Models Used for Assessment Purposes

PROSIM is a monthly "rule-and-demand-driven" computer simulation model of the CVP and SWP. As a linked-node, mathematical model, PROSIM accounts for demands (i.e., diversions) and gains (i.e., pumping and accretions) within various model segments that make up the geographical area covered by the CVP and SWP. Each model segment, or node, represents a specific river reach of the CVP and SWP. At each node, various physical hydrologic processes (e.g., surface water inflow, accretion flow from another node, groundwater accretion or depletion, and/or surface water diversions) can be simulated or assumed and are thus captured within the accounting structure of the model.

Monthly operations for the following water storage and conveyance facilities were simulated using the PROSIM model:

- Trinity, Whiskeytown, Shasta/Keswick reservoirs, and Spring Creek and Clear Creek tunnels (CVP);
- Oroville Reservoir (SWP);
- Folsom Reservoir and Lake Natoma (CVP);
- Tracy (CVP), Contra Costa (CVP), and H.O. Banks (SWP) pumping plants;
- San Luis Reservoir (shared by CVP and SWP); and
- East Branch and West Branch SWP reservoirs.

Associated with the use of PROSIM are environmental models which rely on the output generated from PROSIM. These models provide quantitative output defining other important environmental parameters that are affected by changes in CVP/SWP operations. These models include USBR's Lower American River Temperature Model, Sacramento River Temperature Model, and Early Lifestage Chinook Salmon Mortality models for both rivers.

TABLE 4.1-2. AMERICAN RIVER MAXIMUM SURFACE WATER DIVERSIONS

	BASE CONDITION	BASE w/WFP				FUTURE CUMMULATIVE CONDITION				NO-PROJECT CONSTRAINED
	(1998) *Acre-Feet*	Wet/Avg. Years *Acre-Feet*	Drier Years *Acre-Feet*	Driest Years *Acre-Feet*	Notes	Wet/Avg. Years Acre-Feet	Drier Years Acre-Feet	Driest Years Acre-Feet	Notes	(2030) *Acre-Feet*
Upstream of Folsom Reservoir										
Placer County Water Agency	8,500	35,500	35,500	35,500	(1) (3)	35,500	35,500	35,500	(1) (3)	21,000
Georgetown	10,000	18,700	18,700 to 12,500	12,500	(1)	18,700	18,700 to 12,500	12,500	(1)	10,400
El Dorado Irrigation District	15,000	33,350	33,350 to 29,900	29,900	(1)	33,350	33,350 to 29,900	29,900	(1)	15,080
Folsom Reservoir										
Northridge Water District	0	29,000	0	0	(8) (2)	29,000	0	0	(8) (2)	0
City of Folsom	15,000	34,000	34,000 to 20,000	20,000	(1)	34,000	34,000 to 20,000	20,000	(1)	20,000
Folsom Prison	2,000	2,000	2,000	2,000		2,000	2,000	2,000		2,000
San Juan Water District					(1)				(1)	
Placer County	10,000	25,000	25,000 to 10,000	10,000		25,000	25,000 to 10,000	10,000		25,000
Sacramento County	44,200	57,200	57,200 to 44,200	44,200		57,200	57,200 to 44,200	44,200		44,200
El Dorado Irrigation District	5,000	15,050	15,050 to 9,000	9,000	(1)	15,050	15,050 to 9,000	9,000	(1)	7,550
City of Roseville	23,000	54,900	54,900 to 39,800	39,800	(1) (4)	54,900	54,900 to 39,800	39,800	(1) (4)	27,000
Folsom South Canal										
Southern California Water Company/ Arden Cordova Water Company	3,500	5,000	5,000	5,000		5,000	5,000	5,000		10,000
California Parks and Recreation	0	5,000	5,000	5,000		5,000	5,000	5,000		5,000
SMUD	15,000	30,000	30,000 to 15,000	15,000	(1)	30,000	30,000 to 15,000	15,000	(1)	30,000
South Sacramento County Agriculture	0	35,000	0	0	(8)	35,000	0	0	(8)	0
Canal Losses	1,000	1,000	1,000	1,000		1,000	1,000	1,000		1,000
American River - Nimbus to I-5										
City of Sacramento	50,000	up to 96,300	up to 96,300	50,000	(5)(6)	up to 96,300	up to 96,300	50,000	(5)(6)	90,000
Arcade Water District	2,000	11,200	11,200	3,500	(1)(6)	11,200	11,200	3,500	(1)(6)	3,500
Carmichael Water District	8,000	12,000	12,000	12,000	(1)	12,000	12,000	12,000	(9)(1)	12,000
American River - at I-5										
EBMUD	0	0	0	0		EBMUD 8/3/98 Proposal				EBMUD 8/3/98 Proposal
Sacramento River										
Placer County Water Agency	0	35,000	35,000	35,000		35,000	35,000	35,000		0
City of Sacramento	45,000	up to 80,600	up to 80,600	up to 80,600	(5)(6)	up to 80,600	up to 80,600	up to 80,600	(5)(6)	81,800
Sacramento County Water Agency	0	up to 78,000	up to 78,000	up to 78,000	(7)	up to 78,000	up to 78,000	up to 78,000	(7)	0

(1) Wet/average year conditions when Folsom Reservoir March through November unimpaired inflow exceeds 950,000 ac-ft; drier year conditions when the March through November unimpaired flow is less than 950,000 ac-ft and greater than 400,000 ac-ft; driest conditions when the March through November unimpaired inflow is less than 400,000 ac-ft.

(2) Delivery of 29,000 ac-ft when Folsom Reservoir March-November unimpaired inflow is greater than 1,600,000 ac-ft, diversion moved to Sacramento River when March-November unimpaired inflow is less than 1,600,000 ac-ft.

(3) Continue to divert 35,500 ac-ft, with a replacement to the river equivalent to their drier year diversions above baseline. Replacement water up to 27,000 ac-ft. in driest years.

(4) Decreasing from 54,900 ac-ft to 39,800 ac-ft with a replacement to the river equivalent to their drier year diversions above baseline. Replacement water up to 20,000 ac-ft. in driest years.

(5) Total City of Sacramento future level diversion is 130,600 ac-ft.

(6) Driest year conditions when Folsom Reservoir March through November unimpaired inflow is less than 400,000 ac-ft.

(7) SCWA demand of 78,000 ac-ft represents 45,000 ac-ft of firm entitlements and 33,000 ac-ft of intermittent surplus supply.

(8) Delivery of zero ac-ft when the Folsom Reservoir March through November unimpaired inflow is less than 1,600,000 ac-ft.

(9) Carmichael Water District's diversion in 1998 is restricted by non-compliance with the Surface Water Treatment Rule requiring the blending of surface water with groundwater. Facility capacity or current demand does not restrict the diversion of 8,000 AF.

70-Year Hydrologic Period of Record

The hydrologic period of record used in PROSIM modeling included the years 1922 through 1991 (70 years). The period of record used for water temperature modeling and the associated simulations for early life stage chinook salmon mortality included the period 1922 through 1990 (69 years) because the temperature model operates on a calendar year, rather than a water year, basis. These periods are considered representative of the natural variation in climate and hydrology experienced throughout the Central Valley during recent times, and include periods of extended drought, high precipitation and runoff, and variations in between.

Upstream Middle Fork Project Re-Operation

The Department of Water Resources' (DWR) Upper American River Model was modified and used in conjunction with spreadsheet tools to simulate the upper American River system. The upper American River simulations were performed by using the U. S. Army Corps of Engineers' HEC-III program for hydrologic routing and storage accounting purposes, and spreadsheets to determine operations, including water rights diversions, storage releases for water rights diversions, storage releases for power generation and storage rights restrictions. By using this approach of coupling the HEC-III model and spreadsheets, modeling of constraints and operations were accomplished even though they are not possible to model in HEC-III alone.

Revised CVP/SWP Hydrological Database

Numerous updates and refinements were recently incorporated into the PROSIM model, and its associated hydrologic inputs, by USBR. These updates and refinements included, but were not limited to, the following:

- revising the theoretical storage operation which corrected an overestimation of available water in the Sacramento River;
- redevelopment of CVP deficiency criteria;
- inclusion of SWP interruptible deliveries;
- revising accretions and depletions calculations to more accurately reflect actual conditions;
- revising Trinity River operations to minimize Trinity River exports when surplus water conditions exist in the Sacramento River and Sacramento-San Joaquin River Delta; and
- Department of Interior's Final Administrative Proposal on the Management of Section 3406 (b)(2) Water dated November 20, 1997.

CVP Operational Changes Currently under Consideration by USBR

In addition to the above-mentioned updates and refinements made to PROSIM, USBR also is currently reviewing its coordinated future CVP/SWP operations to address compliance with existing and anticipated future environmental requirements and objectives. USBR may be required to operate its dams and reservoirs differently under future conditions including when purveyors in the Water Forum exercise their water entitlements (i.e., senior water rights and CVP water rights). USBR's changed operation could affect their ability to meet their environmental and water delivery obligations including protection of the Sacramento River and Delta resources. For instance, deliveries to some CVP water service contractors, including certain Water Forum purveyors, could be subject to greater and more frequent deficiencies than is currently the case.

When faced with instream and consumptive water supply demands that exceed the CVP water supply available to USBR at any given time, USBR must make decisions as to which demands should be subject to deficiencies, and to what extent. These decisions are made by USBR in its role as manager of the CVP. In order to run a model predicting the WFP's potential impacts on hydrologic resources that are controlled largely by the operations of the CVP, it is necessary to input into the model assumptions as to how USBR will operate CVP facilities at times when demands exceed available supply (e.g., which demands should be subject to deficiencies, and to what extent). To analyze the WFP's potential effects on the current hydrological condition, these operational assumptions are determined based on USBR's current operations criteria.

A large degree of speculation and uncertainty exists when attempting to characterize the study area 30 years into the future, particularly recognizing the dynamic nature of decisions about water supply and resource protection in the Sacramento and San Joaquin River system. Therefore, it is difficult to define any one scenario as the reasonably foreseeable probable future. Nonetheless, to fulfill the requirements of State CEQA Guidelines §15355, to address future cumulative conditions, the programmatic analysis of this WFP uses one scenario as a good faith effort to assess future cumulative potential effects. The scenario was developed after a year of extensive discussions between the Water Forum technical consultants and the USBR and USFWS. Given all of the competing demands for water and water resource limitations, one outcome that is not speculative is the occurrence of significant impacts of some type in the future.

In the year 2030, significant operational changes likely will be required to respond to the increasing contractual and environmental demands to which the CVP will be subjected, as well as the future demands of in-basin water users exercising rights senior to the CVP. Precisely what these changes will be is currently unknown. Predicting different possible operational responses to these increasing demands could lead to a variety of possible outcomes that entail different hydrologic impacts, depending on which demands are subject to deficiencies, at what times, and to what extent. For example, if it is predicted that, in the year 2030, USBR will impose dry year deficiencies upon instream demands to satisfy CVP water service contract demands, greater environmental impacts would be expected than if it is predicted that USBR will accord environmental requirements as an absolute priority over deliveries to CVP water service contractors (e.g., by imposing more extreme deficiencies on CVP water service contractors before making any reductions in deliveries for instream needs).

In order to perform a quantitative cumulative condition analysis for the WFP, certain CVP operational assumptions were selected for input into the modeling for this analysis. The assumptions selected, and the rationale for their selection, are further described in Appendix G.

Although these assumptions are necessarily speculative, as discussed above, they represent one possible scenario for operation of the CVP in the year 2030, and so provide a basis for discussing potential cumulative impacts, as required by CEQA. The State CEQA Guidelines, §15130(b), advise that cumulative impact discussion should be "guided by standards of practicality and reasonableness." This does not mean, however, that the assumptions used for this cumulative condition analysis describe the only possible future CVP operational scenario. If a different project were being analyzed, it might be appropriate and reasonable to use different CVP operational assumptions for the year 2030 analysis.

For example, the project being analyzed in this document (the WFP) includes water deliveries to CVP water service contractors, as well as settlement contractors and other in-basin water users exercising rights senior to the CVP. Because the WFP includes future deliveries to CVP water service contractors, it was determined that it would not be appropriate to assume that, in the year 2030, CVP operations will impose deficiencies as necessary on CVP water service contractors before making any reductions in deliveries for instream needs. However, this latter assumption could be found to be entirely reasonable for the cumulative condition analysis conducted for a project that does not include any CVP water service contracts, such as a project proposed to meet only the future demands of a settlement contractor or other in-basin water user exercising rights senior to the CVP, due to the legal priority of such demands over the delivery of water to CVP water service contractors. The cumulative condition analysis of such a project would likely involve other, different CVP operational assumptions as well. Using different assumptions to predict future CVP operations would likely result in different predicted changes to the cumulative condition of hydrologic resources influenced by the operations of the CVP, but the cumulative condition predicted could still constitute a reasonable foreseeable future condition as required under CEQA for that project.

Impact Assessment Methodology

Several comparisons of the modeling output generated for the specific simulations were necessary for the DEIR analysis and presentation of potential impacts. The impact assessment methodology needed to consider identification of the WFP increment as well as the time frame of analysis (i.e., Base Condition versus future condition).

Conditions under the Water Forum Proposal added to the Base Condition were compared relative to the Base Condition. Acknowledging that the WFP represents an agreement with 2030 demands, this comparison reduced modeling uncertainty by maintaining a consistent time frame and, therefore, provided the best estimate of the incremental impacts that could occur due to the additional WFP diversions.

Additionally, conditions under the Future Cumulative Condition were compared relative to the Base Condition. This assessment provided the cumulative analysis and included reasonably foreseeable future actions/programs, including the WFP.

Potentially Beneficial Future Actions That Cannot be Modeled

In compliance with CEQA and the State CEQA Guidelines, the impact assessment approach focused on identifying the potential effects resulting from implementation of the WFP (i.e., the proposed project). It should be acknowledged, however, that numerous programs are either underway or planned, that are designed to improve fishery conditions for Sacramento River fisheries, particularly salmonid fisheries. These programs include:

- Anadromous Fish Restoration Program (AFRP) of the CVPIA; and
- Ecosystem Restoration Program Plan of the CALFED Bay-Delta Program.

When implemented over the next few decades, these and other future programs are expected to improve fishery conditions across the Sacramento River. However, it is not possible to quantify all of the expected benefits of these programs at this time. Therefore, the quantitative analyses and impact determinations in this DEIR do not reflect the anticipated benefits of those programs.

4.1.5 RESPONSE TO IMPACTS ON THE SACRAMENTO RIVER AND THE BAY-DELTA

As discussed previously, the WFP already includes many provisions that would reduce impacts. These include potential aquatic impacts of increased diversions on the Sacramento River and the Bay-Delta. Even with these actions, unless additional water supplies are developed or diversions are reduced, there would still be remaining impacts on the Sacramento River and the Bay-Delta, especially under cumulative conditions, based on the scenario addressed in this EIR (refer to Table 2-3 and Chapter 6).

In one sense the WFP, in and of itself, cannot have a direct impact on the Sacramento River upstream of the American River since the direct impact of the WFP on the Sacramento River can only be felt downstream of the American River. Upstream impacts are necessarily indirect with the actual impact that may occur, in fact, based upon how the CVP or SWP may choose to operate in response to the implementation of the WFP elements. WFP is not directly responsible for these CVP or SWP actions nor can it control them. Nonetheless, for the purpose of providing full disclosure of possible impacts, direct and indirect, this document includes analysis of indirect impacts on the Sacramento River upstream of the American River.

When purveyors in the American River watershed exercise area of origin water rights, it will reduce the amount of water available from Folsom Reservoir for use by USBR in meeting Sacramento River and Bay-Delta environmental and water delivery obligations. The USBR will have to operate its entire system, including Shasta and Folsom Reservoirs, differently in order to meet those obligations. Unless additional supplies are developed or diversions are reduced, this would result in impacts on the Sacramento River, above and below the American River, and the Bay-Delta.

The USBR will be involved in almost all of the diversion projects included in the WFP. In some cases the USBR needs to issue a contract for a new water supply. In other cases, it has to sign a Warren Act agreement or grant a right-of-way.

In order to take any of these actions, the USBR is required to consult with the resource agencies under Section 7 of the Endangered Species Act (ESA). In addition to Water Forum actions, the consultation will also cover the USBR's entire Operational Criteria and Plan (OCAP) for the Central Valley Project.

Under the ESA, the USBR is prohibited from taking any actions that will jeopardize the continued existence of threatened or endangered species. Resource agencies participate in the ESA process by developing biologic objectives for species listed or proposed for listing. Biological objectives serve as specific performance criteria which are included in the biological opinions under the ESA. The USBR is required by the ESA to operate the Central Valley Project in a way that meets the biologic objectives set for each species listed or proposed for listing.

Because resource agencies are in the process of developing these biological objectives, it is impossible to specify performance criteria at this time. That uncertainty is combined with uncertainty over the extent and effectiveness of several future actions to protect Sacramento River and Bay-Delta resources. Therefore, it is impossible at this time to formulate specific mitigation measures for Sacramento River or Bay-Delta aquatic impacts or to assign responsibility for the mitigation.

The Water Forum EIR is a program EIR and it is recognized that individual projects included in the WFP will need to comply with CEQA and, where applicable, the National Environmental Policy Act and the state and federal endangered species acts. Compliance with the state and federal Endangered Species Acts (ESA) may result in diversion restrictions or other conditions beyond those that are included in the WFP.

4.2 GROUNDWATER RESOURCES

Groundwater is an important water supply source for urban and agricultural uses in Sacramento County and Placer County. El Dorado County has limited groundwater resources which are not likely to be developed. Demand for groundwater in the portions of the water service study area is expected to increase in the future. This chapter examines the effects of implementing the WFP on the regional groundwater resources. The analysis was conducted using the available data from the Integrated Groundwater-Surface Water Model (IGSM) which simulated the change in groundwater levels resulting from various levels of groundwater yield (see Appendix E, *Baseline Conditions for Groundwater Yield Analysis, Final Report,* May 1997).

The direct effect study area for groundwater resources is Sacramento County. Although Sacramento County's groundwater resource is a part of the aquifer system shared with Placer, Sutter, and San Joaquin counties, the following analysis focuses on Sacramento County, the area for which the Water Forum has made groundwater sustainable yield recommendations. The bordering counties are included in the analysis only by inclusion of groundwater boundary conditions explained under Section 4.2.3, Impact Assessment Methodology.

4.2.1 <u>EXISTING CONDITIONS</u>

An extensive groundwater aquifer system underlies the Central Valley. Three groundwater basins exist within this region including the San Joaquin County groundwater basin, Sacramento County groundwater basin, and the portion of Sacramento Valley groundwater basin south of the Bear River (SMWA and USBR, 1996).

The San Joaquin County groundwater basin is in a state of overdraft. In 1990, the San Joaquin groundwater basin was overdrafted by 210,000 AF. This overdraft has caused water movement from surrounding areas, including poor quality saline water (DWR, 1994). The portion of the Sacramento Valley groundwater basin south of the Bear River is characterized by shallow, near-surface groundwater levels which deepen toward the south. This basin is not considered to be in an overdraft condition (SMWA and USBR, 1996). The Sacramento County groundwater basin is described in more detail below.

SACRAMENTO COUNTY GROUNDWATER BASIN

In Sacramento County, about 20,000 feet of marine sediments overlie the basement rocks of the Great Valley geomorphic province and generally contain saline water. Continental deposits overlie the marine rocks and act as the primary freshwater aquifer for Sacramento County. The important water-bearing formations include the Valley Springs Formation, the Mehrten Formation (the most productive formation), the Laguna Formation, the Fair Oaks Formation, and some Pleistocene gravels and alluvium (SCWA, 1993). The useable groundwater in the Sacramento County aquifer is divided into a shallow aquifer zone and an underlying deeper aquifer zone. The deeper aquifer is separated from the shallow aquifer by a discontinuous clay layer. The thickness of the deeper aquifer ranges from 200 to 1600 feet in Sacramento County and contains water of poor quality. Sacramento County water purveyors draw groundwater from both the shallow and deep aquifer systems (SCWA, 1997).

The aquifer system in Sacramento County is recharged naturally through three primary processes: 1) deep percolation, 2) stream recharge, and 3) boundary flows. Deep percolation consists of rainfall and irrigation water percolating into unconsolidated substrata. Stream recharge consists of water percolating into the streambed under positive head differences and recharging the underlying aquifer. Boundary flows occur when local and regional groundwater migrate along the gradient of total potential. In Sacramento County, based on 1990 investigative modeling, the average annual recharge to this groundwater system was approximately 474,000 AF. Of this amount, it was estimated that approximately 45% of the groundwater recharge occurred through river and stream recharge. Deep percolation contributes approximately 35% with boundary flows making up the remaining 20% (SCWA, 1995).

The Sacramento County groundwater basin has been divided into three hydraulically continuous subareas by the county's basin management studies (SCWA, 1997) (Exhibit 4.2-1):

- Sacramento North Area (north of the American River)
- South Sacramento Area (between the American River and Cosumnes River)
- Galt Area

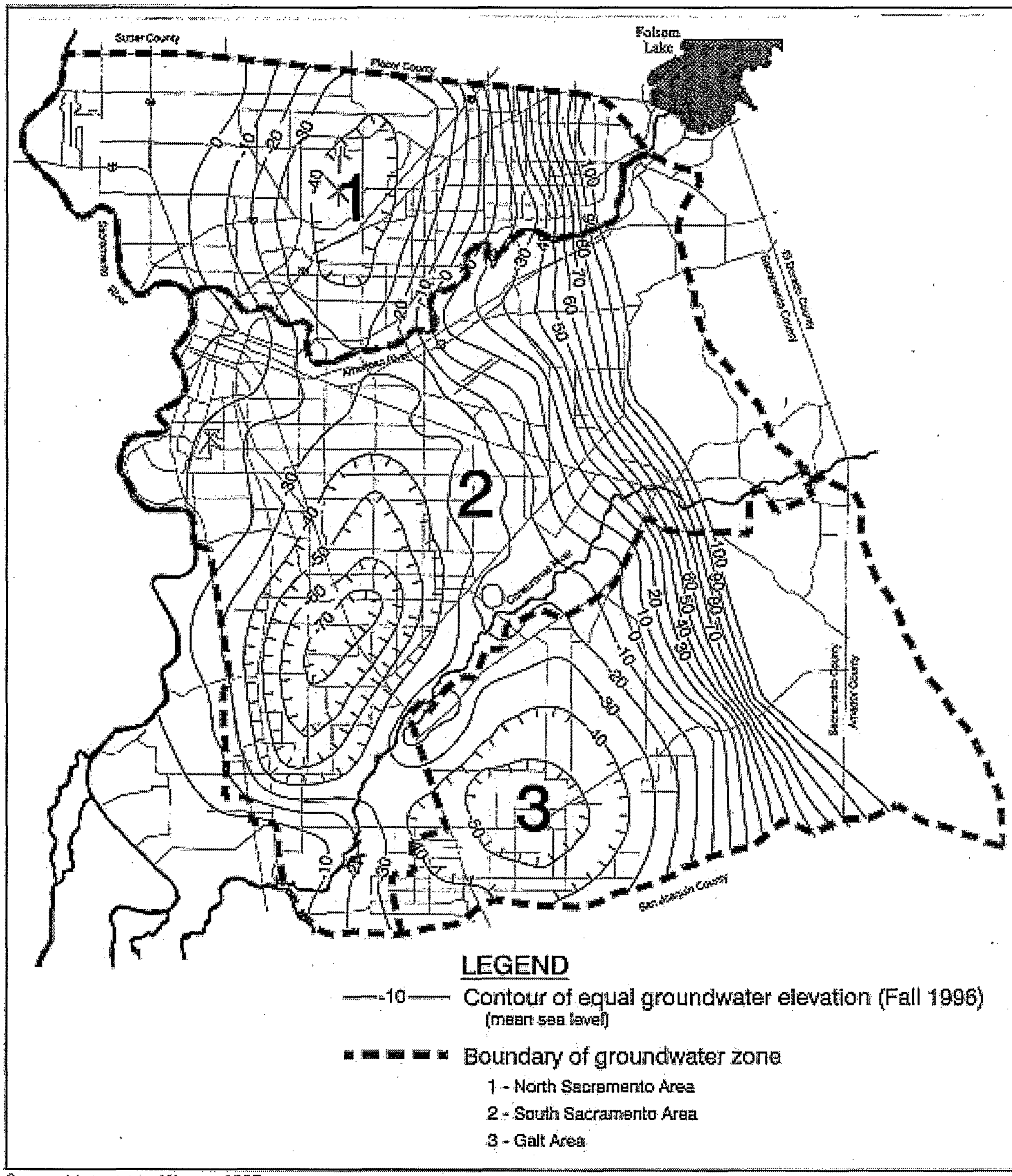
Each area is presently characterized by a cone of depression. Based on 1990 data, the Sacramento North Area has a cone of depression that extends to -60 feet mean sea level (msl), the South Sacramento Area's cone of depression extends to -80 feet msl, and the Galt Area's cone of depression extends to -40 feet msl.

GROUNDWATER USE

In Sacramento County, groundwater has and will likely continue to represent an important supply source for both urban and agricultural uses. Groundwater accounted for an average of 58% of the total water supply between 1970 and 1990 (SCWA, 1993).

The following purveyors utilize the groundwater basin for some or all of their water supply. Residents, businesses and agriculturists also pump groundwater from the basin.

SACRAMENTO NORTH AREA: Arcade Water District, Arden Cordova Water Service (Arden area), Carmichael Water District, Citizens Utilities Company of California (portion), Citrus Heights Water District, City of Sacramento, Del Paso Manor Water District, Fair Oaks Water District, McClellan AFB, Sacramento International Airport, Northridge Water District, Orange Vale Water Company, Rio Linda Elverta Community Water District, Sacramento County Water Maintenance District (portion).



Source: Montgomery Watson, 1997.

Sacramento County Groundwater Zones and Elevations

EXHIBIT 4.2-1

WATER FORUM PROPOSAL EIR

SOUTH SACRAMENTO AREA: Arden Cordova Water Service (Cordova area), Citizens Utilities Company of California (portion), City of Sacramento, Elk Grove Water Works, Florin County Water District, Fruitridge Vista Water Company, Mather AFB, Omochumne-Hartnell Water District (portion), Sacramento County Water Maintenance District (portion), Tokay Park Water Company, Sacramento County Water Agency Zone 40.

GALT AREA: City of Galt, Clay Water District, Galt Irrigation District, Omochumne-Hartnell Water District (portion).

Groundwater can be managed to reduce groundwater overdraft and maintain water quality. Two methods of managing groundwater include developing and maintaining a sustainable yield for a groundwater basin and undertaking a conjunctive use program. Sustainable yield is defined as the amount of groundwater which can be safely pumped from the groundwater basin over a long period of time while maintaining acceptable groundwater elevations and avoiding undesirable effects, which may include increased pumping costs, accelerated movement of underground pollutants, etc. Sustainable yield requires a balance between pumping and basin recharge and will accommodate pumping from the basin on a long-term average annual basis.

Conjunctive use is the planned management and use of both groundwater and surface water in order to improve the overall reliability of a region's total water supply. For example, in wet years when surface water is plentiful, groundwater pumping may be reduced or eliminated. As a result, the groundwater basin would be replenished during these wet years. In dry years with surface water in short supply, groundwater would be pumped for use and surface water diversions would be reduced or eliminated. For purveyors currently reliant on groundwater for the vast majority of their water supply, additional surface water diversions would be required in order for them to implement a conjunctive use program.

GROUNDWATER MANAGEMENT ELEMENT OF THE WATER FORUM PROPOSAL

The Groundwater Management Element provides recommendations on groundwater sustainable yield and includes the basic provisions for a groundwater management governance structure. The purpose of groundwater management under the WFP is to maintain access to a safe and reliable supply of water. The Groundwater Management Element states that a governance structure should recognize the different problems and conditions of each groundwater subarea and provide for local control in each subarea of the basin. Localized control within an overall regional governance structure is seen as the best, most effective means to address these varying problems and conditions. The Sacramento North Area Groundwater Authority, established in August 1998, includes a representative from each water purveyor in the North Area, the cities of Sacramento, and Folsom, and the County of Sacramento. Negotiations for similar arrangements in the South and Galt areas are in progress.

Groundwater sustainable yield recommendations are provided in the WFP by subarea. The groundwater elevations that would be stabilized at the recommended pumping levels have been accepted by the Water Forum.

Sustainable Yield: Sacramento North Area

For the Sacramento North Area, the WFP's recommended estimated average annual sustainable yield is 131,000 AF based on 1990 pumping amounts. The Sacramento North Area would be stabilized at a minimum groundwater elevation of approximately -83 feet msl with a range of -70 to -87 feet msl. This decline of 22 feet from 1990 elevations would occur at the lowest level within the cone of depression.

Sustainable Yield: South Sacramento Area

For the South Sacramento Area, the WFP's recommended estimated average annual sustainable yield is 273,000 AF. This represents the year 2005 projected pumping amounts and exceeds the 1990 pumping by 23,000 AF. The South Sacramento Area basin would stabilize at a minimum elevation of approximately -123 feet msl with a range from -116 to -130 feet msl. This decline of 51 feet from 1990 elevations would occur at the lowest level within the cone of depression.

Sustainable Yield: Galt Area

For the Galt Area, the WFP's recommended estimated average annual sustainable yield is 115,000 AF based on 1990 pumping amounts. The Galt Area basin would stabilize at a minimum elevation of approximately -64 feet msl with a range from -50 to -70 feet msl. This decline of 21 feet from 1990 elevations would occur at the lowest level within the cone of depression.

GROUNDWATER LEVEL DECLINE

Available data indicate that groundwater levels in Sacramento County were fairly stable at an average of 30 feet msl between 1930 and 1940. Between 1941 and 1970, however, the county-wide average groundwater elevations declined to about -5 feet msl (SCWA, 1993). Since 1970, with steadily increasing groundwater pumping, groundwater levels and groundwater storage have declined across Sacramento County and in other counties in the Central Valley. For the Sacramento County groundwater basin, natural groundwater recharge has been unable to maintain equilibrium with pumping; therefore, the basin has not stabilized.

Prolonged pumping has resulted in a cone of depression in each of the subareas previously described (Exhibit 4.2-1). While the cone of depression in the Galt Area has resulted primarily from agricultural pumping, the cone of depression in the South Sacramento Area is attributed to a more even contribution of urban and agricultural pumping. The cone of depression in the Sacramento North Area has resulted from prolonged pumping within the City of Sacramento Place of Use (POU) as well as in neighboring areas (USBR and SMWA, 1996). Declines in groundwater levels can result in the cessation of operations of wells, degradation of groundwater quality, increase in rate of movement of groundwater contaminants, and land subsidence.

GROUNDWATER QUALITY

Title 22 of the *California Code of Regulations* contains standards for drinking water quality. Groundwater in the Sacramento North Area presently meets Title 22 drinking water quality standards. For the aquifers of the South Sacramento and Galt areas, Title 22 water quality standards are met with the exception of iron and manganese which levels exceed secondary standards related to aesthetic concerns. Elevated levels of iron and manganese do not pose a health hazard but may result in odor, taste, and color problems and staining of plumbing fixtures and laundry. The secondary drinking water standards for iron and manganese are 300 and 50 mg/l (parts per billion), respectively. Arsenic and radon have also been measured in the groundwater in the study area, although not at levels exceeding the current drinking water standards. Arsenic is presently regulated by the DHS with a primary drinking water standard of 50 mg/l; a new standard for arsenic has been proposed. No drinking water standard had been set for radon (SCWA, 1997).

An analysis was performed to determine whether historical groundwater level declines have influenced up-rising of poor quality water from the deeper aquifer zones in Sacramento County (SCWA, 1997). The analysis showed that degradation of groundwater quality in Sacramento County can indirectly result from lowered groundwater levels. As groundwater levels decline and a cone of depression develops, the potential in-migration of poorer-quality groundwater from the deeper aquifer is accelerated. There are also 9 sites within Sacramento County identified as having significant locally contaminated groundwater due to past and present industrial uses (SCWA, 1997). A separate discussion of groundwater contamination sites is provided below.

Sacramento North Area

Average concentrations of iron, manganese, and arsenic in the Sacramento North Area have remained below the maximum contaminant levels (MCL) specified in Title 22. Results from the analysis mentioned above have shown that changes in concentrations of iron, magnesium, and arsenic in the Sacramento North Area are not directly related to a decline in groundwater levels (SCWA, 1997). At present, groundwater treatment is not provided at any wells in the Sacramento North Area.

South Sacramento Area

The analysis mentioned above indicated that, in the South Sacramento and Galt areas, groundwater level declines of over 80 feet (from predevelopment conditions) result in average manganese concentrations exceeding the secondary MCL. The average concentration of manganese and arsenic show a notable increase in areas of groundwater level decline in the South Sacramento Area, which is related to uprising of poor quality water from the lower Mehrten Formation mixing with upper shallow aquifer zones (SCWA, 1997). Currently, CUCC provides treatment for ten of its wells and Sacramento County Water Maintenance District provides treatment for six wells (SCWA, 1997).

Galt Area

Water quality data were only available from municipal wells that had over 80 feet of groundwater level decline since pre-development conditions. Average concentrations of manganese and arsenic in the Galt Area are similar to that of the South Sacramento Area. Iron concentrations average 260 μg/l, much higher than in the other county areas for the same level of groundwater level decline (SCWA, 1997). The City of Galt currently provides treatment for 5 of its 12 wells (SCWA, 1997).

GROUNDWATER CONTAMINANTS

Within Sacramento County, nine sites have been identified as having significant locally contaminated groundwater. These sites include the following four USEPA Superfund sites: Aerojet Corporation, Mather AFB, McClellan AFB, and the Sacramento Army Depot. Other sites include the Kiefer Landfill, the abandoned PG&E site adjacent to the Sacramento River near Old Sacramento, the Southern Pacific Railroad yards in downtown Sacramento and the City of Roseville, and the Union Pacific Railroad Yard in downtown Sacramento (SCWA, 1997). See Appendix E for a discussion of each of these groundwater contamination sites.

Some of the groundwater contamination sites within Sacramento County have directly affected drinking water wells. Remediation efforts are underway at all of the nine sites. However, additional drinking water wells may be affected if the contaminants at these locations continue to migrate off-site (SCWA, 1997).

LAND SUBSIDENCE

Land subsidence could result from the lowering of groundwater levels. The compaction of water-bearing deposits caused by intensive groundwater pumping is known to have occurred in certain areas in Sacramento County. Minor land subsidence was observed between 1912 and the late 1960s for the Sacramento North, South Sacramento, and Galt areas with corresponding decreases in groundwater levels. Generally, subsidence did not exceed 0.40 feet during this period (SCWA, 1997).

REGULATORY SETTING

Water Quality Control Plan for the Sacramento/San Joaquin River Basin (Basin Plan)

The Basin Plan, adopted by the Regional Water Quality Control Board on December 9, 1994 and approved by the SWRCB on February 16, 1995, provides water quality objectives and standards for the groundwater resources of the Sacramento and San Joaquin Basins. The Basin Plan states that groundwater designated for use as a municipal supply shall not contain concentrations of chemical constituents in excess of the MCL specified in the provisions of Title 22 of the *California Code of Regulations.* The Basin Plan contains objectives for other groundwater quality parameters, including bacteria, radioactivity, taste and odor, and toxicity.

The Basin Plan also contains policies for the investigation and cleanup of sites that leak contaminants into groundwater.

Title 23, Chapter 15 of the *California Code of Regulations* (Chapter 15)

Chapter 15 regulates waste discharge to land areas. The regulations establish waste management requirements for waste treatment, storage, or disposal in landfills, surface impoundments, waste piles, land treatment facilities, and other waste management units. They include minimum standards for the proper management of each waste category. The RWQCB issues Waste Discharge Requirements (WDR) to any facility that may discharge waste into waterbodies, including groundwater, according to Chapter 15. The WDR include a groundwater monitoring program which is designed to determine if leakage from solids storage and disposal facilities is occurring and affecting groundwater quality.

4.2.2 THRESHOLDS OF SIGNIFICANCE

The significance criteria described below have been developed for use in assessing potential affects to groundwater quantity and quality resulting from the implementation of the WFP. Significance criteria were applied to the results of modeling simulations described under Section 4.2.3, Impact Assessment Methodology, to determine the level of significance of the impacts.

Appendix G, the Environmental Checklist in the State CEQA Guidelines, provides general guidance about ground water effects that may be deemed significant. For this EIR, and in accordance with the State CEQA Guidelines, changes in groundwater quantity and/or quality were considered to represent a significant impact to the regional groundwater resources if the WFP would result in:

- Groundwater quality not meeting the Title 22 of the California Code of regulations for drinking water standards;
- Substantial increases in groundwater movement rates such that groundwater contaminants in each of the nine sites identified above threaten to affect additional wells;
- Substantial increase in the risk of land subsidence caused by declines in groundwater level.
- The decrease of both the yield and efficiency of a substantial percentage of municipal, agricultural, or rural domestic wells, indicating that groundwater levels dropped below the pump opening;

4.2.3 IMPACT ASSESSMENT METHODOLOGY

The IGSM was used to analyze the impacts of the WFP on groundwater levels in Sacramento County. The IGSM was developed for the Sacramento area groundwater basin as a water planning tool and can be used to predict the groundwater conditions under a variety of "what if" scenarios. It is capable of simulating the long-term effects of prolonged groundwater pumping on groundwater levels within Sacramento County (SCWA, 1997). To analyze the conditions at the boundaries of the Sacramento County aquifer, the groundwater models of the San Joaquin and Sutter/Placer Counties were linked to the Sacramento County IGSM. This linkage is explained under "Assumptions Used in the IGSM." The assumptions and results of IGSM are described in Sacramento County Water Agency's *Baseline Conditions for Groundwater Yield Analysis*, Final Report (May, 1997) and are summarized below (see Appendix E).

The IGSM simulated six scenarios, each of which represented a static condition of land use and corresponding water demands. The output of each simulation is the resulting groundwater elevations over a 70-year period, starting with groundwater elevations assumed in present (1990) conditions. The six scenarios developed for this investigation included year 1990 with a 25% level of groundwater conservation, 1990 (without conservation), 2000, 2010, 2020, and 2030. Each IGSM scenario is referred to as a Baseline Condition (not to be confused with Base Condition), which is the existing condition.

The Baseline Conditions of interest for the purpose of determining impacts on groundwater levels under the WFP are the 1990 and 2010 Baseline Conditions. These two Baseline Conditions represent the sustainable yields proposed in the WFP. As mentioned earlier, the WFP recommends sustainable yield objectives for each subarea of the groundwater basin within the County. These recommended sustainable yields are presented below with the corresponding Baseline Condition used for analysis of the recommended yield:

- 131,000 AFY yield for the Sacramento North Area was analyzed using the 1990 Baseline Condition
- 273,000 AFY yield for the South Sacramento Area was analyzed using the 2010 Baseline Condition (the 2005 condition, on which these recommended pumping levels are based, was not modeled)
- 115,000 AFY yield for the Galt Area was analyzed using the 1990 Baseline Condition

The following discussion of the IGSM simulations includes descriptions of key assumptions used in the IGSM and results of the simulations. Impacts resulting from groundwater level declines were determined using the IGSM results.

ASSUMPTIONS USED IN IGSM

Assumptions were made for the following parameters for each of the Baseline Conditions:

- Land use and water demands;
- Water supply (quantities of surface and groundwater supplies);
- Location and depth of groundwater pumping;
- Hydrologic conditions;
- Boundary conditions; and
- Initial conditions.

Each of the six Baseline Conditions analyzed by the model represents a particular level of development and the associated increases in water demands in the county up to the buildout conditions indicated in the 1993 Sacramento County General Plan. The 2030 Baseline Condition assumed a level of development corresponding with buildout of the Urban Policy Area (UPA) described in the 1993 Sacramento County General Plan. Rainfall was assumed to be the same as the historical rainfall from 1922 to 1991. Assumptions regarding water supply and boundary conditions significantly influence the IGSM results and are, therefore, more fully described below. Detailed descriptions of the other assumptions are contained in Appendix E, *Baseline Conditions for Groundwater Yield Analysis*, Final Report (May, 1997).

Water Supply

The water use and water supply assumptions for the 1990 and 2010 Baseline Conditions are contained in Table 4.2-1. The information in this table indicates that most of the water supply is provided from groundwater sources. In addition, the Baseline Conditions assume that the existing levels of surface water supply will remain at present levels with the following exceptions (SCWA, 1997):

- The City of Folsom, Rancho Murieta and SMUD (Rancho Seco) are presently served solely by surface water and are located in areas with limited groundwater availability. The Baseline Conditions assume that all demands in these areas will continue to be met through surface water supplies.

- The City of Sacramento has water rights from the American River. The American River POU encompasses the City of Sacramento as well as adjacent areas outside the city limits. A portion of the area outside of the city is served by other water purveyors (i.e., CUCC, Florin County Water District, and Fruitridge Vista Water Company) with the remainder undeveloped. The Baseline Conditions assume that all additional demands within the city limits, and new demands in areas presently outside existing water purveyor boundaries within the POU, will be met through surface water. However, additional demands within the POU that are within existing water purveyor boundaries are assumed to be met by additional groundwater pumping.

Table 4.2-1 contains data on assumptions made with regards to land use and water supply conditions for the model runs at 1990 and 2010 used in the analysis.

Table 4.2-1
Summary of Assumptions for the
1990 Baseline Condition and the 2010 Baseline Condition

Land Use (Acres)	1990 Baseline Condition	2010 Baseline Condition
Agriculture		
Sacramento North Area	21,188	14,612
South Sacramento Area	49,253	45,899
Galt Area	27,041	27,085
Total	97,482	87,596
Urban		
Sacramento North Area	81,199	92,313
South Sacramento Area	78,896	111,065
Galt Area	5,950	9,720
Total	166,045	213,098
Water Use (AF)		
Agriculture		
Sacramento North Area	76,499	47,166
South Sacramento Area	183,344	162,737
Galt Area	98,988	94,511
Total	358,831	304,414
Urban		
Sacramento North Area	192,174	235,167
South Sacramento Area	163,259	284,304
Galt Area	33,528	41,500
Total	388,961	560,971
Total Water Use	747,792	865,385
Water Supply (AF)		
Groundwater		
Sacramento North Area	131,085	145,208
South Sacramento Area	250,336	299,435
Galt Area	115,292	111,079
Total	496,713	555,722
Surface Water		
Sacramento North Area	137,589	137,124
South Sacramento Area	96,270	147,605
Galt Area	17,224	24,934
Total	251,083	309,663
Total Water Supply	747,796	865,385

Note: The 1990 Baseline Condition was used for the impact analysis for the Sacramento North and Galt areas and 2010 Baseline Condition was used for the South Sacramento Area.

Source: SCWA, 1997

Hydrologic Conditions

With respect to hydrologic condition assumptions, streamflow projections were developed from USBR operations models utilizing the 2020 level of development over the historical 1922-91 hydrologic period. These streamflow projections are based on the projected levels of demands and river diversions in the Sacramento and American Rivers. Streamflows in the Sacramento and American Rivers are dependent on the level of water diverted and the operations of upstream reservoirs. The groundwater levels in large portions of Sacramento County are generally highly dependent on the recharge rate from the rivers (and tributaries), the rivers' stage, and groundwater pumping rates in these areas. As such, if the groundwater pumping does not change substantially, the changes in diversion rates from the rivers will not significantly affect the groundwater. A sensitivity analysis indicated that there is no significant difference in recharge from rivers utilizing the different streamflow projections for the American and Sacramento rivers.

To quantify the impacts on groundwater levels, diversion locations, delivery areas, and associated changes in groundwater pumping need to be considered.

Boundary Conditions

The aquifer of Sacramento County is a part of the regional groundwater basin which extends throughout California's Central Valley. Therefore, the potential exists for groundwater movement to occur between Sacramento County and adjacent areas. Groundwater pumping in adjacent areas can induce groundwater movement from Sacramento County to the adjacent area. Groundwater pumping within the county can induce groundwater movement from the adjacent areas into Sacramento County. The areas adjacent to Sacramento County which are of primary concern are Placer/Sutter counties to the north and San Joaquin County to the south (SCWA, 1997).

Because of the potential impacts that groundwater pumping in the areas adjacent to the county may have both on groundwater levels and groundwater recharge (through subsurface inflows), the specification of the groundwater conditions at the model boundaries is an important consideration in the Baseline Conditions development. Groundwater models of the San Joaquin and Sutter/Placer Counties were developed and linked to the Sacramento County IGSM. Model runs with this linkage were used to develop the boundary conditions for the Baseline Conditions (SCWA, 1997).

The boundary conditions of the model's northern boundary (i.e., Sacramento County's boundary with Sutter and Placer Counties) were simulated interactively via linkage of the Sacramento County model to the North American River model. The boundary conditions of the southern boundary were developed, prior to simulating the Baseline Conditions. The linked models of the Sacramento and San Joaquin counties were used to obtain time variable groundwater levels for the southern boundary. These groundwater levels were imported as input to IGSM. The results of the model for the southern boundary indicate a decline of 20 feet at the boundary. Key assumptions incorporated in the model runs are that: a) urban and agriculture land use and water demands will remain at the existing level of development in San Joaquin County to the south, and b) the existing combination of surface water and groundwater supplies will be utilized to meet these demands.

An exception to this is in the southwestern area of Sutter County and Placer County which is presently pumping groundwater at a rate greater than can be naturally replenished. Although this area presently relies on groundwater for most of its water supplies, it is within the service area of PCWA which has sufficient surface water entitlements to supply the area with surface water. However, at present, the facilities are not in place to provide surface water to this area. For the IGSM simulations, it was assumed that facilities will be constructed to supply the western Placer County area with 25,000 AFY of surface water to reduce the groundwater decline currently occurring in this area. It should be noted that this assumption was utilized to avoid excessive declines in the groundwater table in this area. No planning studies or efforts were made to determine an optimum water supply option in this area (SCWA, 1997).

Although the model runs used for developing the baseline boundary conditions utilize land use and water use conditions fixed at the present levels of development, the actual land use and water use conditions in the adjacent county areas will change over the next 40 years. DWR has projected that municipal and industrial water demands in Sutter, Placer, and San Joaquin counties will increase through the year 2030 in response to increased urbanization. Over the same period, agricultural demands in all three of these counties were projected to decrease. The projected net increase of water demands (municipal and agricultural combined) is 48,100 AFY in Placer County and 28,600 AFY in San Joaquin County. The projected net decrease in demands is approximately 35,000 AFY in Sutter County (SCWA, 1997).

As discussed above, the boundary conditions developed for the IGSM are based on groundwater pumping in adjacent counties remaining at the existing levels (with the exception of southwestern Placer County). Therefore, a key assumption in the use of these boundary conditions is that surface water in the adjacent counties will be made available to supply additional water demands (beyond the 1990 levels) in these areas. The assumptions regarding land use, water use, and water supply in areas adjacent to Sacramento County represent one of many potential water use scenarios. If groundwater pumping in the adjacent areas significantly increases over existing levels, it will likely result in lower groundwater levels in the adjacent Sacramento County areas than those estimated as part of this Baseline Conditions analysis. However, if groundwater pumping is reduced in these adjacent counties (as a result of increased surface water supplies or a reduction in demands), it will likely result in groundwater levels higher than those estimated as part of this study.

MODEL RESULTS

Resulting groundwater levels are presented as the average groundwater levels over portions of the aquifer. Table 4.2-2 shows the 1990 average and minimum groundwater levels for the North and Galt areas, 2010 projections for the South Area, and the change in groundwater levels at stabilization when the yield is kept at the recommended amounts contained in the WFP. The results are summarized from *Baseline Conditions for Groundwater Yield Analysis* (SCWA, 1997).

Table 4.2-2
Groundwater Yield and Water Level Decline Resulting from the Pumping

Recommended Under the 1990 Baseline Condition and the 2010 Baseline Condition of the IGSM

County Area / Subregion	Assumed Pumping Amount (AFY)	Initial GW Elevation		Elevation Change	
		1990 Average GW Elevation (ft msl)	1990 Minimum GW Elevation (ft msl)	Change in Average Elevation	Change in Minimum Elevation
Sacramento North Area (1990 Baseline Condition)					
North Sacramento POU	58,149	-21.2	-45.8	-11.1	-20.2
Citizens Utilities	15,184	-13.4	-50.1	-24.5	-29.4
Fair Oaks WD	0	91.8	28.3	-2.8	-8.3
Orangevale WD	199	146.7	103.2	-18.0	-1.7
San Juan	0	214.0	137.9	-43.4	-4.6
Carmichael	5,411	17.7	-10.2	-6.3	-6.2
Citrus Heights	0	68.2	-14.7	-10.9	-22.0
Northridge	13,964	-32.6	-56.1	-18.1	-22.1
McClellan AFB	3,360	-39.9	-63.3	-34.6	-16.2
Arcade WD	5,346	-61.0	-61.1	-19.0	-20.5
Rio Linda	17,932	-28.3	-45.4	-33.5	-28.5
Natomas Mutual	9,891	2.3	-12.5	-18.5	-31.3
International Airport	1,649	7.5	5.8	-9.6	-11.8
Subtotal	131,085				
South Sacramento Area (2010 Baseline Condition)					
South Sacramento POU	34,095	-19.9	-58.5	-22.3	-71.2
Zone 40	87,510	-42.7	-69.9	-49.3	-93.4
Southwest	99,619	-42.7	-65.2	-25.5	-47.0
Omochumne-Hartnell	17,550	23.9	-45.0	-24.8	-28.7
Rancho Murieta	0	96.7	76.1	-12.2	-17.8
Sunrise "A"	28,935	9.2	-17.8	-40.7	-41.9
Sunrise 'B"	15,231	49.8	15.8	-34.8	-36.6
City of Folsom	7	134.7	59.5	-7.1	-19.3
Arden Cordova	12,173	43.8	0.5	-17.0	-13.7
SCWMD	1,040	66.0	43.9	-43.9	-34.6
Foothills North	3,275	108.7	61.4	-17.0	-25.2
Subtotal	299,435				
Galt Area (1990 Baseline Condition)					
Galt ID	64,368	-36.1	-45.3	-18.1	-15.0
City of Galt	6,698	-45.6	-50.8	1.2	-1.7
OFSCU	20,044	-35.8	-45.1	-15.9	-14.4
SMUD	26	62.7	13.2	-31.0	-22.3
Clay WD	5,493	-16.4	-24.7	-26.6	-30.6
Foothills South	18,664	65.6	-40.6	-19.4	-13.7
Subtotal	115,293				

Notes:
1) Groundwater elevations and elevation differences represent groundwater levels averaged over the specified portion of the aquifer.
2) Negative and positive groundwater elevation differences indicate declines and rises, respectively, in groundwater levels from 1990 conditions.
3) The WFP recommended yield for the South Sacramento Area is based on 2005 pumping amount of 273,000 AFY. However, IGSM did not model this amount and, thus, the 2010 Baseline Condition was used for the analysis of the south Sacramento area.

Source: SCWA, 1997

As mentioned above, each Baseline Condition model run simulates the groundwater level for a static level of land and water use. For each of the Baseline Conditions, the groundwater levels in Sacramento County tend to decline for approximately 20 years due to groundwater pumping in excess of groundwater recharge. However, groundwater recharge from streams and subsurface boundary inflows increases in response to the lowered groundwater levels, eventually reaching a quasi-equilibrium condition whereby groundwater levels become stabilized (Table 4.2-2). Under a quasi-equilibrium condition, groundwater levels fluctuate in response to wet and dry hydrologic cycles; however, the long-term average levels remain the same. It should be noted that, in general, excess groundwater pumping beyond a certain limit results in a continuous groundwater level
decline causing a permanent mining condition of a groundwater basin. However, the results from the static Baseline Conditions demonstrate that this would not occur, even under the projected level of pumping under the worst case analyzed (2030 conditions when the Sacramento North Area would continually pump 148,838 AFY, South Sacramento Area would pump 351,273 AFY, and the Galt Area would pump 112,034 AFY).

Model results of groundwater level declines for the Sacramento North Area and the Galt Area show that the amount of groundwater level decline is projected to be less in these areas than in the South Sacramento Area. In the Sacramento North Area, the Arcade Water District has, initially, the lowest groundwater level at an average elevation of -61.0 feet msl. This cone of depression persists such that at the end of the 70-year hydrologic period modeled, the groundwater level stabilizes at an average elevation of -80.0 feet msl. In the South Sacramento Area, the location of the cone of depression, in the Zone 40 area, also remains in the same place according to the IGSM results. The model results indicate the average groundwater level, initially -42.7 feet msl, declines by an average of 49.3 feet to stabilize at an average elevation of -92.0 feet msl. For the Galt Area, the location of the cone of depression changes from the City of Galt to the Galt Irrigation District Area. The resulting cone of depression stabilizes at an average elevation of -54.2 feet msl, from an initial elevation of -36.1 feet msl.

In addition, model results for both the Sacramento North and Galt areas indicate that the groundwater levels in these areas are affected by boundary conditions. The model results indicate a groundwater level decline at the north Sacramento County boundary of up to 40 feet (beyond 1990 levels). The groundwater level decline at the south boundary of up to 20 feet was an input into the model as presented under the assumptions discussion in Section 4.2.3, Impact Assessment Methodology. As previously discussed, the boundary conditions at the north and south boundaries of Sacramento County may affect the groundwater levels in the areas adjacent to Sacramento County.

4.2.4 WATER FORUM PROPOSAL IMPACTS

Information used in the following discussion of the impacts was taken from the Sacramento County Water Agency, *Phase II - Groundwater Yield Analysis, Technical Memorandum No. 2 - Impacts Analysis* (1997) as well as from the IGSM modeling results described above. The Baseline Conditions used in the assessment of project impacts include the 1990 Baseline Condition for the Sacramento North and Galt areas, and the 2010 Baseline Condition for the South Sacramento Area. Although the sustainable yield identified by the WFP for the South Sacramento Area is based on 2005 pumping amounts, the IGSM modeling did not include the simulation of the long-term effects of pumping at that amount. Thus, the 2010 Baseline Condition was used to assess the impacts for the South Sacramento Area sustainable yield level because the 2010 modeling results would reflect impacts close to, although greater than, the 2005 pumping amounts. Using the 2010 modeling results provides a level of conservative assurance that affects of the 2005 pumping amounts were considered.

Several potential impacts of groundwater level declines have been identified based on the IGSM simulations. Potential impacts to groundwater resources are assessed against the following parameters:

- deterioration of groundwater quality
- increase in the rate of movement of groundwater contamination
- land subsidence
- reduced efficiency or discontinued operation of wells

Impact 4.2-1

Groundwater Quality. *Further lowering of groundwater levels is anticipated to occur until the elevation of the groundwater table would stabilize under the groundwater yield recommendations of the WFP. This lowering may result in continued deterioration of groundwater quality in the South Sacramento and Galt areas due to up-rising of poorer quality water from the lower aquifer zone. In the future, elevated manganese and iron levels may occur in groundwater but at levels that would represent an aesthetic, rather than health-related impact. Continued treatment of manganese and iron is expected for municipal wells in the future. Additionally, arsenic levels are not anticipated to exceed current Title 22 standards. This would be considered a* ***less-than-significant*** *impact.*

Lowering of groundwater levels in the South Sacramento and Galt areas is associated with the up-rising of poorer quality water from the lower aquifer zone which then mixes with the water of the shallow aquifer zone. For the Sacramento North Area, no direct relationship between groundwater level decline and groundwater quality was observed from the available data. Thus, additional water level declines are not likely to significantly affect regional groundwater quality in the Sacramento North Area. In the South Sacramento and Galt areas, both manganese and arsenic have recently shown significant increases in average concentrations corresponding to a decline of 80 feet or more from pre-development conditions. It is anticipated that elevated levels of manganese and iron may occur in groundwater but at levels that would constitute an aesthetic, rather than health-related effect. Arsenic levels are not expected to exceed current Title 22 standards. No standards for radon have yet been established.

Table 4.2-3 shows the number of acres for which the groundwater quality could deteriorate under the sustainable groundwater yields recommended by the WFP. As indicated in Table 4.2-3, groundwater quality under approximately 67,720 acres in the South Sacramento Area and

68,821 acres in the Galt Area have the potential to exhibit elevated levels of manganese, arsenic, and/or iron. Exhibit 4.2-2 shows where the groundwater quality decline is projected to occur.

Table 4.2-3
Area Affected by Groundwater Quality Decline

County Area	Total Area (acres)	Affected Area Under the WFP (acres)
Sacramento North	122,646	0
South Sacramento	278,515	67,720
Galt	161,494	68,821

Source: SCWA, 1997

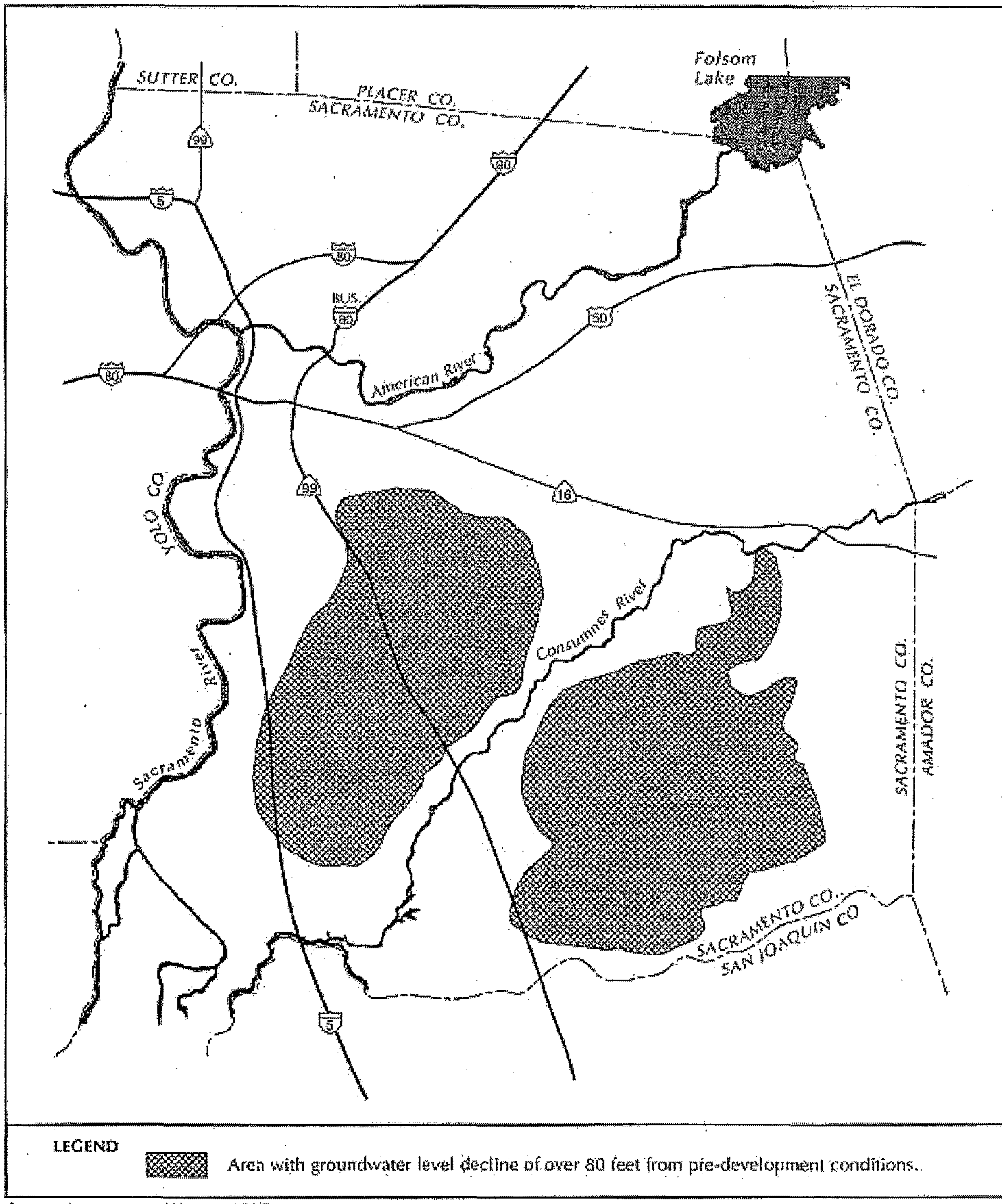
Impact 4.2-2

Movement of Groundwater Contaminants. *Further lowering of the groundwater levels is anticipated to occur until the elevation of the groundwater table would stabilize under the groundwater yield recommendations of the WFP. This lowering would result in no substantial increase in the rate of groundwater contaminant movement. This is a* ***less-than-significant*** *impact because of the small magnitude of increase expected and because the contaminated sites are currently undergoing remediation.*

In general, the present rate of regional groundwater movement laterally is on the order of hundreds of feet per year. IGSM was used to provide a general projection of the migration rate and direction of known groundwater contaminant plumes. Table 4.2-4 summarizes the modeled regional flow directions and rates of migration at each of the nine contaminated sites identified in Section 4.2.1, Existing Conditions.

IGSM results showed that the rate of groundwater movement at each of the groundwater contamination sites increases with the additional groundwater level declines for the sites in the South Sacramento Area. The highest groundwater migration rate with the implementation of the recommended sustainable yields under the WFP, 662 feet/yr, is projected to occur at the Army Depot site located in the South Sacramento Area. This, however, would represent an increase in the rate of migration resulting from the WFP of 86 feet/yr. This increase in migration rate would not be instantaneous and would occur after groundwater levels have declined and stabilized. As such, the increase in migration rate that may occur each year over 20 to 30 years would be less than 5 feet/year for the Union Pacific site. As a result, no substantial increase in the rate of groundwater contaminant movement is expected.

As discussed above, each of these sites is presently undergoing clean-up efforts, much of which includes the use of extraction wells in pump and treat programs. With remediation and future monitoring of clean-up efforts, the effects of contaminants to groundwater supplies would be less-than-significant.



Source: Montgomery Watson, 1997.

Integrated Groundwater - Surface Water Model (IGSM) Results Showing Areas Impacted by Water Quality Decline Under the Water Forum Proposal

EXHIBIT 4.2-2

WATER FORUM PROPOSAL EIR

0 2.5 5 MILES NORTH

SWRI SURFACE WATER RESOURCES, INC.

Table 4.2-4 Simulated Migration Rate and Flow Direction of Groundwater at Nine Contaminated Sites			
Contamination Site	**Current (ft/yr)**	**With Full Implementation of the WFP (ft/yr)**	**WFP Increment (ft/yr)**
Sacramento North Area			
Southern Pacific-Roseville	569(W)	569(W)	0
McClellan AFB	187(NE)	187(NE)	0
South Sacramento Area			
Southern Pacific-Sacramento	152 (S)	177 (S)	25 (S)
PG&E	97 (S)	128 (SE)	31 (SSE)
Union Pacific	299 (SE)	384 (SE)	85 (SE)
Army Depot	576 (S)	662 (S)	86 (S)
Mather AFB	470 (SW)	473 (SSW)	3 (SSW)
Kiefer Landfill	302 (W)	303 (W)	1 (W)
Aerojet	584 (SW)	635 (SW)	51 (SW)

Notes: Direction and rate of movement reported for the shallow aquifer system were developed from the IGSM results for the 1990 Baseline Condition and 2010 Baseline Condition. The rate of movement represents the regional groundwater movement rate in the vicinity of the contamination sites.

Source: SCWA, 1997

Impact
4.2-3

Land Subsidence. *Further lowering of groundwater levels is anticipated to occur until the elevation of the groundwater table would stabilize under the groundwater yield recommendations of the WFP. This lowering of groundwater levels is unlikely to result in substantial land subsidence. Historical data on subsidence in relation to past groundwater decline indicate that the area is not susceptible to substantial land subsidence given the anticipated groundwater level decline in the future. The range of land subsidence estimated to occur with the projected groundwater decline is 0.13 to 0.35 feet, and would occur over the course of several decades. Since no substantial land subsidence is expected to occur, this would be a* ***less-than-significant*** *impact.*

Potential additional land subsidence was evaluated utilizing IGSM results with the ratio between observed groundwater head data and the observed historical subsidence developed by the Sacramento County Water Agency. The stabilization of groundwater levels 35 feet below the current level at McClellan AFB in the Sacramento North Area will result in a potential additional land subsidence of up to approximately 0.35 feet, given the ratio of approximately 0.01 feet of subsidence per foot of groundwater decline in this area.

For the South Sacramento and Galt areas, the ratio of land subsidence to groundwater decline was calculated at 0.007 feet per foot. Therefore, simulated groundwater level declines of 49 ft in Zone 40 could result in additional land subsidence of up to approximately 0.34 feet for the South Sacramento Area. For the Galt Area, additional subsidence would be up to approximately 0.13 feet corresponding to groundwater level declines of approximately 18 feet in the Galt Irrigation District. The data, based on historical evidence, indicate that additional land subsidence could be minor. It is not likely that there would be infrastructure damage to private or public property since historical land subsidence has been minor and regional in nature, and potential land subsidence will likely exhibit the same regional trends of minor land subsidence. In addition, land subsidence that would occur would be gradual as the estimated extent would occur over several decades as groundwater levels gradually decline.

Impact 4.2-4

Efficiency of Wells. *Further lowering of groundwater elevations is anticipated to occur until the elevation of the groundwater table stabilizes under the recommended sustainable yields of the WFP. This further lowering may result in reduced efficiency of existing groundwater wells due to the need to: 1) deepen many existing wells, and 2) increase pumping at deepened wells. This reduced efficiency, however, would translate into an economic, rather than environmental impact, as the volume of groundwater available and its quality are not anticipated to be substantially affected following well deepening or increased pumping. The economic effects would be the increased costs associated with the implementation of these actions. This is a* ***less-than-significant*** *impact.*

Table 4.2-5 summarizes the number of potential wells that could require deepening as a result of groundwater level declines. There are approximately 450 municipal wells in Sacramento County. Data associated with each well (e.g., location, depth, and perforation intervals) were incorporated in the Sacramento County IGSM. Based on the groundwater levels provided by the IGSM simulations, the number of wells that would require some modification were determined. The number of municipal wells that would require deepening due to the lowering of groundwater levels would be highest in the South Sacramento Area, at between 7 and 14 wells.

There are an estimated 600 active agricultural wells in Sacramento County. In the Sacramento North Area, none of the agricultural wells are projected to require deepening. In this area, most agricultural wells are located where the average groundwater level decline is projected to be less than 20 feet and the wells in these areas are developed deep enough not to be affected by this additional level of groundwater decline. Agricultural wells in the Galt Area are also expected to continue operating. In the South Sacramento Area, however, although no additional wells are projected to require deepening at the year 2000, 5% (or 19 agricultural wells) are projected to require some further deepening by 2010.

As with agricultural wells, the specific location and construction details of each rural domestic well was not available, and therefore the impacts were estimated by utilizing the information developed from the existing well inventory (i.e., distribution of well depths within each County area). As presented in Table 4.2-5, approximately 6% of the rural wells are projected to require some further deepening in the South Sacramento Area and no rural wells are expected to require deepening in the other two areas.

Table 4.2-5 Wells Potentially Requiring Further Deepening as a Result of Additional Groundwater Level Decline[1]			
County Area	Total Number of Wells	Number of Wells Potentially Requiring Deepening	Percentage
Sacramento North			
Municipal	279	9	3
Agricultural	28	0	0
Rural Domestic	1,399	0	0
South Sacramento			
Municipal	157	7 - 14	4 - 9
Agricultural	385	0 - 19	0 - 5
Rural Domestic	6,068	344 - 350	6 - 6
Galt			
Municipal	12	2	17
Agricultural	182	0	0
Rural Domestic	1,253	0	0
TOTAL	9,763	394	

[1] Based on IGSM simulation.

Source: SCWA, 1997

4.2.5 MITIGATION MEASURES

No mitigation measures are necessary for the following less-than-significant impacts:

4.2-1: Groundwater Quality
4.2-2: Movement of Groundwater Contaminants
4.2-3: Land Subsidence
4.2-4: Efficiency of Wells

4.2.6 LEVEL OF SIGNIFICANCE AFTER MITIGATION

All groundwater impacts identified in this EIR are less-than-significant.

4.3 WATER SUPPLY

4.3.1 EXISTING CONDITIONS

CENTRAL VALLEY PROJECT

The Central Valley Project (CVP) is a multipurpose project operated by USBR that stores and transfers water from the Sacramento, San Joaquin, and Trinity River basins to the Sacramento and San Joaquin Valleys. The CVP was authorized by Congress in 1937 to serve water supply, hydropower generation, flood control, navigation, fish and wildlife, recreation, and water quality control purposes.

The CVP service area extends about 430 miles through much of California's Central Valley, from Trinity and Shasta reservoirs in the north to Bakersfield in the south. The CVP also includes the San Felipe Unit, which delivers water to the Santa Clara Valley. In 1988, CVP deliveries totaled about 5.3 million acre-feet (AF), or about 75% of its total contracted deliveries of 7.1 million AF. These deliveries included almost 1.9 million AF to the Sacramento River Service Area, 285,000 AF to the American River Service Area, and about 3.1 million AF to the Delta Export Service Area (Table 4.3-1).

Table 4.3-1
CVP Contracts and Deliveries

Service Area	Contract Amount (1,000 AF)	1988 Deliveries (1,000 AF)
Sacramento River	3,140	1,880
American River	935	285
Delta Export	3,060	3,171
Total All CVP Service Areas	7,135	5,336

Source: SWRI, 1997.

The CVP is operated as an integrated system to meet multiple authorized purposes. Minimum fishery releases to the Lower American River from Nimbus Dam are made in accordance with the State Water Resources Control Board (SWRCB) water rights Decision No. 893 (D-893). The SWRCB increased the D-893 minimum release schedule in their Decision 1400 (D-1400). This decision was applied to the water rights permit for Auburn Dam and does not apply to operation of Folsom and Nimbus dams at this time. However, USBR voluntarily operates Folsom and Nimbus dams to meet a modified D-1400 for minimum fishery flows, and more recently has been striving to meet the recommended AFRP flows for the Lower American River. For further background information on the CVP, see the *Long-Term Central Valley Project Operations Criteria and Plan; CVP-OCAP (October 1992)*, commonly referred to as the "OCAP Report."

The CVP is also governed and limited in its actions by area of origin protections which exist under California law and which have been adopted and incorporated within congressional CVP authorizations. These provisions of law and policy preserve, and reserve, as a matter of water rights priority over CVP water rights, the quantities of water necessary to provide for the existing and future needs within the areas of origin. Development of the CVP could not have taken place absent the CVP's acquiescence to this limitation in rights. Federal law and policy accept and incorporate these protections for the areas of origin.

STATE WATER PROJECT

Thirty agencies throughout California have contracted with the State Water Project (SWP) for an annual total of 4.2 million AF of water. Existing SWP facilities can supply less than 2.4 million AF during drought conditions. Additional facilities are planned to increase the supply. Authorized, but not yet built, are conveyance facilities to improve transfer of water across the Delta.

The initial facilities of the SWP, completed in 1973, include 18 reservoirs, 17 pumping plants, eight hydroelectric powerplants, and 550 miles of aqueducts and pipelines. Water from the Feather River watershed and the Delta is captured and conveyed to areas of need in the San Francisco Bay area, the San Joaquin Valley, and southern California. Parts of the project have been serving Californians since 1962.

The northernmost SWP facilities consist of three small lakes on Feather River tributaries in Plumas County, including Lake Davis, Frenchman Lake, and Antelope Lake. In addition to providing fishing and recreation, their releases enhance the downstream environment as those waters flow to the Feather River. The branches and forks of the Feather River flow into Oroville Reservoir, the SWP's principal reservoir with a capacity of 3.5 million AF. From Oroville Reservoir, water flows through three hydroelectric power plants, down the Feather River, the Sacramento River, and to the Delta.

The North Bay Aqueduct, completed in 1988, supplies water to Napa and Solano counties from the northern Delta. Near Byron in the south Delta, the Harvey O. Banks Delta Pumping Plant lifts water into Bethany Reservoir. From this reservoir, a portion of Delta water is lifted by the South Bay Pumping Plant into the South Bay Aqueduct, which serves Alameda and Santa Clara counties.

Most of the water flows from Bethany Reservoir into the Governor Edmund G. Brown California Aqueduct, which winds along the west side of the San Joaquin Valley to the O'Neill Forebay. From there, part of the water is pumped through the William R. Gianelli Pumping-Generating Plant for storage in San Luis Reservoir until it is needed for later use. The B.F. Sisk San Luis Dam, which impounds 2.04 million AF of water, is jointly owned; it was built by USBR and is operated by the Department of Water Resources. The rest of the water continues south down the valley and is raised another 1,069 feet by four more pumping plants (Dos Amigos, Buena Vista, Wheeler Ridge, and Chrisman) before reaching the foot of the Tehachapi Mountains. The water is then raised 1,926 feet by the Edmonston Pumping Plant into a tunnel that conveys water to southern California. In the southern San Joaquin Valley, a short Coastal Branch Aqueduct serves agricultural areas west of the California Aqueduct along with Santa Barbara and San Luis Obispo counties.

The SWP is also governed and limited in its actions by area of origin protections which exist under California law and which were incorporated within the SWP's authorization. These provisions of law preserve, as a matter of water rights priority over SWP water rights, the quantities of water necessary to provide for the existing and future needs of areas of origin. Development of the SWP could not have taken place absent acceptance of these area of origin limitations.

AMERICAN RIVER WATERSHED

The American River Watershed is contained within Sacramento, El Dorado, and Placer counties. Water demands within the watershed include agricultural, municipal, and industrial uses. The primary sources of water supply for the study area are groundwater and surface water. Principal sources of surface water in the region are the American, Sacramento, and Cosumnes rivers.

Municipal and industrial demands include areas above Folsom Reservoir (Auburn, Georgetown, and Placer County Water Agency), communities adjacent to Folsom Reservoir (El Dorado Hills, Citrus Heights, Orangevale, Roseville, Folsom, and Fair Oaks), and areas below Folsom Reservoir (Rancho Cordova, Carmichael, Sacramento, Elk Grove, and Galt). Some agricultural demands originate in areas northwest of Folsom Reservoir. However, the major irrigation demands are in southeast Sacramento County. In western Placer County, there is potential for additional irrigation demands from Folsom Reservoir via diversion pipelines or from the upper American River via Auburn Ravine.

Table 4.3-2 summarizes the service areas by diversion points in the American River watershed. The water delivery system from Folsom Dam to the City of Roseville, San Juan Water District (SJWD), Folsom Prison, and City of Folsom consists primarily of an intake structure, the Natomas and North Fork Water Distribution System, and a pumping plant. The delivery system main intake subdivides into two pipelines at the inlet control center. An 84-inch pipeline (North Fork Distribution System) through the right abutment non-overflow section provides deliveries to the City of Roseville and SJWD via a combination of gravity feed and pumping. Pumping is required when the reservoir elevation falls below 433 ft msl (640,000 AF) during high water demand periods (generally April through October). During periods of lower water demand, the water can be delivered via gravity flow as long as the reservoir elevation is above 426 ft msl (575,000 AF). A 42-inch pipeline (Natoma Distribution System, or Natoma Pipeline) passing through the dam to the left abutment serves the City of Folsom and Folsom Prison via gravity flow until the reservoir elevation falls below elevation 414 msl (477,000 AF). The 42-inch Natoma Pipeline from the inlet control center and pumping plant, discharges into a concrete box where it feeds a 48-inch line leading to the City of Folsom and an 18-inch line to Folsom Prison. The water distribution system is designed to supply an ultimate demand of 65 cfs for the Natoma Pipeline and 250 cfs for the North Fork Pipeline.

Table 4.3-2
Existing Diversion Points and Service Areas

Diversion Point	Service Area
Folsom Reservoir	San Juan Water District (Citrus Heights Water District) (Orangevale Mutual Water District) (Fair Oaks Water District) (Placer County Water Agency)[1] City of Folsom Folsom Prison City of Roseville El Dorado Irrigation District
Folsom South Canal	Arden Cordova Water Service Omochumne Hartnell Water District Galt Irrigation District Clay Water District SMUD Sacramento County Water Agency, Portions Mather AFB
American River near Landis Avenue and Ancil Hoffman Park American River near Arden Bar American River above H Street Bridge Sacramento River near Metropolitan Airport Sacramento River near Discovery Park Cosumnes River	Carmichael Water District Arcade Water District City of Sacramento Natomas Central Mutual Water District City of Sacramento Omochumne-Hartnell Water District Rancho Murieta CSD

[1] Placer County obtains portions of its American River water entitlements through San Juan Water District distribution system.

Source: USACE, 1992.

4.3.2 THRESHOLDS OF SIGNIFICANCE

The State CEQA Guidelines do not provide guidance associated with impact significance related to changes in water supply. Therefore, significance thresholds have been developed specifically to address the potential effects of implementing the WFP. For this EIR, impacts to water supplies as a result of the WFP were considered significant if:

- annual deliveries to SWP customers (in any year of the 70-year hydrologic period of record) would be less than the corresponding year of the Base Condition; or

- annual deliveries to any category of CVP customer (in any year of the 70-year hydrologic period of record) would be less than the corresponding year of the Base Condition.

4.3.3 WATER FORUM PROPOSAL IMPACTS

Potential impacts to water supplies resulting from the implementation of the WFP were identified and evaluated relative to the Base Condition (i.e., current levels of demand). Impacts focused on changes to annual water deliveries to contractors within the CVP and SWP.

The Base Condition was modeled with current level hydrology and water demands in conjunction with current CVP and SWP operations criteria for flood control, water quality, hydropower, recreation, and instream flow requirements. To analyze impacts due to the WFP, a simulation of the WFP under current level hydrology was compared to the Base Condition. This comparison allows for an assessment of the project impacts at the current level of development.

American River deliveries would be increased by the WFP (in this instance, American River deliveries include all deliveries to purveyors receiving water from the American River and waters delivered from the Sacramento River in lieu of the American River). Table 4.3-3 displays the American River deliveries for each simulation.

Table 4.3-3
American River Deliveries (TAF)

Contract Year (Mar –Feb)	Base Condition	1998 with WFP
Maximum	230.8	496.9
Minimum	222.4	350.2
69-year average	229.1	462.7

TAF = thousand acre-feet

Source: SWRI, 1998.

The American River deliveries include a component of water that is delivered to CVP customers. Table 4.3-4 displays the American River deliveries to CVP customers.

Table 4.3-4
American River Deliveries to CVP Customers (TAF)

Contract Year (Mar –Feb)	Base Condition	1998 with WFP
Maximum	16.2	178.0
Minimum	8.1	59.7
69-year average	14.5	145.4

Source: SWRI, 1998.

Exhibits 4.3-1 through 4.3-3, display probability distributions for American River purveyor deliveries. It is apparent from the simulation results that deliveries to American River purveyors under the WFP would be greater than, or equal to current deliveries under the Base Condition in all years. However, because of the increase in delivery to American River purveyors under the WFP, there may be concomitant reductions in deliveries to non-WFP water purveyors. Impacts 4.3-1 through 4.3-4 identify and discuss those potential effects.

Impact 4.3-1

Decrease in Deliveries to SWP Customers*. Implementation of the WFP could result in decreased water deliveries to SWP customers in 6 years of the 70-year record, ranging between 15 and 173 thousand acre-feet. This would represent a* ***significant impact****.*

SWP customers receive deliveries from the Feather River and the Delta. The Feather River service area customers received full deliveries (no deficiencies) in all years under the Base Condition and WFP hydrology simulations. Therefore, no impact to SWP customers in this service area would result from the implementation of the WFP.

SWP customers dependent on water supplies from the Delta would, however, be subject to delivery reductions resulting from CVP/SWP operations under the WFP. Although the PROSIM modeling does not substitute deliveries to WFP purveyors from the SWP, the change in surplus Delta inflow caused by increased CVP demands would result in water availability differences to SWP contractors. Deliveries to SWP contractors are not distinguished by contract type in PROSIM, therefore, impacts reported are aggregate reductions in deliveries. Exhibit 4.3-4 displays the probability of SWP deliveries for each of the simulations. From this Exhibit, it is evident that under the WFP, SWP deliveries would be lower in about 8% of the years, relative to the Base Condition. Individual year effects are displayed in Exhibit 4.3-5. This chronological illustration of projected SWP deliveries identifies six years when the WFP would affect SWP deliveries, with reductions ranging between 15,000 and 173,000 AF. Although the greatest annual reduction is less than 5% of the maximum SWP demand for that year, the volume is, nevertheless significant and constitutes a significant impact to SWP water users.

Impact 4.3-2

Decrease in Deliveries to CVP Customers*. Implementation of WFP could result in a decrease in water deliveries to CVP customers in up to 27 years of the 70-year record, depending on the type of CVP contractor. This would represent a* ***significant impact****.*

Discussions of the effects of the WFP on CVP deliveries focuses on individual and distinct CVP locations and contract types. It is important to note, however, that several of the WFP purveyors will be utilizing CVP water to serve a portion of their demands. To the extent that some of the identified impacts to CVP deliveries can be characterized as a reallocation of supply among CVP contractors, the WFP should not be held accountable for cause. Exhibit 4.3-6 illustrates CVP delivery probabilities for each of the simulations. In about 65% of the years, total CVP deliveries would be higher under the WFP, relative to the Base Condition. In the remaining 35% of the years, total CVP deliveries are comparable between the WFP and Base

Condition. Identification of the specific CVP contractor groups affected is provided in the following paragraphs.

CVP customers north of the Delta can be placed in three categories based on contract type; water settlement, municipal and industrial (M&I), and agricultural. Since each of these contract types possess deficiency criteria specific to their purposes, it is desirable to analyze potential impacts to each category individually rather than aggregate all CVP deliveries into one group. (For purposes of this discussion, American River CVP contractors are not included in North of Delta contractors, but are analyzed separately.) Exhibit 4.3-7 presents probability curves for total CVP deliveries north of the Delta (excluding American River and WFP purveyors) for the Base Condition and the WFP. In general, over the 70-year period of hydrologic record, deliveries to CVP customers north of the Delta are shown to be greater in all years, relative to the Base Condition. Therefore, no impacts to CVP customers north of the Delta are expected to occur.

CVP water settlement contractors in the Sacramento Valley have specific deficiency criteria based on Sacramento River runoff conditions. These criteria were included in the PROSIM modeling assumptions for both the Base Condition and WFP. The WFP does not, at any time, reduce deliveries to CVP water settlement contractors, therefore, no significant impacts are expected to occur to this CVP contractor category.

CVP M&I water service contractors are also served from the Sacramento River north of the Delta. These contractors have deficiency criteria in their contracts that prescribe water supply deficiencies. The PROSIM modeling assumptions recognized and applied these deficiency criteria for both the Base Condition and WFP simulations. Exhibit 4.3-8 illustrates the influence of WFP on CVP M&I deliveries north of the Delta. In three years of the 70-year period of hydrologic record, CVP M&I deliveries are reduced by a maximum of about 1,000 AF. This reduction is considered a significant impact to CVP M&I contractors.

CVP agricultural water service contracts are the remaining category of water customers north of the Delta. These contracts have the lowest priority for water delivery of the three CVP water contract classifications. CVP agricultural deliveries may be reduced by as much as 100% in any given year, although a zero delivery would be an extremely uncommon occurrence. The PROSIM assumptions for both the Base Condition and WFP applied deficiencies to CVP agricultural contractors in response to available water supply and imposed deficiencies of up to 90 percent (10 percent water delivery) if required to maintain instream flow or water quality criteria and/or other contractual obligations. CVP agricultural contract deliveries would, therefore, have the least priority among all existing CVP water supply users. Exhibit 4.3-9 illustrates the annual reductions in CVP agricultural deliveries resulting from the implementation of the WFP. The potential effects of the WFP are evident in 34 years, seven of which, conversely show determinable increases in deliveries. Decreases in deliveries, however, occur in the remaining 27 years and range from 1,000 to 42,000 AF. Such reductions in deliveries would represent a significant impact to CVP agricultural contractors. It is recognized that CVP agricultural water users north of the Delta have the same area-of-origin priority as the

WFP purveyors. This priority is senior to non-area-of-origin diverters. Relative priorities among area-of-origin diverters remain subject to existing laws.

CVP customers south of the Delta can also be placed in three categories based on contract type; exchange, M&I, and agricultural. Exhibit 4.3-10 illustrates the probability of deliveries for both the Base Condition and WFP. The WFP is shown to have an effect on deliveries to CVP customers south of the Delta in about 50% of the years. Similar to CVP customers north of the Delta, each of the contract types has deficiency criteria specific to their purposes. Therefore, it is desirable to analyze impacts to each category individually rather than aggregate all CVP deliveries into one group.

CVP exchange contractors in the San Joaquin Valley have specific deficiency criteria based on Sacramento River runoff conditions. These criteria were included in the PROSIM modeling assumptions for both the Base Condition and WFP. There would be no years when the WFP would have an effect on deliveries to CVP exchange contractors in the San Joaquin Valley, therefore no significant impacts would occur.

CVP municipal and industrial (M&I) water service contractors are also served from the Delta. These contractors have deficiency criteria in their contracts that prescribe water supply deficiencies depending on water availability. The PROSIM modeling assumptions, therefore, recognized and applied these deficiency criteria. Exhibit 4.3-11 illustrates the effects of the WFP on CVP M&I deliveries served from the Delta. There are eight years when reductions would occur under the WFP, and two years in which increases in deliveries would occur under the WFP. The magnitude of both reductions and increases are about 8,000 AF. The magnitude of such reductions would be considered a significant impact.

Similar to CVP agricultural water service contracts north of the Delta, south of the Delta CVP agricultural contracts also have the lowest priority for water delivery of the three CVP water contract classifications. These contract deliveries may be reduced by as much as 100% although a zero delivery would be an uncommon occurrence. The PROSIM assumptions for each of the simulations applied deficiencies to CVP agricultural contractors in response to available water supply and imposed deficiencies of up to 90 percent (10 percent water delivery) if required to maintain instream flow or water quality criteria and/or other contractual obligations. Exhibit 4.3-12 illustrates the effects of the WFP on CVP agricultural delivery results south of the Delta. There are six years when the WFP would result in an increase in deliveries of at least 98,000 AF. There are 27 years when, under the WFP, reductions in deliveries would range from 98,000 to as much as 293,000 AF. These reductions in deliveries would be a significant impact.

4.3.4 MITIGATION MEASURES

The WFP includes features intended to reduce surface water diversions from the Lower American River, which would also serve to decrease environmental effects to other resources. These mitigating features include water conservation, dry-year diversion restrictions, and conjunctive use of groundwater and surface water. Adoption of the WFP with these features would reduce adverse water supply effects to SWP and CVP contractors elsewhere in the system.

The water rights of the CVP and SWP are constrained by a combination of state and federal law as well as certain water rights terms and conditions. In the existing situation, the WFP contemplates the diversion and use of American River water to primarily benefit interests in Sacramento, El Dorado and Placer counties. The American River flows through these counties. As a consequence, these counties are protected by both state and federal law from adverse water supply impacts associated with the operation of the CVP and SWP, and are guaranteed a priority of right to water senior to the water rights held by the CVP and SWP, even if this means a reduction of water supply that will be available for service to existing CVP and SWP customers.

Because of the long-term nature of the WFP, it is possible that additional water supplies would be developed by the CVP and/or SWP before the WFP is fully implemented. Development of additional water supplies could mitigate the effects on CVP and SWP deliveries.

County of Origin Protection

The "county of origin" provision is found in Water Code §10505, which provides: "No priority under this part shall be released nor assignment made of any application that will, in the judgment of the board, deprive the county in which the water covered by the application originates of any such water necessary for the development of the county." This section applies in those cases where the Department of Water Resources, or its predecessor, has filed applications for water under §10500, which provides that the department may make applications for water which in its judgment "is or may be required in the development and completion of the whole or any part of a general or coordinated plan looking toward the development, utilization or conservation of the water resources of the state."

USBR's water rights, both for Folsom Dam and Reservoir and associated with the once-proposed Auburn Dam project, are based, at least in part, on these types of filings. In order to grant the permits requested by USBR, and upon which they now rely, the SWRCB had to decide whether to release the existing state applications and had to find that such releases would not deprive the counties of origin of water necessary for future development. These types of findings were made by the SWRCB for both its Folsom and Auburn water rights permits based upon the inclusion, within these permits, of terms and conditions protecting counties of origin.

Watershed of Origin Protection

Protection for the watershed of origin is provided by the Central Valley Project Act, Water Code §§11460-63. These sections do not depend on prior state filings, but operate as a limitation on the state or federal agency operating the Central Valley Project. The sections provide as follows:

> §11460: In the construction and operation by the department of any project under the provisions of this part, a watershed or area wherein water originates, or an area immediately adjacent thereto which can conveniently be supplied with water therefrom, shall not be deprived by the department directly or indirectly of the prior

right to all of the water reasonably required to adequately supply the beneficial needs of the watershed, area, or any of the inhabitants or property owners therein.

> §11461: In no other way than by purchase or otherwise as provided in this part shall water rights of a watershed, area, or the inhabitants be impaired or curtailed by the department, but the provisions of this article shall be strictly limited to the acts and proceedings of the department, as such, and shall not apply to any persons or state agencies.
>
> §11462: The provisions of this article shall not be so construed as to create any new property rights other than against the department as provided in this part or to require the department to furnish to any person without adequate compensation therefor any water made available by the construction of any works by the department.
>
> §11463: In the construction and operation by the department of any project under the provisions of this part, no exchange of the water of any watershed or area for the water of any other watershed or area may be made by the department unless the water requirements of the watershed or area in which the exchange is made are first and at all times met and satisfied to the extent that the requirements would have been met were the exchange not made, and no right to the use of water shall be gained or lost by reason of any such exchange.

As a matter of state law, this protection applies to the federal Central Valley Project, pursuant to Water Code §11128, which provides:

> The limitations prescribed in §§11460 and 11463 shall also apply to any agency of the State or Federal Government which shall undertake the construction or operation of the project, or any unit thereof, including, besides those specifically described, additional units which are consistent with and which may be constructed, maintained, and operated as part of the project and in furtherance of the single object contemplated by this part.

The state watershed of origin protection applies to USBR so long as such provisions are not inconsistent with congressional provisions authorizing the project. (*See California v. United States* (1978) 438 U.S. 645.) The acts authorizing Auburn Dam and Folsom Dam indicate a congressional intent to recognize the state area of origin protections. The American River Act of October 14, 1949, 63 Stat. 852, provides that the Secretary of the Interior "shall make recommendations for the use of water in accord with state water laws, including but not limited to such laws giving priority to the counties and areas of origin for present and future needs." Similar language is found in Public Law 89-161, 79 Stat. 615 (1965), authorizing the Auburn-Folsom South Unit.

The language of §11460 is quite broad. The quantity of water to which the watershed protection attaches is "all of the water reasonably required to adequately supply the beneficial needs of the watershed, area, or any of the inhabitants or property owners therein." The amount of water reasonably required to supply the beneficial needs of the watershed, the adjacent area and the inhabitants and property owners therein is a question of fact depending upon the circumstances in a particular case at any given time. (15 Ops.Atty.Gen. 8,20.)

The Attorney General, in his 1955 opinion, *supra* at 20-21, sets forth the following interpretation of the scheme intended by §§11460 to 11463:

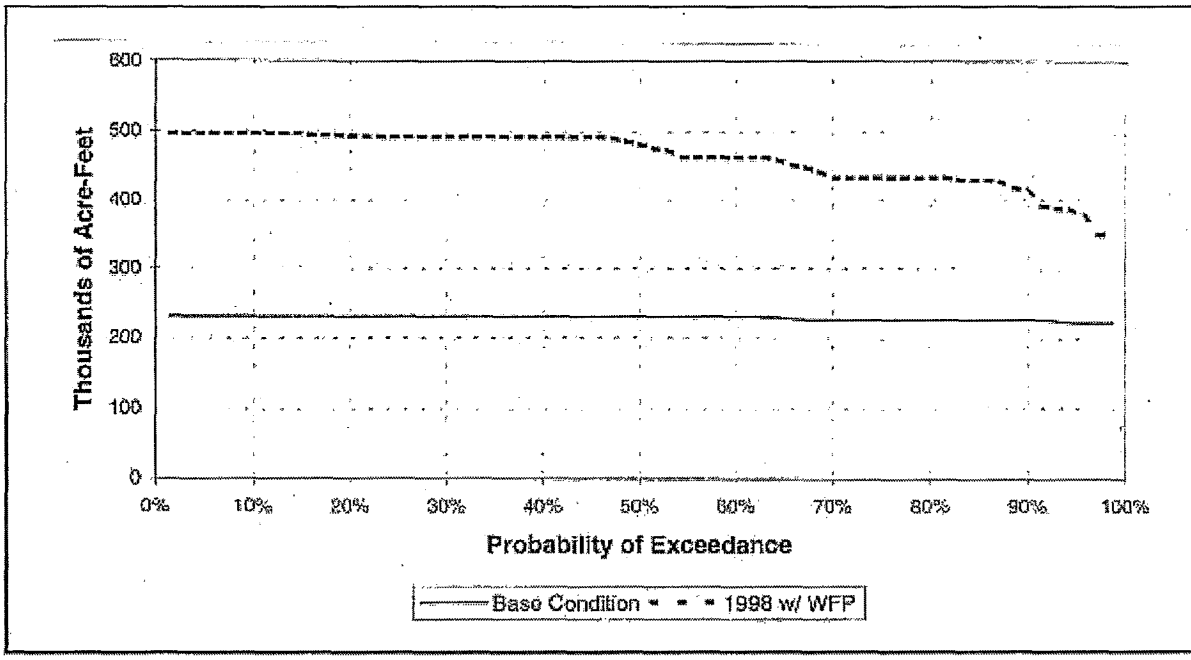
> (1) Section 11460 has the effect of reserving to the entire body of inhabitants and property owners in watersheds of origin a priority as against the water project authority in establishing their own water rights in the usual manner as their needs increase from time to time up to the maximum of either their ultimate needs or the yield of the particular watershed.
>
> (2) The establishment of this priority does not create or vest in any individual person a presently definable "water right" in the conventional sense of the term. ... As the need of such an inhabitant develops he must comply with the general water law of the state both substantively and procedurally to apply for and perfect a water right for water which he then needs and can then put to beneficial use. (Sections 1200 to 1800.) However, when he makes such an application, as a member of the class of persons protected by the statute, his application is not to be gainsaid, denied, or limited by reason of any activity on the part of the water project authority. *Specifically, this means that if prior to the development of the applicant's increased needs the authority had been exporting from the watershed in question water required to supply the applicant's increased needs, such use by the authority would not justify denial of the application.* Assuming the application to be otherwise meritorious, the state engineer would grant a permit in the usual form, and the authority would thereafter be compelled to honor the water right thus created and vested. (Emphasis added.)
>
> (3) [I]t must be constantly borne in mind that the priority is a reservation granted to an entire class of citizens *in the aggregate*. The class is ascertainable at any given time with constitutional exactitude, but the individual inhabitants and property owners comprising it will change and vary over the years. ... [The right is defined] as the needs of the individual develop and, by actually putting more water to beneficial use, he is able to establish a "water right" in himself in the usual form and manner.

The net result of the application of these statutory and policy protections is to ensure that even if the WFP has a significant adverse effect upon CVP and SWP customers, the WFP may proceed. In this light, it should be noted that the WFP mitigates substantially the impacts which would otherwise exist if the Water Forum participants were, in a less coordinated fashion, to assert their individual rights under the area of origin provisions of state and federal law.

It is recognized that CVP agricultural water users north of the Delta have the same area-of-origin priority as the WFP purveyors. This priority is senior to non-area-of-origin diverters. Relative priorities among area-of-origin diverters remain subject to existing laws.

4.3.5 LEVELS OF SIGNIFICANCE AFTER MITIGATION

Although the WFP contains features that lessen environmental impacts (including water conservation, dry-year diversion restrictions, and conjunctive use of groundwater and surface water), the WFP does not entirely avoid significant effects on the environment. Areas north of the Delta are also protected, in terms of overall CVP operations if not operations on the American River, by the area of origin statutes discussed above. As a consequence, in order to reduce significant adverse impacts associated with WFP water diversions and consequent reduced CVP water supply to CVP customers in these areas, USBR must adjust its operations to take into account and meet these local needs. However, because the Water Forum cannot assure that water supply impacts are reduced to less-than-significant levels, to fulfill the disclosure requirements of CEQA, this EIR must indicate that water supply impacts are considered significant and unavoidable.

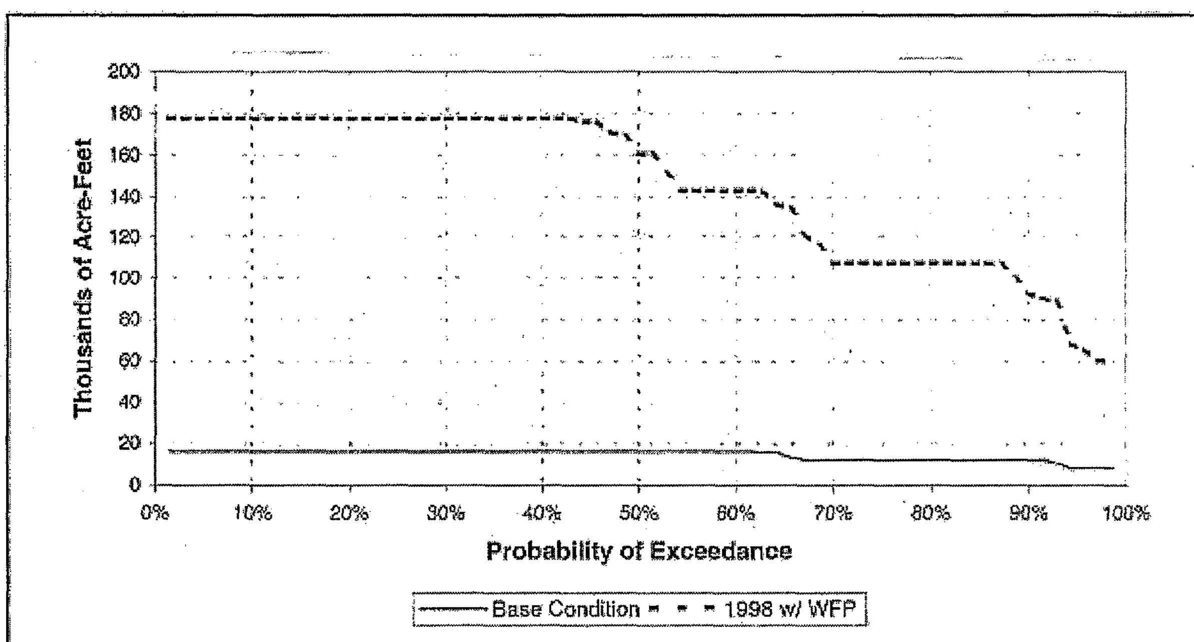


Total American River Purveyor Deliveries

EXHIBIT 4.3-1

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES, INC.



American River Purveyor CVP Deliveries

EXHIBIT 4.3-2

WATER FORUM PROPOSAL EIR

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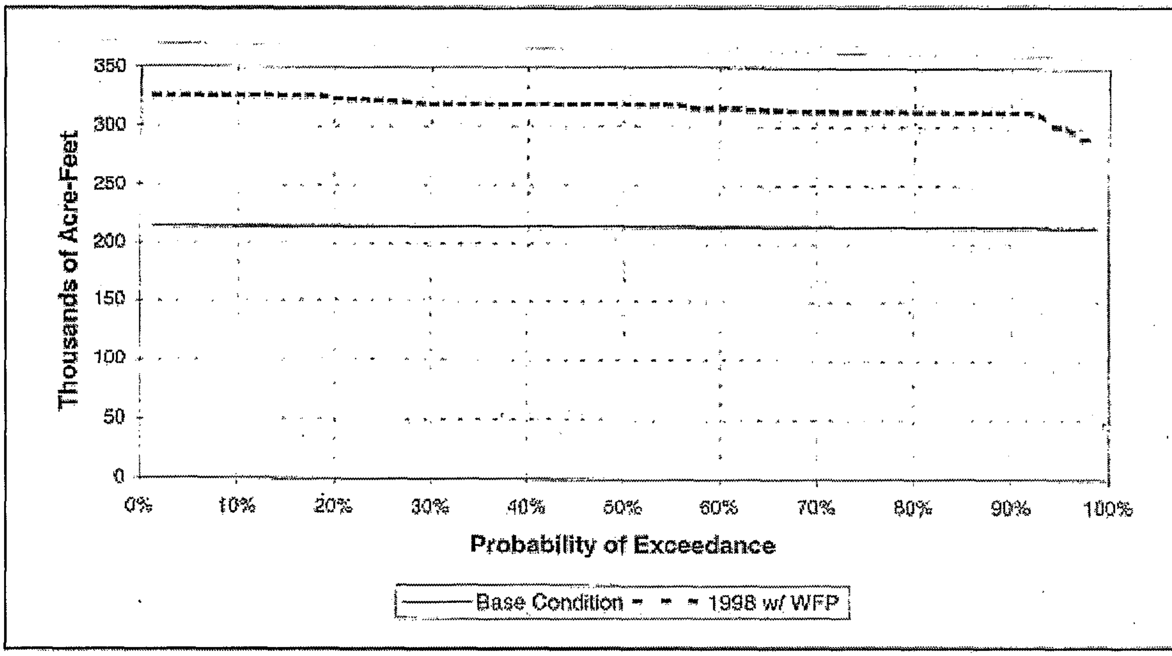
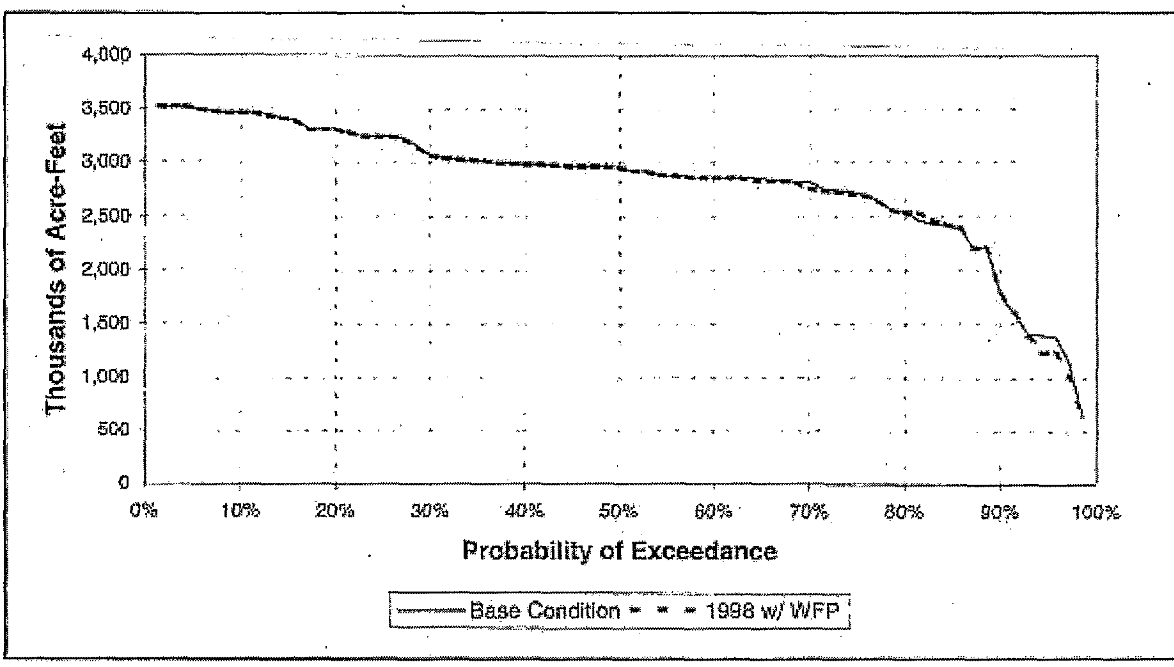


American River Purveyor Non-CVP Deliveries

EXHIBIT 4.3-3

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES, INC.

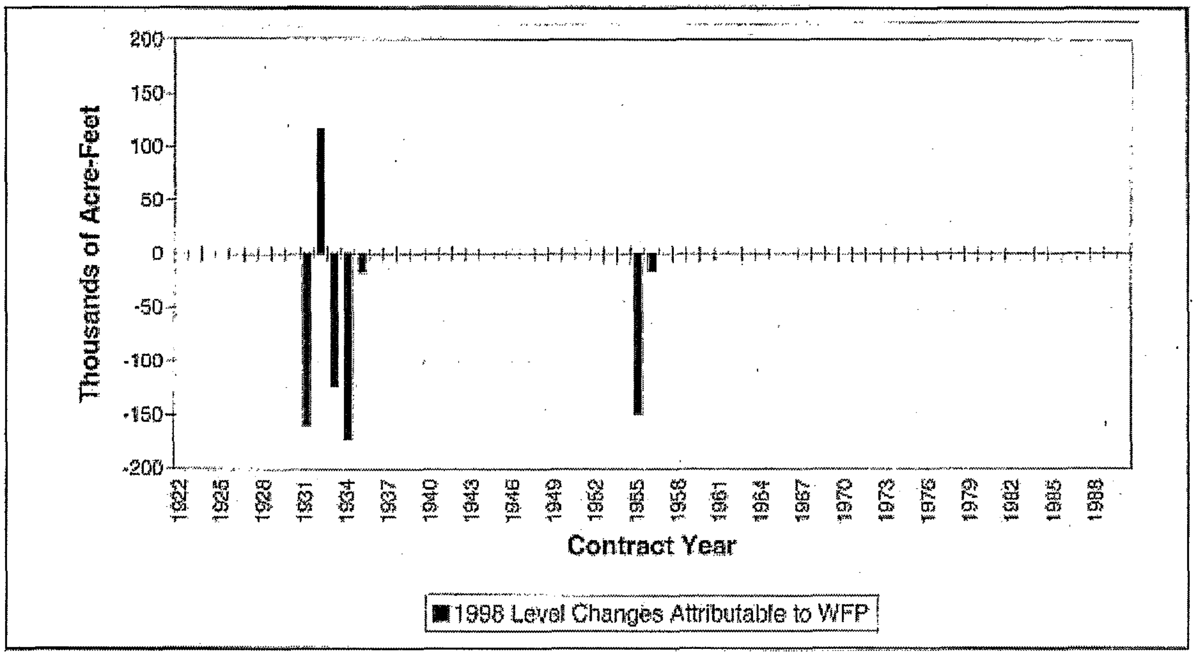


Total SWP Delta Water Deliveries

EXHIBIT 4.3-4

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES, INC.

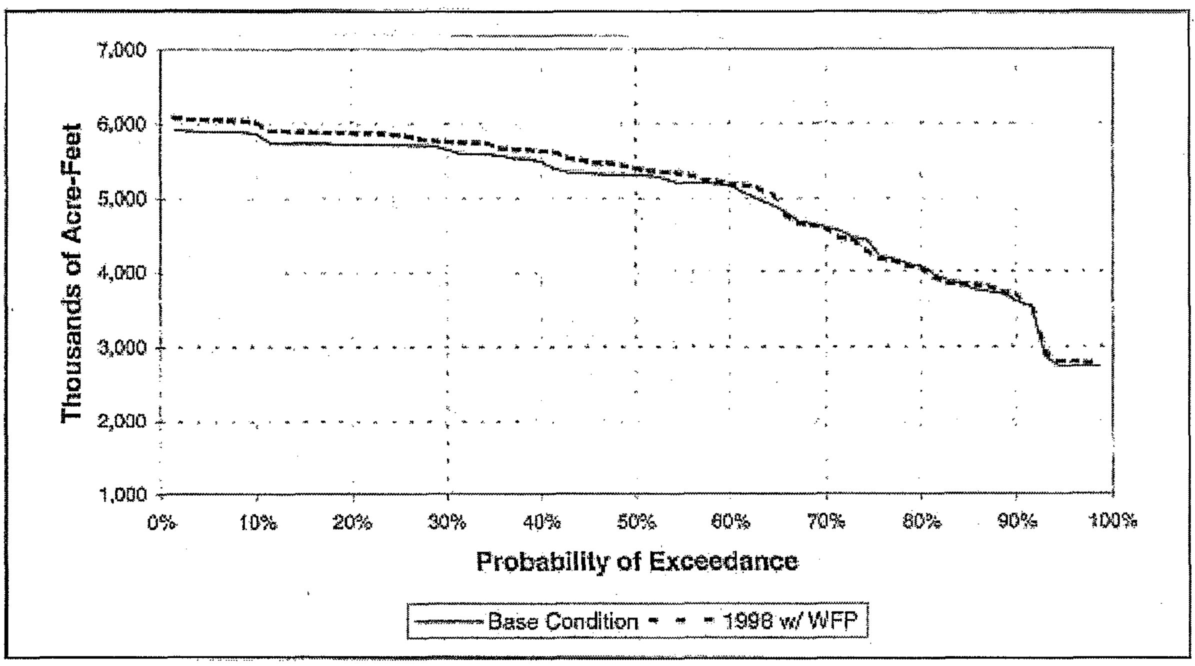


WFP Impact on SWP Delta Water Deliveries

EXHIBIT 4.3-5

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES, INC.

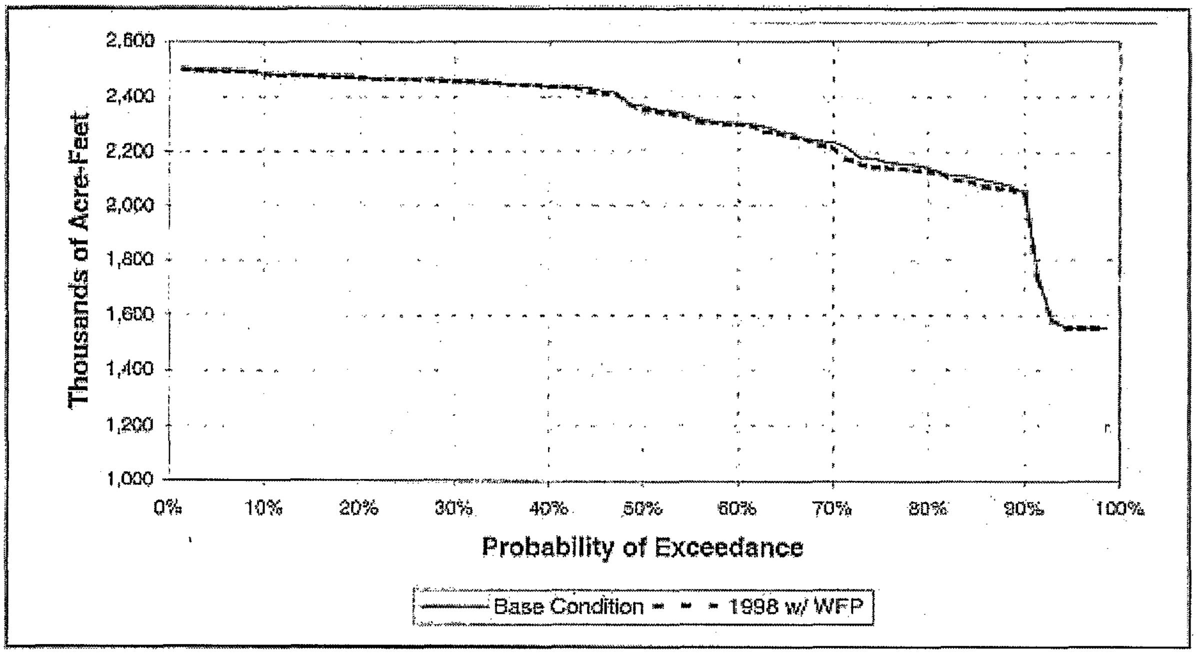


Total CVP Deliveries

EXHIBIT 4.3-6

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES, INC.

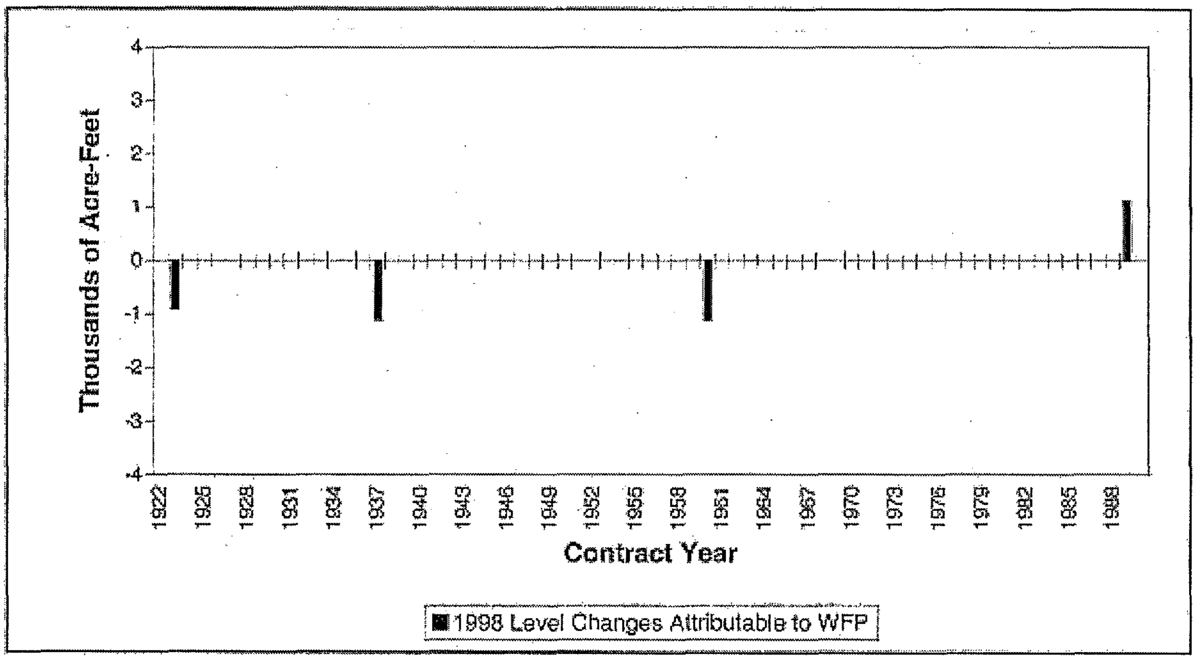


Total CVP Deliveries North of Delta

EXHIBIT 4.3-7

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES INC.

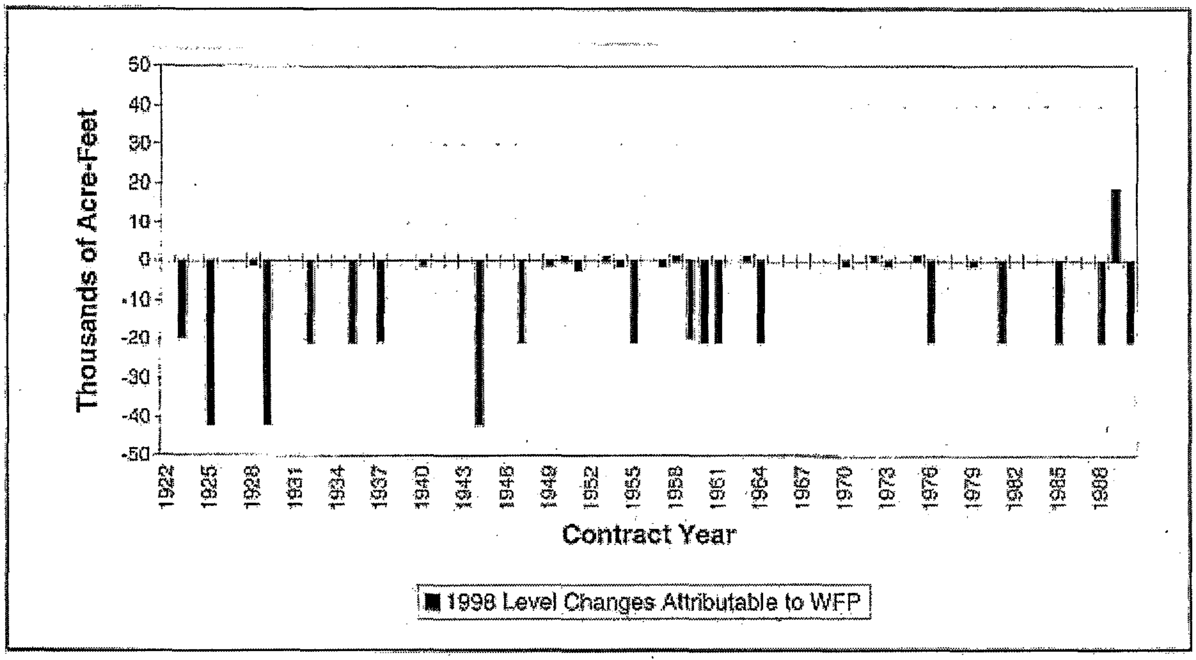


WFP Impact on Non-American River CVP M&I Deliveries North of Delta

EXHIBIT 4.3-8

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES INC.

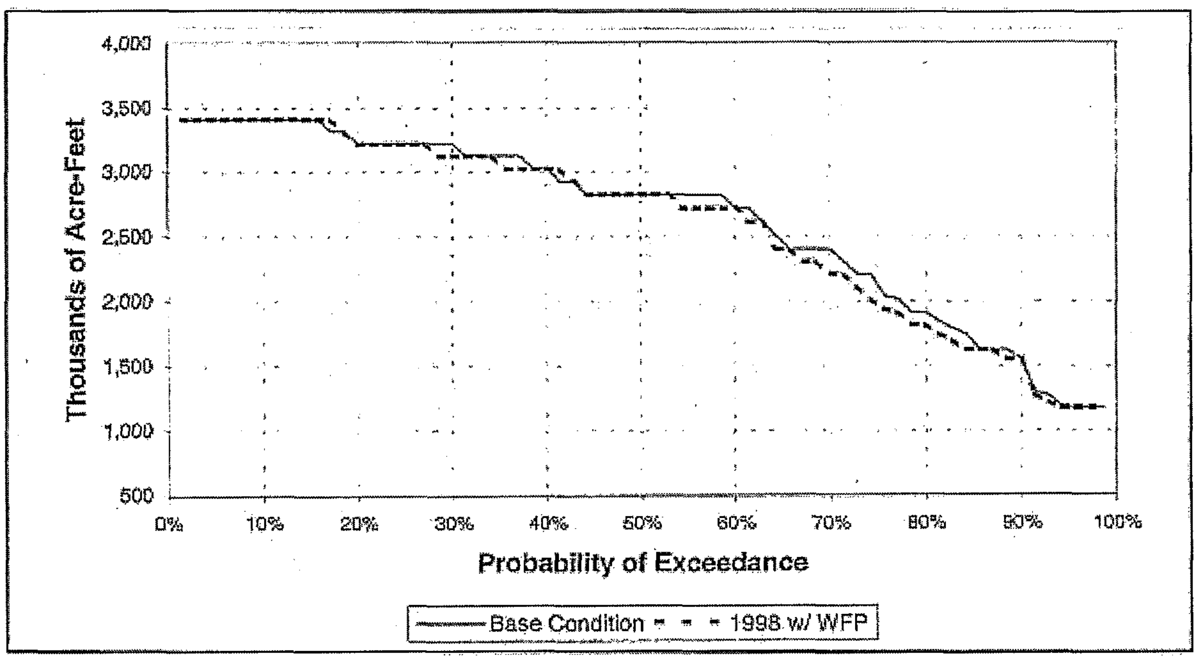


WFP Impact on Non-American River CVP
Agricultural Deliveries North of Delta

EXHIBIT 4.3-9

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES, INC.

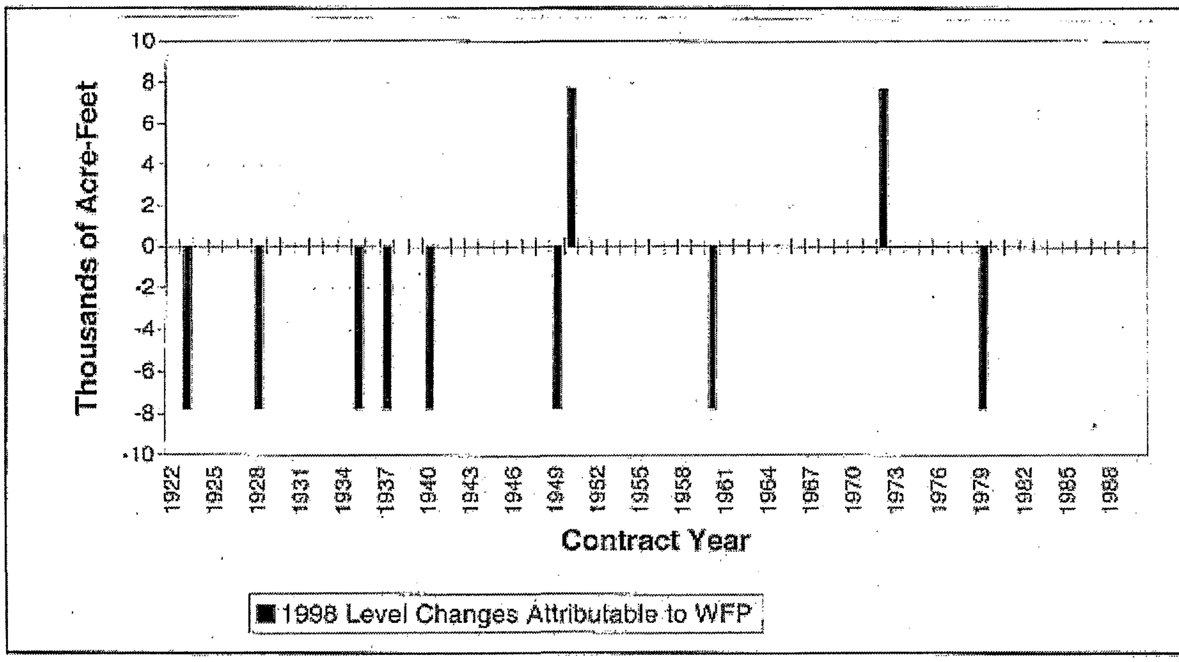


Total CVP Deliveries South of Delta

EXHIBIT 4.3-10

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES, INC.

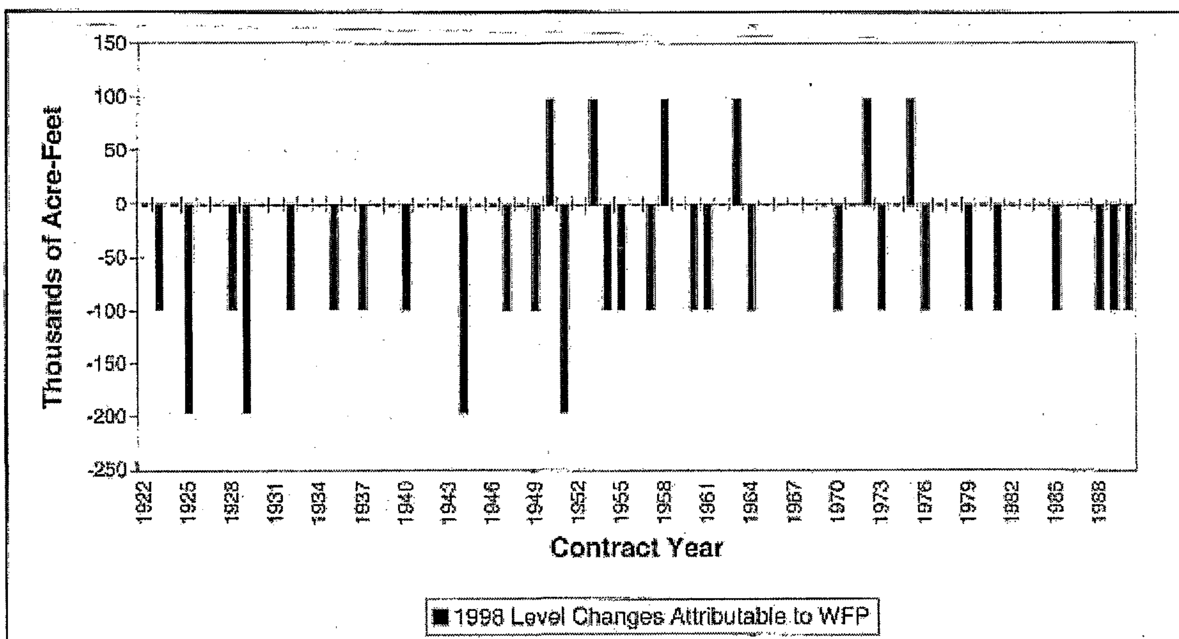


WFP Impact on CVP Deliveries South of Delta

EXHIBIT 4.3-11

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES, INC



WFP Impact on CVP Agricultural Deliveries
South of Delta

EXHIBIT 4.3-12

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES, INC

4.4 WATER QUALITY

4.4.1 EXISTING CONDITIONS

This section provides information on the designated beneficial uses and current water quality for the waterbodies of the direct effect study area (i.e., Folsom Reservoir, Lake Natoma, and the Lower American River) and the indirect effect study area (i.e., the Sacramento River and the Delta). In addition, this section provides an overview of the regulatory setting for water quality, and discusses a number of the key water quality monitoring and management programs that are currently ongoing in the region.

DIRECT EFFECT STUDY AREA

Surface water quality in Folsom Reservoir, Lake Natoma, and the Lower American River depends primarily on the mass balance of various water quality constituents from groundwater inputs, tributary inflow, permitted discharges from municipal and industrial sources, direct watershed runoff, urban runoff, and stormwater discharges. Water quality varies somewhat among years and seasonally within a year based primarily on these and related factors.

Folsom Reservoir and Lake Natoma

Folsom Reservoir is formed by Folsom Dam, which is located approximately 30 miles upstream from the American River's confluence with the Sacramento River. Folsom Reservoir has a storage capacity of approximately 977,000 AF. The USBR operates Folsom Dam and Reservoir for the purposes of flood control, meeting water contract obligations, providing adequate instream flows in the Lower American River for recreation and fisheries resources, and as a means of meeting Delta water quality standards.

Folsom Reservoir and Lake Natoma have numerous beneficial uses.[1] The following existing and potential beneficial uses have been defined by the Central Valley Regional Water Quality Control Board (CVRWQCB) for these waterbodies (RWQCB, 1994):

- municipal, domestic, and industrial water supply
- irrigation
- power
- water contact and non-contact recreation
- warm and cold freshwater habitat, warm freshwater spawning habitat
- wildlife habitat

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[1] State law defines beneficial uses of California's waters as uses that may be protected against quality degradation. Such beneficial uses include, but are not limited to, domestic, municipal, agricultural and industrial supply, power generation, recreation, aesthetic enjoyment, navigation, and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves (Water Code Section 13050(f)).

Water quality in Folsom Reservoir and Lake Natoma is generally acceptable for the beneficial uses currently defined for these waterbodies. However, taste and odor problems have occurred in municipal water supplies diverted from Folsom Reservoir in the past, which were attributed to blue-green algal blooms that occasionally occur in the reservoir as a result of elevated water temperatures.

Lower American River

The Lower American River encompasses the 23-mile reach of river between Nimbus Dam and the river's confluence with the Sacramento River. Beneficial uses of the Lower American River include all of those listed for Folsom Reservoir and Lake Natoma as well as recreational canoeing and rafting, warm and cold fish migration habitat, and cold spawning habitat (RWQCB, 1994).

Historically, water quality parameters for the Lower American River have typically been well within acceptable limits to achieve water quality objectives and beneficial uses identified for this waterbody (SWRCB, 1992), and remain so today. Principal water quality parameters of concern for the river (e.g., pathogens, nutrients, total dissolved solids (TDS), total organic carbon (TOC), priority pollutants, and turbidity) are primarily affected by urban land use practices and associated runoff and stormwater discharges. The stormwater discharges to the river temporarily elevate levels of turbidity and pathogens during and immediately after storm events. TOC and TDS levels in the Lower American River are relatively low compared to Sacramento River and Delta waters and thus are generally not of substantial concern.

Although urban land use practices, urban runoff and stormwater discharges all contribute priority pollutants to the river, recent monitoring has not identified any priority pollutant at concentrations consistently above State water quality objectives (City of Sacramento, 1993). However, water quality objectives for dissolved oxygen, temperature, and pH are not always met in the Lower American River (Sacramento County, 1992). Finally, taste and odor problems occasionally arise (generally during the late summer months) in the domestic water supplies taken from the Lower American River at the Fairbairn WTP.

Water released from Folsom Reservoir, through Lake Natoma, and into the Lower American River affects numerous water quality parameters in the river. In addition, operation of Folsom Dam and Reservoir directly affects Lower American River temperatures throughout much of the year. Water temperatures in the Lower American River are often unfavorably high for salmonids during the summer and fall months of the year. Elevated river temperatures can be particularly problematic to the river's salmonid resources under low-flow conditions, which occur during the drier years.

INDIRECT EFFECT STUDY AREA

Sacramento River

The Sacramento River system drains a 26,146 square mile basin that extends from the Sierra Nevada to the Coast Ranges. The RWQCB has defined the following existing and potential beneficial uses for the Sacramento River (RWQCB, 1994):

- municipal and domestic water supply
- industrial service and industrial process supply
- irrigation and stock watering
- power generation
- groundwater recharge
- contact recreation, non-contact recreation, and canoeing/rafting
- warm and cold freshwater habitat, warm and cold freshwater migration and spawning habitat, wildlife habitat
- navigation

Several of these beneficial uses (i.e., municipal, industrial and agricultural supply, recreation, groundwater recharge, and fish and wildlife habitat) depend, in part, on maintaining existing water quality. A discussion of each of these beneficial uses is provided below because of their relevance to the discussion of impacts to follow.

Municipal, Industrial, and Agricultural Uses

Water is diverted from the Sacramento River for use in municipal systems. Industrial uses of water diverted from the river include mining, plant cooling, hydraulic conveyance, gravel washing, fire protection and oil well repressurization. In addition, extensive use is made of Sacramento River waters for agricultural purposes. These uses include irrigation of crops, orchards, and pastures; stock watering; support of vegetation for range grazing; and ranching- and farming-support operations.

Recreation

Recreational uses of the Sacramento River include swimming, sport fishing, rafting, boating/canoeing and related activities that involve direct water contact and the possibility of water ingestion. Non-contact recreational uses include picnicking, hiking, camping, hunting, education, and aesthetic enjoyment.

Groundwater Recharge

Sacramento River flows serve to recharge the groundwater aquifer within the project study area. Groundwater recharge maintains soil column salt balance, to prevent salt water intrusion into freshwater aquifers, and provides for future groundwater extraction to support other beneficial uses.

Maintenance of Fish and Wildlife Habitat

The Sacramento River provides important aquatic habitats that support a wide variety of aquatic and terrestrial wildlife populations. These habitats provide migration, spawning, and rearing areas for anadromous and other migratory fish species, as well as resident fishes. In general, the anadromous salmonid species using the river (i.e., steelhead and chinook salmon) have the most restrictive water quality requirements. The water quality parameter most likely to adversely affect anadromous salmonids annually is water temperature.

Existing Water Quality

Sacramento River water quality monitoring studies indicate that the river's water is generally of high quality (Larry Walker Associates, 1991, 1996; Brown and Caldwell *et al.*, 1995; Larry Walker Associates and Brown and Caldwell, 1995). Sacramento River water quality is primarily affected by land use practices within the watershed and associated urban runoff, stormwater discharges, agricultural runoff, effluent discharge from wastewater treatment plants, and acid mine drainage. The Lower Sacramento River receives urban runoff, either directly or indirectly (through tributary inflow), from the cities of Sacramento, Roseville, Folsom, and their surrounding communities (City of Sacramento, 1993). The Natomas East Main Drainage Canal discharges to the Sacramento River immediately upstream of the confluence with the American River. This canal transfers both agricultural discharges and urban runoff into the Sacramento River.

Past monitoring studies have occasionally shown certain priority pollutants (e.g., trace metals, pesticides) to be at concentrations above State water quality objectives in portions of the Sacramento River (City of Sacramento and City of West Sacramento, 1995). Despite the seasonal variability of many constituents, a recent study revealed that monitored water quality parameters in the vicinity of Freeport (immediately upstream of the SRWWTP's point of discharge) typically met water quality objectives specified in the former Inland Surface Waters Plan (described below), except for some metals (SWRCB, 1994). The principal source of trace metal loading to the Sacramento River is believed to be the Iron Mountain Mine complex, which discharges to the Sacramento River via Spring Creek and Keswick Reservoir. The complex is thought to contribute approximately one-half of the metals loadings attributable to mine drainage.

Ongoing water quality management initiatives (e.g., Sacramento River Coordinated Monitoring Program, Sacramento River Watershed Program, Cal EPA Department of Pesticide Regulation's Rice Pesticides Program) are helping to reduce the frequency with which water quality objectives are exceeded. In terms of the river's quality as a raw municipal water source, TDS, TOC, and pathogen levels are of particular concern, but are currently at acceptable regulatory levels is of concern primarily because of its effects on treatment water costs. TOC is of concern because of its role in the formation of carcinogenic disinfection by-products (e.g., trihalomethanes) during the chlorination process of treatment. Pathogens (i.e., *Cryptosporidium* and *Giardia*) also are of concern with regard to their potential to affect human health. Because Sacramento River water is diverted for municipal and industrial uses, and because Sacramento River flows constitute the bulk of freshwater inflows to the Delta where municipal and industrial diversions also occur, additional discussion of these important water quality parameters is provided below.

Salinity, often measured in terms of TDS, is relatively low in the Sacramento River (on the order of hundreds of mg/l, whereas the TDS concentration of seawater is approximately 35,000 mg/l or 35 ppt). However, salinity does vary somewhat seasonally and among years, depending on flow levels (San Francisco Estuary Project [SFEP], 1992). TDS concentrations measured at the West Sacramento Intake on the Sacramento River between April 19, 1994 and May 1, 1996 revealed a mean concentration of 92 mg/l. TDS concentrations measured at Greene's Landing (located downstream of the SRWWTP) averaged 102 mg/l during the period March 13, 1986 to November 9, 1995 (DWR data as transmitted by R. Woodard, 1996). High TDS concentrations can result in increased municipal water treatment costs. When reaching sufficiently high levels (i.e., many hundreds to thousands of mg/l), productivity of crops and habitat quality for freshwater aquatic life can be reduced (DWR, 1994).

Organic carbon and bromide in waters serving municipal uses are of concern because they can react with disinfectants during the water treatment process to form trihalomethanes (THM), which pose carcinogenic risks to humans. Between December 1992 and July 1996, mean TOC concentrations at Freeport were determined to be 2.2 mg/l, with a maximum measured concentration of 6.8 mg/l (Larry Walker Associates, 1996). Dissolved organic carbon (DOC) for Sacramento River at Greene's Landing for the period 1990-1993 ranged from 1.4 to 5.7 mg/l (Brown and Caldwell *et al.*, 1995). Because the vast majority of the organic carbon in this system tends to be in the dissolved form, TOC and DOC values are generally similar.

Agricultural drainage of constituents concern include nutrients, pesticides/herbicides, suspended and dissolved solids and organic carbon (City of Sacramento, 1993). In the 1980s, rice pesticides were responsible for fish kills in agricultural drains and also for taste and odor problems in the water treated at the SRWTP. The major fish kills in the Colusa Basin Drain have since been eliminated as a result of the multi-agency rice pesticide control program (City of Sacramento and City of West Sacramento, 1995).

The concern over *Giardia* and *Cryptosporidium* concentrations in Sacramento River water, as well as other pathogens, has increased in recent years. The most comprehensive study of these pathogens conducted to date was performed by the Metropolitan Water District of Southern California (MWD, 1993), which monitored concentrations of both *Giardia* and *Cryptosporidium* at four geographic locations (Greene's Landing, Banks Pumping Plant, the Delta Mendota Canal, and the California Aqueduct Checkpoint 29) for one calendar year. Findings from this study showed that quantification of *Giardia* and *Cryptosporidium* is currently subject to poor recovery and reproducibility, resulting in highly variable detection limits for both pathogens. Therefore, the results from this study should be regarded as qualitative and should not be interpreted to represent definitive concentrations of these pathogens in the waterbodies monitored. Nevertheless, spatial differences in the relative abundance of these pathogens in the Sacramento River and Delta, as well as their prevalence relative to other surface waters of the United States, can be approximated from this study. Concentrations of the pathogens *Giardia* and *Cryptosporidium* are measured in cysts (the dormant state) or oocysts (fertilized egg form) per 100 liters of water.

Results reported by MWD (1993) indicated that *Giardia* and *Cryptosporidium* were detected in 42% and 50%, respectively, of the Greene's Landing samples. In the positive samples, the mean concentration of *Giardia* cysts was 37 per 100 liters, with a range of 8 to 82 per 100 liters. However, it should be noted that the mean detection limit for *Giardia* was 38 cysts per 100 liters (range: 8-125). The mean concentration of *Cryptosporidium* oocysts at this Sacramento River site was 50 per 100 liters (range: 5-132), with the mean detection limit for this pathogen reported as 46 oocysts per 100 liters (range: 8-125). It should be noted that the above results do not provide information regarding the viability of these organisms or the human risk of infection associated with the observed levels.

Sacramento-San Joaquin Delta

The Delta is a network of interconnected waterways covering approximately 1,500 square miles. Beneficial uses of the Delta are the same as those of the Sacramento River, except that the Delta cannot be used for power generation, rafting, or cold freshwater spawning habitat, due to its physical characteristics.

Water quality in the Delta is heavily influenced by a combination of environmental and institutional variables, including upstream pollutant loading, water diversions within and upstream of the Delta, and agricultural and other land use activities throughout the watershed. Critical Delta water quality parameters (e.g., salinity and/or TDS, TOC, bromide, pathogens, temperature, nutrients, and priority pollutants) can show considerable geographic and seasonal variation. Salinity, bromide concentrations, and temperature are strongly related to changes in Delta inflows (SFEP, 1992).

The extent of saltwater intrusion into the Delta from the Pacific Ocean is largely controlled by freshwater inflow from the Sacramento, San Joaquin, Mokelumne, Calaveras, and Cosumnes rivers. Water development facilities upstream and within the Delta can reduce Delta inflows resulting in higher salinity levels at specific locations within the Delta than might otherwise occur. Conversely, water development facilities also can augment Delta inflows in certain months, resulting in salinity levels lower than would otherwise occur. By augmenting natural or historic flows via releases from upstream reservoirs, existing water development facilities have eliminated the severe salinity level intrusions that once occurred every summer—which sometimes moved upstream as far as the City of Sacramento on the Sacramento River, and as far as Stockton on the San Joaquin River.

An additional source of salt or TDS to the Delta is upstream agricultural discharges to the Sacramento and San Joaquin rivers, which can sometimes create elevated salinity levels in portions of the south Delta. Runoff and treated wastewater, to a limited degree, also influence Delta TDS levels (Brown and Caldwell *et al.*, 1995). TDS concentrations at the Banks Pumping Plant for the period 1990-1993 ranged from 44 to 417 mg/l, with an annual average of approximately 300 mg/l (Brown and Caldwell *et al.*, 1995). Salinity requirements, represented in electrical conductivity (EC) units, for the Delta are defined in Table 4.4-1. These standards are intended to protect various beneficial uses of Delta waters.

Table 4.4-1
Sacramento-San Joaquin Delta Water Quality Control Plan Standards for Delta Inflow and Outflow

Location	Parameter	Standard	Description
Contra Costa Canal at Pumping Plant #1	Chloride (Cl-)	240 days [1]	Maximum mean daily 150 mg/l Cl- for at least the number of days shown during the calendar year
Contra Costa Canal at Pumping Plant #1	Chloride (Cl-)	250 mg/l	Maximum mean daily (mg/l)
Sacramento River at Emmaton	Electrical Conductivity (EC)	0.45 EC [2]	Maximum 14-day running average of mean daily EC (μmhos/cm) Apr 1 through Aug 15
West Canal at mouth of Clifton Court Forebay and Delta Mendota Canal at Tracy Pumping Plant	Electrical Conductivity (EC)	1.00 EC	Maximum monthly average of mean daily EC (μmhos/cm)
Sacramento River at Collinsville	Electrical Conductivity (EC)	8.00 EC [3]	Maximum monthly average of both daily high tide EC values (μmhos/cm)
Sacramento River at Rio Vista	Flow Rate	4,500 cfs [4]	Minimum monthly average flow rate (cfs)
Delta Outflow	Net Delta Outflow Index	8,000 cfs [5]	Minimum Monthly average (cfs)

1 Number of days per year is dependent on water year type. Wet ⇒ 240 days; Above Normal ⇒ 190 days; Below Normal ⇒ 175 days; Dry ⇒ 165 days; Critical ⇒ 155 days.

2 *EC standard is relaxed before August 15 depending on water year type. Wet ⇒ no relaxation; Above Normal ⇒* on July 1 relaxed to 0.63; Below Normal ⇒ on June 20 relaxed to 1.14; Dry ⇒ on June 15 relaxed to 1.67; *Critical ⇒ on April 1 relaxed to 2.78*

3 EC standard varies by month. October ⇒ 19.0; November-December ⇒ 15.5; January ⇒ 12.5; February-March ⇒ 8.0; April-May ⇒ 11.0

4 Flow rate varies by month and water year type. September ⇒ all year types = 3,000 cfs; October ⇒ Wet, Above Normal, Below Normal & Dry year types = 4,000 cfs; October ⇒ Critical year type = 3,000 cfs; November & December ⇒ Wet, Above Normal, Below Normal & Dry year types = 4,500 cfs; November & December ⇒ Critical year type = 3,500 cfs

5 Index varies by month and water year type. January ⇒ all year types = 4,500 cfs or 6,000 cfs depending on Eight River Index; February through June ⇒ all year types = variable between 7,100 cfs and 4,000 cfs depending on Eight River Index; July ⇒ Wet & Above Normal year types = 8,000 cfs; July ⇒ Below Normal year type = 6,500 cfs; July ⇒ Dry year type = 5,000 cfs; July ⇒ Critical year type = 4,000 cfs; August ⇒ Wet, Above Normal & Below Normal year types = 4,000 cfs; August ⇒ Critical year type = 3,000 cfs; September ⇒ all year types = 3,000 cfs; October ⇒ Wet, Above Normal, Below Normal & Dry year types = 4,000 cfs; October ⇒ Critical year type = 3,000 cfs; November & December ⇒ Wet, Above Normal, Below Normal & Dry year types = 4,500 cfs; November & December ⇒ Critical year type = 3,500 cfs

Sources: RWQCB, 1994; *SWRCB, 1995.*

Delta waters receive organic carbon materials from a variety of sources, including agricultural drainage, surface runoff, algal productivity, in-channel soils, levee materials, riparian vegetation and wastewater discharges (DWR, 1991). The principal source of organic carbon loading to Delta waters comes from natural runoff from soils and agricultural return flows within the Delta. DOC concentrations for the Banks Pumping Plant during 1990-1993 ranged from 2.6 to 10.5 mg/l, approximately double that at Greene's Landing.

Recent work has shown an average increase in TOC concentrations of 1.5 mg/l between Greene's Landing and the Banks Pumping Plant, which may be largely attributed to agricultural drainage (Brown and Caldwell *et al.*, 1995).

Nutrients in the Delta (nitrogen, phosphate, and silicate) are derived from several sources including river inflow, ocean water, runoff, wetlands, atmospheric fallout (rain and dust), and upstream sewage treatment plants. Nutrient concentrations vary seasonally. In the northern reach, where river flow provides most of the nutrient load, nutrient concentrations are highest in winter and lowest in summer (SFEP, 1992). Nutrients lead to algal blooms that can deplete oxygen in the water during decomposition.

Metals, pesticides and petroleum hydrocarbons enter the Delta through several avenues, including agricultural runoff, municipal and industrial wastewater discharge, urban runoff, recreational uses, river inflow, and atmospheric deposition (SFEP, 1992). The concentrations of these pollutants in the Delta vary both geographically and seasonally. Pesticides from agricultural runoff are of particular concern, as biologically significant concentrations have been recorded in portions of the Delta (SFEP, 1992). Toxic effects of priority pollutants to aquatic life can vary with flow levels, as water flowing into and through the Delta acts to dilute concentrations of priority pollutants.

Finally, levels of *Cryptosporidium, Giardia,* and other pathogens in Delta waters are becoming of increasing concern to municipal water suppliers. *Giardia* was not detected at Banks Pumping Plant or Checkpoint 29, but was found in one sample at the Delta Mendota Canal at a concentration of 6 cysts per 100 liters. *Cryptosporidium* was detected at Banks Pumping Plant, the Delta Mendota Canal, and Checkpoint 29 at mean concentrations of 54, 40, and 17 oocysts per 100 liter, respectively (MWD, 1993).

REGULATORY SETTING

Designated beneficial uses of waterbodies, together with their corresponding water quality objectives, can be defined per federal regulations as water quality standards. Water quality objectives are established by the State in various plans to protect designated beneficial uses of a waterbody consistent with applicable provisions of Section 303 of the federal Clean Water Act (CWA) and the State's Porter-Cologne Water Quality Control Act.

Regulatory Plans

Water Quality Control Plan for the Sacramento-San Joaquin River Basins (Basin Plan)

The Water Quality Control Plan for the Sacramento-San Joaquin River Basins (Basin Plan), adopted by the RWQCB on December 9, 1994 and approved by the SWRCB on February 16, 1995, provides water quality objectives and standards for waters of the Sacramento River and San Joaquin River Basins. The Basin Plan contains specific numeric water quality objectives for bacteria, dissolved oxygen, pH, pesticides, electrical conductivity (EC), TDS, temperature, turbidity, and trace elements, as well as numerous narrative water quality objectives, that are applicable to certain waterbodies or portions of waterbodies. As discussed above, the Basin Plan contains specific numeric standards for Delta inflow and outflow, chloride, and electrical conductivity (EC) (Table 4.4-1). EC standards in the Delta exist for agricultural and fish and wildlife beneficial uses. EC is a measure of water's ability to conduct an electric current. The degree to which water conducts an electrical current (i.e., its conductivity) is dictated by the relative abundance of free ions in the water, which come from the dissociation of solid materials into the water. Therefore, EC is directly related to TDS.

California Inland Surface Waters Plan

In 1992, the SWRCB adopted the California Inland Surface Waters Plan (ISWP). The ISWP guided and protected beneficial uses of water for both aquatic life and human use and set limits on the quality of water discharges from both point and non-point sources. The ISWP set forth both narrative and numerical water quality objectives and toxicity objectives for several toxic pollutants. However, a final judgment issued by the Sacramento County Superior Court in July 1994 found the ISWP unlawful. As a consequence, on September 22, 1994, the SWRCB rescinded the ISWP and its subsequent amendments. Hence, the standards established by the ISWP are no longer binding.

In the absence of State-defined objectives for toxic pollutants as listed in the ISWP, the USEPA may impose its regulatory standards. In December, 1992, the USEPA adopted the National Toxics Rule (NTR) that established federal water quality standards for a number of the priority pollutants covered in the rescinded ISWP. In the Sacramento River, USEPA adopted standards for 38 priority pollutants in the NTR. In May, 1995, USEPA issued a revised policy for aquatic life criteria for trace metals that advocates use of dissolved metal measurements instead of total recoverable values in setting standards for protection of aquatic life. USEPA is in the process of preparing a California Toxics Rule that will propose standards for all of the remaining priority pollutants. The proposed California Toxics Rule was published for public review on August 5, 1997 (62 FR 150), and is expected to be adopted in 1999.

Regulatory Accords and Policies

Bay-Delta Pollutant Policy Document and Accord

The Pollutant Policy Document (PPD) for the San Francisco/Sacramento-San Joaquin Delta Estuary was adopted by the SWRCB on June 21, 1990. The PPD sets forth basic policies for the control of toxic pollutants in the Bay-Delta Estuary. The PPD identifies seven pollutants of concern: arsenic, cadmium, copper, mercury, selenium, silver, and polynuclear aromatic hydrocarbons (PAHs). The PPD also indicates that publicly owned treatment works (POTWs) are a significant source (i.e., greater than 10%) of three of the seven pollutants of concern: cadmium, mercury, and silver. The RWQCB has identified the entire Bay-Delta as a waterbody of concern and designated the seven pollutants listed by the PPD as pollutants of concern. The most significant provision of the Document for POTWs is the mass emission strategy (MES), which is designed to control the accumulation of toxic pollutants in sediments and aquatic tissue.

In June 1994, State and federal agency cooperation was formalized with the signing of a Framework Agreement. The Agreement stated that the State and federal agencies would focus on the following three areas of concern: water quality standards formulation; coordination of SWP and CVP operations with regulatory requirements; and long term solutions to problems in the Bay-Delta Estuary (DWR, 1995). On December 15, 1994, an agreement was reached regarding water quality standards and related provisions that would remain in effect for three years. This agreement included springtime export limits, regulation of the salinity gradient, specified springtime flows on the lower San Joaquin River and intermittent closure of the Delta Cross Channel gates. Many of the standards and provisions in the December 1994 agreement were incorporated into the SWRCB's "Draft Water Quality Control Plan for the San Francisco Bay/Sacramento San Joaquin Delta Estuary" dated December 1994. After revisions were made that addressed comments, the final Delta Water Quality Control Plan was adopted on May 22, 1995 (SWRCB, 1995), and remains in effect today.

Antidegradation Policy (State Water Board Resolution 68-16)

In addition to designating beneficial uses and water quality objectives to define water quality standards, federal water quality regulations require each State to adopt an "antidegradation" policy and to specify the minimum requirements for the policy (40 CFR §131.12). The SWRCB has interpreted State Water Board Resolution 68-16 to incorporate the federal antidegradation policy.

The SWRCB adopted State Water Board Resolution No. 68-16 on October 28, 1968. The goal of this policy is to maintain high quality waters where they exist in the State. Resolution No. 68-16 does not prohibit any reduction to existing water quality. Rather, the RWQCB applies Resolution No. 68-16 when considering whether to allow a certain degree of degradation to occur or remain. As stated in Resolution No. 68-16, whenever the existing quality of water is better than that defined by State water quality objectives and policies, such existing high water quality will be maintained until it has been demonstrated to the State that any change will: 1) be consistent with the maximum benefit to the people of the State; 2) not unreasonably affect present and anticipated beneficial use of such water; and 3) not result in water quality less than that prescribed in water quality control plans or policies (RWQCB, 1994). In addition, the discharger must apply best practicable treatment or control measures to assure that: 1) a pollution or nuisance will not occur; and 2) the highest water quality, consistent with the maximum benefit to the people of the State, will be maintained (RWQCB, 1994). Hence, for actions that produce significant changes in water quality, the State policy states that a showing must be made that such changes result in the maximum benefit to the people of the State and are necessary to the social and economic welfare of the community in order to be consistent with the antidegradation policies.

The Porter-Cologne Water Quality Control Act states that water quality objectives are to be established that "... will ensure the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area." The State Water Code further states that "... it may be possible for the quality of water to be changed to some degree without unreasonably affecting beneficial uses." This policy statement supports the position that some level of water quality change is allowable under the antidegradation policies.

EXISTING MONITORING PROGRAMS

Sacramento Coordinated Water Quality Monitoring Program (CMP)

The SRCSD, the Sacramento County Water Agency, and the City of Sacramento formed the CMP in July of 1991. The CMP has the following goals and objectives (Larry Walker Associates and Brown and Caldwell, 1995):

- Implement a long-term Ambient Water Quality Monitoring Program in the Sacramento and American rivers;
- Coordinate surface water quality monitoring activities in the Sacramento area;
- Implement a centralized database management system for water quality data; and
- Research and implement new water quality monitoring efforts to address present and future regulatory needs.

Sacramento River Watershed Program (SRWP)

The SRWP was initiated by the SRCSD for the express purpose of addressing water quality issues that are best addressed on a watershed-wide basis rather than an individual point or non-point source basis. An important early task of the watershed program is to design and implement a water quality monitoring program, which has occurred. SRCSD participation in this program will contribute to efforts to reduce and control priority pollutant loadings to the Sacramento River and Delta from key point and non-point sources in the watershed.

Comprehensive Stormwater Management Program

The Sacramento County Water Agency (SCWA), City of Sacramento, City of Galt, and City of Folsom have implemented a comprehensive program to manage stormwater in Sacramento County. The program consists of ongoing stormwater programs and monitoring activities that integrate the various city and county programs, water quality monitoring results, legal authority, and overall stormwater management as a condition of approval of a National Pollutant Discharge Elimination System (NPDES). The program's final report was prepared in 1994 (SCWA *et al.*, 1994). Since then the effectiveness of the program has been evaluated and modifications have been made to refine and improve water quality results (SCWA *et al.*, 1995).

4.4.2 THRESHOLDS OF SIGNIFICANCE

The significance criteria described below have been developed for use in assessing potential impacts to water quality resulting from the WFP. These significance criteria were also used to determine the level of significance of any identified impacts.

Section 303 of the federal CWA requires states to adopt water quality *standards* that "... consist of designated uses of the navigable waters involved and water quality criteria for such waters based upon such uses." The SWRCB carries out its water quality protection obligations and authority through the adoption of specific Water Quality Control Plans (e.g., the Delta Water Quality Control Plan). These Plans establish water quality standards for particular waterbodies through the designation of: 1) beneficial uses of those waters; and 2) water quality *objectives* to protect those uses. Moreover, the RWQCB provides additional protection of water quality within the Central Valley region through designation of additional, waterbody-specific objectives in its Basin Plan. Since beneficial uses, together with their corresponding water quality objectives, can be defined per federal regulations as water quality *standards*, these plans regulate the State and federal requirements for water quality control.

For the purposes of this EIR, the significance of a water quality impact was determined by compliance with State water quality standards and objectives, as well as consistency with the intent and purpose of State and federal antidegradation policies. Under the antidegradation policy, water quality impacts may be judged to be significant if a change in ambient water quality occurs and the change is deemed to be significant. No firm policy exists to establish the threshold for this significance determination. At present, this determination is based on professional judgment and the specific facts of each case. Specific facts may include the degree of compliance with established objectives, the magnitude of water quality change, the magnitude of loading increase, and other related factors.

Changes or potential changes in water quality parameters were considered to represent a significant adverse impact to water quality in the waterbodies assessed if the WFP would:

- change levels of any priority pollutant or other regulated water quality parameter in a waterbody such that the waterbody would more frequently exceed State and/or federal numeric or narrative water quality standards, objectives, or criteria; or

- substantially degrade existing water quality on a long-term basis, even if State water quality objectives would not be exceeded, thereby causing substantial adverse effects to one or more beneficial uses designated for a given waterbody.

The significance criteria listed above were applied to all waterbodies that could be impacted by the WFP. Changes in water quality were assessed at a programmatic level, and were determined relative to the Base Condition.

4.4.3 WATER FORUM PROPOSAL IMPACTS

The WFP could affect water quality in waterbodies of both the direct and indirect effect study areas. Direct impacts to water quality could occur as a result of increased surface water diversions that would result in lower reservoir storage and river flows. Lower volumes of water in both Folsom Reservoir and the Lower American and Sacramento rivers would provide less dilution for existing levels of nutrient, pathogen, TDS, TOC, and priority pollutant loadings. Similarly, reduced Delta inflows could affect various Delta water quality parameters. With the possible exception of the temperature of water released from Keswick Dam (see Section 4.5.3 - Fisheries Resources and Aquatic Habitat), the minor changes in Shasta and Trinity reservoir storage anticipated under the WFP would not be expected to adversely affect water quality in these reservoirs.

This section discusses the potential water quality impacts that could occur in Folsom Reservoir, Lake Natoma, the Lower American River, the Sacramento River and the Delta as a direct result of the additional surface water diversions proposed under the WFP.

Direct Effect Study Area

Impact 4.4-1

Lower American River and Folsom Reservoir Water Quality. *Implementation of the WFP would directly result in seasonal reductions in Folsom Reservoir storage and Lower American River flows during most years, but would have little effect on the volume of water maintained in Lake Natoma. Volume reductions in Folsom Reservoir and the Lower American River would be expected to alter water temperatures and could increase concentrations/levels of nutrients, pathogens, TDS, TOC, turbidity, and/or priority pollutants due to reduced dilution capacity. With the exception of water temperature (see Section 4.5.3, Fisheries Resources and Aquatic Habitat, for a discussion of temperature impacts to these waterbodies), program-level assessment indicated that any direct impacts to water quality in these waterbodies resulting from seasonal reductions in Folsom Reservoir storage and/or Lower American River flows would be* ***less than significant****.*

The primary water quality parameter anticipated to be directly affected in Folsom Reservoir, Lake Natoma, and the Lower American River with implementation of the WFP is water temperature. For a detailed, quantitative discussion of the impacts of the WFP on water temperatures in these waterbodies, see Section 4.5, Fisheries Resources and Aquatic Habitat.

Levels or concentrations for other water quality parameters of interest such as nutrients, pathogens, TDS, TOC, turbidity, and priority pollutants (e.g., metals, organics) would not be expected to be directly altered by substantial magnitudes, if at all, by implementation of the WFP. This is because diverting water from Folsom Reservoir and the Lower American River would not directly change these water quality parameters downstream of the point(s) of diversion. Mass-balance calculations were conducted to depict anticipated reductions in dilution capacity that could occur in Folsom Reservoir and the Lower American River due to seasonal reductions in reservoir storage and river flow. These calculations indicated that the reductions in storage and flow would not, by themselves, be expected to regularly cause substantial degradation of existing water quality in these waterbodies, or that of Lake Natoma, under current levels of constituent loading.

Indirect Effect Study Area

Impact 4.4-2

Sacramento River Water Quality. *Implementation of the WFP would result in seasonal reductions in Sacramento River flows at Freeport in some years, thereby reducing the lower river's dilution capacity. In addition, the amount of treated effluent discharged from the SRWTP into the Sacramento River at Freeport would increase substantially. Urban runoff and stormwater discharges would also increase to some degree. Slightly reduced river dilution capacity, coupled with increased constituent loading from urban runoff and stormwater and wastewater discharges would be expected to increase, to some degree, concentrations/levels of nutrients, pathogens, TDS, TOC, turbidity, and/or priority pollutants in the Sacramento River and portions of the Delta. Project-specific water quality mitigation measures are expected to be implemented as urban growth occurs. Moreover, ongoing water quality management plans and programs are expected to prevent State and federal water quality standards, objectives and criteria from being exceeded on a more frequent basis than currently occurs. However, substantial uncertainty exists with regard to seasonal changes in Sacramento River flow, constituent loading, and the extent and effectiveness of project-level water quality mitigation and management measures in the future, all of which are beyond the control of the Water Forum. Because the potential for degradation of Sacramento River water quality in the future depends on uncertain future policy decisions and actions, this would be* ***a potentially significant*** *impact.*

Seasonal reductions in Folsom and Shasta reservoir storage and American and Sacramento river flows would occur regularly under the WFP. Seasonal storage reductions in Shasta Reservoir would not be expected to adversely affect overall water quality in this reservoir. Reductions in lower Sacramento River flows could cause river temperatures to warm more quickly, relative to higher flow conditions, when ambient air temperatures are high (i.e., during the summer and fall months). Conversely, measurable temperature changes would generally not be expected to occur in the Delta under the WFP. For a detailed, quantitative discussion of the effects of the WFP on water temperatures in the Sacramento River, see Section 4.5, Fisheries Resources and Aquatic Habitat.

Implementation of the WFP would result in seasonal reductions in Folsom and Shasta reservoir storage and American and Sacramento River flows during some years. Such hydrologic changes would be expected to cause seasonal reductions in Sacramento River flows at Freeport in some years, thereby reducing the lower river's dilution capacity. In addition, the increased urbanization that would occur in the American River system would result in substantial increases in the amount of treated effluent discharged from the SRWTP into the Sacramento River at Freeport. Assuming the level of treatment at the SRWTP remains unchanged, constituent loading to the Sacramento River from this point-source discharge would increase. Slightly reduced river dilution capacity, coupled with increased constituent loading from urban runoff and stormwater and wastewater discharges would be expected to increase, to some degree, concentrations/levels of nutrients, pathogens, TDS, TOC, turbidity, and/or priority pollutants in the Sacramento River and portions of the Delta.

Overall, measurable increases in constituent concentrations/levels that could occur under the WFP would not be expected to be sufficiently large to cause State or federal water quality criteria or standards to be exceeded in the Sacramento River or Delta when they would not otherwise be exceeded. Nevertheless, the potential for measurable degradation in some water quality parameters does exist, to some degree, particularly in the drier years.

4.4.4 MITIGATION MEASURES

No mitigation measures are necessary for the following less-than-significant impacts:

4.4-1: Lower American River and Folsom Reservoir Water Quality

The following discussion of mitigation is provided for significant and potentially significant impacts.

impact **4.4-2** mitigation

Sacramento River and Delta Water Quality

Changes to Sacramento River and Delta water quality would be an indirect impact of increased urban development facilitated, in part, by the additional diversions of surface and groundwater defined in the WFP. Water quality mitigation measures will be developed for specific projects as they occur in the future. Responsibility for this mitigation lies with the land use planning authorities and individual project proponents, and is beyond the Water Forum's control. Water quality mitigation anticipated to occur with planned growth is addressed in the Sacramento County and other regional General Plans. In addition, the Sacramento County Regional Sanitation District, which operates the SRWTP, is currently updating its Sacramento Regional Wastewater Treatment Plan Master Plan, and plans to update this document every 5 years in the future.

4.4.5 LEVELS OF SIGNIFICANCE AFTER MITIGATION

4.4-1: This impact would be less-than-significant.

4.4-2: Potentially significant, because of the high degree of uncertainty pertaining to future level of effluent treatment at the SRWTP; the effectiveness of project-specific water quality mitigation measures that will be implemented as urban growth occurs; future regulatory standards and criteria; and the degree of change that will actually occur in various water quality parameters of the Sacramento River and Delta, and the impacts of such changes to the beneficial uses of these water bodies.

4.5 FISHERIES RESOURCES AND AQUATIC HABITAT

Increased surface water diversions and new diversion facilities anticipated under 2030 with or without the WFP could have both direct and indirect affects on fisheries resources and aquatic habitats within multiple water bodies of the region. The direct-effect study area for the Water Forum Proposal has been defined as Folsom Reservoir, Lake Natoma, and the Lower American River. For discussions pertaining to fisheries resources and aquatic habitats, the indirect-effects study area includes Shasta and Trinity reservoirs, the upper and lower Sacramento River, and the Sacramento-San Joaquin Delta. Any effect(s) on other water bodies of the region under the WFP or its alternatives would be expected to be minimal and, therefore, are not discussed in this section.

4.5.1 EXISTING CONDITIONS

This section provides an overview of aquatic resources within water bodies of both the direct- and indirect-effect study areas. It also defines the regulatory authority/responsibilities of the California Department of Fish and Game (CDFG), U.S. Fish & Wildlife Service (USFWS), and the National Marine Fisheries Service (NMFS) for management of fisheries and aquatic habitats within the region. Finally, this section discusses life history requirements of fish species of primary management concern occurring within the direct- and indirect-effect study areas to provide, in part, a technical basis from which to assess potential impacts to fisheries resources. Species of primary management concern include those that are recreationally or commercially important (e.g., fall-run chinook salmon, American shad, and striped bass), federal and State listed species of the region (e.g., winter-run chinook salmon, steelhead, and delta smelt), and species proposed for listing under State and/or federal Endangered Species Acts (e.g., spring-run, fall-run, and late fall-run chinook salmon, and Sacramento splittail).

DIRECT EFFECT STUDY AREA

Folsom Reservoir

The completion of Folsom Dam in 1955 transformed a portion of the American River from a lotic (free-flowing) environment into a lentic (lake-like) environment. Folsom Reservoir has a maximum storage capacity of approximately 977,000 AF, and has a maximum depth of approximately 266 feet. Strong thermal stratification occurs within Folsom Reservoir annually between April and November. Thermal stratification establishes a warm surface water layer (epilimnion), a middle water layer characterized by decreasing temperature with increasing depth (metalimnion or thermocline), and a bottom, coldwater layer (hypolimnion) within the reservoir.

In terms of aquatic habitat, the warm epilimnion of Folsom Reservoir provides habitat for warmwater fishes, whereas the reservoir's lower metalimnion and hypolimnion form a "coldwater pool" that provides habitat for coldwater fish species throughout the summer and fall portions of the year. Hence, Folsom Reservoir supports a "two-story" fishery during the stratified portion of the year, with warmwater species using the upper, warmwater layer and coldwater species using the deeper, colder portion of the reservoir.

Native species that occur in the reservoir include hardhead and Sacramento squawfish. However, introduced largemouth bass, smallmouth bass, spotted bass, bluegill, crappie, and catfish constitute the primary warmwater sport fisheries of Folsom Reservoir. The reservoir's coldwater sport species include rainbow and brown trout, kokanee salmon, and chinook salmon. Brown trout have been stocked into the reservoir in the past. Although they are no longer stocked, a population of brown trout remains in the reservoir. Rainbow trout are stocked into Folsom Reservoir by CDFG at multiple sizes, including catchable-size (2 fish/lb). Kokanee salmon are stocked as fingerlings. Chinook salmon stocked into Folsom Reservoir are reared at the Feather River Hatchery as part of CDFG's Inland Chinook Salmon Program. These species are stream spawners and, therefore, do not reproduce within the reservoir. However, some spawning by one or more of these species may occur in the American River upstream of Folsom Reservoir.

Species-specific spawning times for those fish species that do spawn in Folsom Reservoir define the months of concern during which additional surface water diversions under the WFP or its alternatives could impact fish spawning and young-of-the-year rearing success. For example, largemouth and smallmouth bass spawn primarily in April and May, whereas peak spawning for sunfish and catfish generally occurs in late-May and June.

The reservoir's coldwater pool is not only important to the reservoir's coldwater fish species identified above, but also is important to Lower American River fall-run chinook salmon and steelhead. Seasonal releases from the reservoir's coldwater pool provide thermal conditions in the Lower American River that support annual in-river production of these salmonid species. Any reduction in the reservoir's coldwater pool reduces the volume of coldwater that is available to be released in any given year into the Lower American River to benefit the river's chinook salmon and steelhead populations. Folsom Reservoir's annual coldwater pool is not large enough to facilitate coldwater releases during the warmest months (i.e., July-September) to provide maximum thermal benefits to Lower American River steelhead and coldwater releases during October and November that would maximally benefit fall-run chinook salmon immigration, spawning, and incubation. Consequently, optimal management of the reservoir's coldwater pool on an annual basis is essential in order to provide the maximum thermal benefits to both fall-run chinook salmon and steelhead, within the constraints of coldwater pool availability.

Lake Natoma

Lake Natoma was constructed to serve as a regulating afterbay for Folsom Reservoir. Consequently, water surface elevations in Lake Natoma fluctuate from three to seven feet on a daily and weekly basis (USFWS 1991). During most of the year, Lake Natoma receives controlled releases from Folsom Reservoir. Due to its small size (i.e., operating range of 2,800 AF) and rapid turnover rate, Lake Natoma has relatively little influence on water flowing through it, with the possible exception of water temperature. As residence time in the lake increases during warm summer months, warming of water released from Folsom Reservoir increases. Water is released from Lake Natoma into the Lower American River at Nimbus Dam.

Lake Natoma supports many of the same fisheries found in Folsom Reservoir (e.g., rainbow trout, bass, sunfish, and catfish). Some recruitment of warmwater and coldwater fishes likely comes from Folsom Reservoir. In addition, the CDFG stocks catchable-size rainbow trout into Lake Natoma annually. Although supporting many of the same fish species found in Folsom Reservoir, Lake Natoma's limited primary and secondary production, colder epilimnotic water temperatures (relative to Folsom Reservoir), and daily elevation fluctuations are believed to reduce the size and annual production (USFWS 1991) of many of its fish populations, relative to Folsom Reservoir. Lake Natoma's characteristics, coupled with limited public access, result in its lower angler use compared to Folsom Reservoir.

Nimbus Hatchery

The CDFG operates the Nimbus Salmon and Steelhead Hatchery and the American River Trout Hatchery which are both located at the same facility immediately downstream from Nimbus Dam. This hatchery facility (henceforth referred to as the Nimbus Hatchery when discussing both the salmon/steelhead and trout hatcheries) receives its water supply directly from Lake Natoma.

The Nimbus Salmon and Steelhead Hatchery is devoted to producing anadromous fall-run chinook salmon and steelhead. The current production goal for fall-run chinook salmon is 4 million smolt-size (60 fish/lb) fish. The hatchery's fish ladder is opened to fall-run chinook salmon annually when the average daily river temperature declines to approximately 60°F, which generally occurs in October or early November. The fall-run chinook salmon produced are released directly into the Delta. In the event that the hatchery's inventory of chinook salmon requires reduction prior to releasing all of the year's production, chinook salmon fry are released into the Sacramento River at either Miller Park or Garcia Bend (Barngrover, pers. comm., 1997).

Immigrating adult steelhead typically begin arriving at the hatchery fish ladder in December. Peak steelhead egg collection generally occurs during January and February, but sometimes continues through March. The current production goal for steelhead is 430,000 yearling (4 fish/lb) fish, which are released into the Sacramento River at either Miller Park or Garcia Bend. Steelhead are no longer stocked directly into the Lower American River on an annual basis. In the event that water temperatures at the hatchery become too high to successfully rear juvenile steelhead through the summer, these fish are generally transported to rearing facilities at the hatcheries on the Feather and Mokelumne rivers (Barngrover, pers. comm., 1997).

The second hatchery, located at this same facility, is called the American River Trout Hatchery. This hatchery is devoted to producing non-anadromous rainbow trout. The 1997 production goals for this hatchery are 736,000 catchable (2 fish/lb), 280,000 sub-catchable (6-16 fish/lb), and 1.4 million fingerling rainbow trout (Barngrover, pers. comm., 1997). These trout are stocked into numerous water bodies throughout the region.

The Nimbus Hatchery receives water for its operations directly from Lake Natoma via a 60-inch pipeline. Water temperatures in the hatchery are dictated by the temperature of water diverted from Lake Natoma which, in turn, is primarily dependent upon the temperature of water released from Folsom Reservoir, meteorological conditions, and retention time in Lake Natoma. The temperatures of water diverted from Lake Natoma for hatchery operations is frequently higher than that which is optimal (i.e., 55-56°F) for hatchery production of rainbow trout, steelhead, and chinook salmon. Under such conditions, more suitable temperatures may be achieved by increasing releases at Folsom Dam and/or releasing colder water from a lower elevation within Folsom Reservoir via the water release shutters at the power penstocks of Folsom Dam. However, seasonal releases from Folsom Reservoir's limited coldwater pool to benefit hatchery operations must be considered in conjunction with seasonal in-river benefits from such releases.

Lower American River

The American River drains a watershed of approximately 1,895 square miles (USBR 1996), and is a major tributary to the Sacramento River. Historically, the American River provided over 125 miles of riverine habitat to anadromous and resident fishes. Presently, use of the American River by anadromous fishes is limited to the 23 miles of river below Nimbus Dam (i.e., the Lower American River).

The Lower American River provides a diversity of aquatic habitats, including shallow, fast-water riffles, glides, runs, pools, and off-channel backwater habitats. The Lower American River from Nimbus Dam (river mile (RM) 23) to approximately Goethe Park (RM 14) is primarily unrestricted by levees, but is bordered by some developed areas. This reach of the river is hydrologically controlled by natural bluffs and terraces cut into the side of the channel. The river reach downstream of Goethe Park, and extending to its confluence with the Sacramento River (RM 0), is bordered by levees. The construction of levees changed the channel geomorphology and has resulted in a reduction in current velocities and meanders and an increase in depth.

The river is utilized by over 30 species of fish, including numerous resident native and introduced species, as well as several anadromous species. A number of species are of primary management concern due either to their declining status or their importance to recreational and/or commercial fisheries. Steelhead occurring in the Central Valley Evolutionary Significant Unit (ESU) (which includes the Lower American River) were listed by the NMFS as threatened on March 19, 1998 (63 FR 53). Species proposed for listing under the federal Endangered Species Act (ESA) include fall-run chinook salmon (proposed for listing as threatened) and Sacramento splittail (proposed for listing as threatened). Current recreationally and/or commercially important anadromous species include fall-run chinook salmon, steelhead, striped bass, and American shad.

Historically, the majority of fall-run chinook salmon and steelhead spawning and rearing habitat within the American River was located in the watershed above Folsom Dam. The Lower American River currently provides spawning and rearing habitat for fall-run chinook salmon and steelhead below Nimbus Dam. The majority of the steelhead run is believed to be of hatchery origin. However, with the exception of an emergency release during January of 1997 due to poor water quality caused by flooding, no stocking of steelhead directly into the Lower American River has occurred since 1990 (Barngrover, pers. comm., 1997).

Current fall-run chinook salmon and steelhead production within the Lower American River is believed to be limited, in part, by inadequate instream flow conditions and excessively high water temperatures during portions of their freshwater residency in the river. High water temperatures during the fall can delay the onset of spawning by chinook salmon, and river water temperatures can become unsuitably high for juvenile salmon rearing during spring and steelhead rearing during summer. Relatively low October and November flows, when they occur, tend to increase the amount of fall-run chinook salmon redd superimposition, thereby limiting initial year-class strength. Life history strategies and environmental requirements for fish species of primary management concern occurring within the Lower American River are provided in a separate subsection, below..

INDIRECT EFFECT STUDY AREA

Shasta, Keswick, and Trinity Reservoirs

Shasta Reservoir is a deep reservoir supporting a wide variety of cold and warmwater fish species. Fish inhabiting the reservoir include several species of trout, landlocked salmon, Sacramento sucker, Sacramento squawfish, largemouth and smallmouth bass, channel catfish, white catfish, threadfin shad, and common carp. Water surface elevations in this reservoir generally fluctuate by approximately 55 feet over the course of a year. The reservoir's littoral (i.e., shallow, nearshore) habitats are often subject to physical perturbations caused by water surface elevation fluctuations and shoreline wave action resulting from wind and boating activity.

Keswick Reservoir, the area between Shasta and Keswick dams, serves as a regulating afterbay for Shasta Reservoir. It is characterized as a coldwater impoundment that supports a rainbow and brown trout sport fishery. Keswick Dam is a complete barrier to the upstream migration of anadromous fishes in the Sacramento River. Some of the migrating anadromous fish impeded by Keswick Dam are captured in a fish trap at the dam and transported to the Coleman National Fish Hatchery (USBR 1991) located on Battle Creek (southeast of the town of Anderson).

Trinity Reservoir, an impoundment produced by Trinity Dam, lies on the Trinity River. A portion of the water from this reservoir is directed through the Clear Creek Tunnel into Whiskeytown Reservoir and then into Keswick Reservoir. This water mixes with water from Shasta Reservoir and is released into the Sacramento River from Keswick Dam. Trinity Reservoir supports both warm- and coldwater fish species. Common fish species in the reservoir include smallmouth bass, largemouth bass, white catfish, and rainbow trout (Corps 1991a).

Upper and Lower Sacramento River

The upper Sacramento River is often defined as the portion of the river from Princeton (RM 163) (the downstream extent of salmonid spawning in the Sacramento River (Burmester, pers. comm., 1996)), and Keswick Dam (the upstream extent of anadromous fish migration and spawning). The Sacramento River serves as an important migration corridor for anadromous fishes moving between the ocean and/or Delta and upper river/tributary spawning and rearing habitats. The upper Sacramento River is differentiated from the river's "headwaters" which lie upstream of Shasta Reservoir. The upper Sacramento River provides a diversity of aquatic habitats, including fast-water riffles and shallow glides, slow-water deep glides and pools, and off-channel backwater habitats.

In excess of 30 species of fish are known to use the Sacramento River. Of these, a number of both native and introduced species are anadromous. Anadromous species include chinook salmon, steelhead, green and white sturgeon, striped bass and American shad. The upper Sacramento River is of primary importance to native anadromous species, and is presently utilized for spawning and early-life-stage rearing, to some degree, by all four runs of chinook salmon (i.e., fall, late-fall, winter, and spring runs) and steelhead. Consequently, various life stages of the four races of chinook salmon and steelhead can be found in the upper Sacramento River throughout the year. Other Sacramento River fishes are considered resident species, which complete their life cycle entirely within freshwater, often in a localized area. Resident species include rainbow and brown trout, largemouth and smallmouth bass, channel catfish, sculpin, Sacramento squawfish, Sacramento sucker, hardhead, and common carp (USBR 1991b).

The lower Sacramento River is generally defined as that portion of the river from Princeton to the Delta, at approximately Chipps Island (near Pittsburg). The lower Sacramento River is predominantly channelized, leveed and bordered by agricultural lands. Aquatic habitat in the lower Sacramento River is characterized primarily by slow-water glides and pools, is depositional in nature, and has reduced water clarity and habitat diversity, relative to the upper portion of the river.

Many of the fish species utilizing the upper Sacramento River also use the lower river to some degree, even if only as a migratory pathway to and from upstream spawning and rearing grounds. For example, adult chinook salmon and steelhead primarily use the lower Sacramento River as an immigration route to upstream spawning habitats and an emigration route to the Delta. The lower river is also used by other fish species (e.g., Sacramento splittail and striped bass) that make little to no use of the upper river (i.e., upstream of RM 163). Overall, fish species composition in the lower portion of the Sacramento River is quite similar to that of the upper Sacramento River and includes resident and anadromous cold- and warmwater species. Many fish species that spawn in the Sacramento River and its tributaries depend on river flows to carry their larval and juvenile life stages to downstream nursery habitats. Native and introduced warmwater fish species primarily use the lower river for spawning and rearing, with juvenile anadromous fish species also using the lower river, to some degree, for rearing.

An important component of aquatic habitat throughout the Sacramento River is referred to as Shaded Riverine Aquatic Cover (SRA). SRA consists of the portion of the riparian community that directly overhangs or is submerged in the river. SRA provides high-value feeding and resting areas and escape cover for juvenile anadromous and resident fishes. SRA also can provide some degree of local temperature moderation during summer months due to the shading it provides to nearshore habitats (USFWS 1992). The importance of SRA to chinook salmon was demonstrated in studies conducted by the USFWS (DeHaven 1989). In early summer, juvenile chinook salmon were found exclusively in areas of SRA, and none were found in nearby rip-rapped areas (DeHaven 1989).

Life history strategies and environmental requirements for fish species of primary management concern occurring within the Sacramento River are provided in a separate subsection, below.

Sacramento-San Joaquin Delta

The Delta and San Francisco Bay comprise the largest estuary on the west coast (EPA 1993). Its importance to fisheries is illustrated by the over 120 fish species which rely on its unique habitat characteristics for one or more of their life stages (EPA 1993). Fish species found in the Delta include anadromous species, as well as freshwater, brackish water, and saltwater species. Delta inflow and outflow are important for species residing primarily in the Delta (e.g., delta smelt and longfin smelt) (USFWS 1994a) as well as juveniles of anadromous species (e.g., chinook salmon) that rear in the Delta prior to ocean entry. Seasonal Delta inflows affect several key ecological processes, including: 1) the migration and transport of various life stages of resident and anadromous fishes using the Delta (SFEP 1992); 2) salinity levels at various locations within the Delta as measured by the location of X2 (i.e., the position in kilometers eastward from the Golden Gate Bridge of the 2 parts per thousand (ppt) near-bottom isohaline); and 3) the Delta's primary (phytoplankton) and secondary (zooplankton) production.

Life history strategies and environmental requirements for fish species of primary management concern occurring within the Delta are provided below.

Life Histories and Environmental Requirements of Fish Species of Management Concern

Evaluating potential impacts to fishery resources requires an understanding of fish species' life histories and life-stage-specific environmental requirements. Therefore, this information is provided for fish species of primary management concern that occur (or potentially occur) within both the direct- and indirect-effect study areas. Fish species of primary management concern include recreationally/commercially important species, species listed under the State and/or federal ESA, and those species being considered for State and/or federal ESA listing or other special status.

Chinook Salmon - Four runs of chinook salmon (i.e., fall-run, late-fall-run, winter-run, and spring-run) occur in the Sacramento River system, whereas only fall-run occur in the Lower American River. Chinook salmon are anadromous, meaning they spend most of their lives in the ocean and return to their natal freshwater stream to spawn. A separate discussion for each of the four runs of chinook salmon is provided below.

Winter-run - Winter-run chinook salmon are listed as endangered under both the federal and State ESA. Under Section 7 of the ESA, federal agencies are required to ensure that their actions are not likely to result in the destruction or adverse modification of a listed species' critical habitat. Critical habitat for the winter-run chinook salmon is defined to occur in the Sacramento River from Keswick Dam (RM 302) to Chipps Island (RM 0) in the Delta. Also included are waters west of the Carquinez Bridge, Suisun Bay, San Pablo Bay, and San Francisco Bay north of the Oakland Bay Bridge (NMFS 1993).

Adult winter-run chinook salmon immigration (upstream spawning migration) through the Delta and into the lower Sacramento River occurs from December through July, with peak immigration during the period January through April (USFWS 1995). Winter-run chinook salmon primarily spawn in the main-stem Sacramento River between Keswick Dam (RM 302) and Red Bluff Diversion Dam (RM 258). Winter-run chinook salmon spawn between late-April and mid-August, with peak spawning generally occurring in June.

Winter-run chinook salmon fry rearing in the upper Sacramento River exhibit peak abundance during September, with fry and juvenile emigration past Red Bluff Diversion Dam occurring from August through March (USBR 1992). Emigration (downstream migration) of winter-run chinook salmon juveniles past Red Bluff Diversion Dam is believed to peak during September and October (Hallock and Fisher 1985), with abundance of juveniles in the Delta generally peaking during February, March, or April (Stevens 1989). Differences in peak emigration periods between these two locations suggest that juvenile winter-run chinook salmon may exhibit a sustained residence in the middle or lower Sacramento River or upper Delta prior to seaward migration. The location and extent of this middle-area rearing is unknown, although it has been suggested that the duration of fry presence in an area is directly related to the magnitude of river flows during the rearing period (Stevens 1989). Additional information on the life history and habitat requirements of winter-run chinook salmon is contained in the NMFS Biological Opinion for this species, which was developed to specifically evaluate impacts to winter-run associated with CVP and SWP operations (NMFS 1993).

Spring-run - Spring-run chinook salmon enter the Sacramento River during the period late March through September (Reynolds et al. 1990), but peak abundance of immigrating adults in the Delta and lower Sacramento River occurs from April through June (USFWS 1994a). Adult spring-run chinook salmon hold in areas downstream of spawning grounds during the summer months until their eggs fully develop and become ready for spawning. This is the primary characteristic distinguishing the spring-run from the other runs of chinook salmon. Spring-run chinook salmon spawn primarily upstream of Red Bluff Diversion Dam, and in several upper Sacramento River tributaries (e.g., Mill and Deer creeks). Spawning occurs during mid-August through early October (Reynolds et al. 1990). Although some portion of an annual year-class may emigrate as post-emergent fry (i.e., individuals less than 45 mm in length), most are believed to rear in the upper river and tributaries during the winter and spring, and emigrate as juveniles (i.e., individuals greater than 45 mm in length, but not having undergone smoltification) or smolts (silvery colored fingerlings having undergone the smoltification process in preparation for ocean entry). The timing of juvenile emigration from the spawning and rearing grounds varies among the tributaries of origin, and can occur during the period November through June.

Late fall-run - Adult immigration of late fall-run chinook salmon in the Sacramento River generally begins in October, peaks in December, and ends in April (USBR 1991b). Primary spawning grounds for late fall-run chinook salmon are in tributaries to the upper Sacramento River (e.g., Battle, Cottonwood, Clear, and Mill creeks), although late fall-run chinook salmon are believed to return to the Feather and Yuba rivers as well (USFWS 1994a). Spawning in the main-stem Sacramento River occurs primarily from Keswick Dam (RM 302) to Red Bluff

Diversion Dam (RM 258), and generally occurs from December through April (USBR 1991b). Post-emergent fry and juveniles emigrate from their spawning and rearing grounds in the upper Sacramento River and its tributaries during the period May through November. Juveniles emigrate through the Delta primarily during the period October through December (USFWS 1994a).

Fall-run - The fall run of chinook salmon is currently the largest run of chinook salmon in the Sacramento River system, and the primary run of chinook salmon using the Lower American River. Because fall-run chinook salmon represent the greatest percentage of all four runs, they continue to support commercial and recreational fisheries of significant economic importance. Regulations pertaining to the commercial and recreational fisheries for this species are anticipated to change now that they have been proposed for listing as threatened under the federal ESA.

In general, adult fall-run chinook salmon migrate into the Sacramento River and its tributaries from July through December, with immigration peaking from mid-October through November (Reynolds et al. 1990). Fall-run chinook salmon spawn in numerous tributaries of the Sacramento River, including the Lower American River, lower Yuba River, Feather River, as well as tributaries to the upper Sacramento River. The majority of main-stem Sacramento River spawning occurs between Keswick and Red Bluff Diversion dams. A greater extent of fall-run spawning (relative to the other three runs) occurs below Red Bluff Diversion Dam, with limited spawning potentially occurring as far downstream as Princeton (RM 163) (Burmester, pers. comm., 1996). Spawning generally occurs from October through December, with fry emergence typically beginning in late December and January. Fall-run chinook salmon emigrate as post-emergent fry, juveniles, and as smolts after rearing in their natal streams for up to six months. Consequently, fall-run emigrants may be present in the Lower American and Sacramento rivers from January through June (Reynolds et al. 1990; Herbold et al. 1992), and remain in the Delta for variable lengths of time prior to ocean entry.

Because fall-run chinook salmon occur within the direct-effect study area, and because they are a species of primary management concern in the Lower American River, additional life history and environmental requirement information pertaining more specifically to the Lower American River fall-run population is provided below.

Adult fall-run chinook salmon begin entering the Lower American River annually in August and September, with immigration continuing through December in most years and January in some years. Both historic (fish passage at Old Folsom Dam, 1944-46) and recent (creel survey, 1991-94) data indicate that adult chinook salmon arrivals in the Lower American River peak in November, and that typically greater than 90% of the run has entered the river by the end of November (CDFG 1992, 1993, 1994, 1995). The arrival distribution of fall-run chinook salmon is dictated largely by life history events (i.e., maturation, photoperiod, and other seasonal environmental cues); therefore, it generally tends to be temporally similar from year-to-year in the Lower American River.

Once in the Lower American River, the timing of adult chinook salmon spawning activity is strongly influenced by water temperature. When daily average water temperatures decrease to approximately 60°F, female chinook salmon begin to construct nests (redds) into which their eggs (simultaneously fertilized by the male) are eventually released. Fertilized eggs are subsequently buried with streambed gravel. Due to the timing of adult arrivals and occurrence of appropriate spawning temperatures, spawning activity in recent years (i.e., 1991-1993) has peaked during mid- to late-November (CDFG 1992b, 1993a, 1995). These same studies indicated that approximately 98% of all redds observed during these years were located between Watt Avenue (RM 9.5) and Nimbus Dam (RM 23).

The intragravel residence period of incubating eggs and alevins (i.e., yolk-sac fry) is highly dependent upon water temperature. The intragravel egg and fry incubation lifestage for chinook salmon in the Lower American River generally extends from about mid-October through March. Egg incubation survival rates are dependent on water temperature and intragravel water movement. CDFG (1980) reported egg mortalities of 80% and 100% for chinook salmon at water temperatures of 61°F and 63°F, respectively. Egg incubation survival is highest at water temperatures at or below 56°F.

Fall-run chinook salmon fry emergence generally occurs from late-December through mid-May in the Lower American River (Snider and Titus 1996). Fall-run chinook salmon emigrate from the Lower American River during two distinct time periods. The primary period of emigration occurs from mid-February through early March. The vast majority (99.6%) of chinook salmon emigrants captured during this period in both 1994 and 1995 were pre-smolt. As in 1994, most (i.e., 86%) of the emigrants captured in 1995 were recently emerged (< 45 mm FL) fish. The remaining fry rear in the Lower American River where they feed and grow for up to 6 months, prior to emigrating as juveniles or smolts through June. Emigration surveys conducted by CDFG have shown no evidence that peak emigration of chinook salmon is related to the onset of peak spring flows (Snider et al. 1997). Temperatures required during emigration are believed to be about the same as those required for successful rearing.

Water temperatures between 45°F and 58°F are believed to be optimal for rearing of chinook salmon fry and juveniles (Reiser and Bjornn 1979; Rich 1987). Raleigh et al. (1986) reviewed the available literature on chinook salmon thermal requirements and suggested a range of approximately 53.6°F to 64.4°F as suitable rearing temperatures, and 75°F as an upper limit. Lower American River water temperatures at Watt Avenue generally range from about 46°F to 60°F during the period December through April, and from 60°F to 69°F during the months of May and June. The 69-year average (1922-1990) water temperatures at Watt Avenue, as indicated by the USBR's Lower American River Temperature Model under existing hydrology, are 61.7°F in May and 65.9°F in June. Hence, average May and June river temperatures at Watt Avenue are currently at the upper end of the suitable range of chinook salmon rearing temperatures, as defined above.

Steelhead - Steelhead are the anadromous form of rainbow trout. Adult steelhead migrate through the Sacramento River system beginning in August and continue through March. Adult steelhead return to spawning grounds in the upper Sacramento River and tributaries (including the Lower American River). Steelhead also are produced at the Coleman Fish Hatchery on Battle Creek, the Nimbus Hatchery on the American River, and the Feather River Hatchery on the Feather River (Reynolds et al. 1990). Spawning generally occurs from January through April (McEwan, pers. comm., 1997). Juvenile steelhead rear in their natal streams for 1 to 2 years prior to emigrating from the river. Emigration of 1- to 2-year-old fish primarily occurs from April through June (Reynolds et al. 1990; McEwan, pers. comm., 1997).

The Lower American River steelhead population is believed to be supported almost entirely by fish produced at the Nimbus Hatchery. Adult steelhead immigration into the Lower American River typically begins in November and continues into April. The steelhead spawning immigration generally peaks during January (CDFG 1986; CDFG, unpublished data). Optimal immigration temperatures are reported to range from 46°F to 52°F (CDFG 1991).

Spawning usually begins during late-December and may extend through March, but can range from November through April (CDFG 1986; CDFG, unpublished data). Optimal spawning temperatures are believed to range from 39°F to 52°F (CDFG 1991). Unlike chinook salmon, not all steelhead die after spawning. Those that do not die return to the ocean after spawning, and may return to spawn again in future years. The egg and fry incubation lifestage for steelhead in the Lower American River typically extends from December through May.

Fry emergence from the gravel generally begins in March and occurs through June, with peak emergence occurring during April (CDFG 1986; Snider and Titus 1996; CDFG, unpublished data). Optimal egg and fry incubation temperatures are believed to range from 48°F to 52°F (CDFG 1991). Optimal temperatures for fry and juvenile rearing is reported to range from 45°F to 60°F (CDFG 1991). As with chinook salmon, it is believed that temperatures up to 65°F are suitable for steelhead rearing, with each degree increase between 65°F and the upper lethal limit of 75°F (Bovee 1978) being increasingly less suitable and thermally more stressful. The primary period of steelhead emigration from the Lower American River is believed to occur from March through June (Castleberry et al. 1991).

American Shad - American shad occur in the Sacramento River, its major tributaries (including the Lower American River), and the Delta. A popular sport fishery for American shad exists annually in the Sacramento River and certain tributaries, including the Lower American River (CDFG 1980).

Adult American shad typically enter the Lower American River from April through early July (CDFG 1986), with the spawning migration peaking from mid-May through June (CDFG 1987a). Water temperature is an important factor influencing the timing of spawning. American shad are reported to spawn at water temperatures ranging from approximately 46°F to 79°F (USFWS 1967), although optimal spawning temperatures range from about 60°F to 70°F (Leggett and Whitney 1972; Painter et al. 1977; Bell 1976; CDFG 1980; Rich 1987). American shad spawning migrations are comprised mostly of first-time spawners (or "virgin" fish) which accounted for an average of approximately 72% of the females and 67% of the males sampled in the Sacramento-San Joaquin River system from 1975 through 1978 (CDFG 1980).

Based on their 1990 field investigation, Jones and Stokes Associates (1990) reported that water velocity was the most important physical variable determining shad spawning habitat preference in the lower Yuba River, followed by depth and water temperature. In contrast to salmonids, distributions of spawning virgin shad are determined by river flow rather than homing behavior (Painter et al. 1979). Substrate and cover played no apparent role in habitat selection. Snider and Gerstung (1986) recommended flow levels of 3,000 to 4,000 cfs in the Lower American River during May and June as sufficient attraction flows to sustain the river's American shad fishery. When suitable spawning conditions are found, American shad school and broadcast their eggs throughout the water column.

Based on laboratory experiments conducted on American shad incubation, Walburg and Nichols (1967) concluded that temperatures suitable for normal egg development ranged from about 54°F to 70°F. These investigators further reported that eggs hatched in 3 to 5 days at 68°F to 74°F and in 4 to 6 days at temperatures of 59°F to 64.4°F. Egg incubation and hatching, therefore, are coincident with the primary spawning period (i.e., May through June). A large percentage of the eggs spawned in the Lower American River probably do not hatch until they have drifted downriver and entered the Sacramento River (CDFG 1986). Few juvenile American shad have been collected in the Lower American River (CDFG 1980). Thus, the presence of American shad in the Lower American River is primarily restricted to adult immigration, spawning, and fry lifestages.

Striped Bass - Striped bass occur in the Sacramento River, its major tributaries (including the Lower American River), and the Delta. Substantial striped bass spawning and rearing occurs in the Sacramento River and Delta. Year-class strength of striped bass in the Delta has been correlated with survival and growth during the first 60 days after hatching. The abundance of young striped bass, in turn, was positively correlated with freshwater outflow from the Delta, and negatively correlated with the percentage of Delta inflow diverted from Delta channels during spring and early summer by the SWP and CVP (USFWS 1988).

Adult striped bass are present in the Lower American River throughout the year (DeHaven 1977), with peak abundance occurring during the summer months (DeHaven 1977, 1979; CDFG 1971). No studies have definitively determined whether striped bass spawn in the Lower American River (CDFG 1971; CDFG 1986). However, the scarcity of sexually ripe adults among sport-caught fish indicates that minimal, if any, spawning occurs in the Lower American River, and that adult fish which entered the river probably spawned elsewhere or not at all (DeHaven 1977, 1978). The number of striped bass entering the Lower American River during the summer is believed to vary with flow levels and food production (CDFG 1986). Snider and Gerstung (1986) suggested that flows of 1,500 cfs at the mouth during May and June would be sufficient to maintain the striped bass fishery in the Lower American River. However, these investigators reported that, in any given year, the population level of striped bass in the Delta was probably the greatest factor determining the relative number of striped bass occurring in the Lower American River. Most striped bass spawning is believed to occur in the Sacramento River and Delta. The majority of Sacramento River spawning occurs in the lower Sacramento River, downstream of RM 140 (USFWS 1988).

The Lower American River apparently is a nursery area for young striped bass (CDFG 1971, 1986). Numerous schools of 5- to 8-inch-long fish have been reported in the river during the summer months (CDFG 1971). In addition, juvenile and sub-adult fish have been reported to be abundant in the Lower American River during the fall (DeHaven 1977). Optimal water temperatures for juvenile striped bass rearing range from approximately 61°F to 71°F (USFWS 1988).

Sacramento Splittail - Sacramento splittail are currently proposed for listing as threatened under the federal ESA (59 FR 862, January 6, 1994), and are currently listed as a State species of special concern (CDFG 1995). Splittail are members of the minnow family (Cyprinidae), achieving lengths of up to about 16 inches.

Adult splittail usually reach sexual maturity in their second year, and migrate upstream in the late fall to early winter prior to spawning activities. Spawning occurs from mid-winter through July in water temperatures between 9-20°C (48-68°F) (Wang 1986) at times of high winter or spring runoff (CDWR 1994). Splittail prefer to spawn over flooded streambank vegetation or beds of aquatic plants, and the timing of their upstream movements and spawning corresponds to the historically high-flow period associated with snowmelt and runoff each spring. The precise timing and location of spawning varies among years, and the timing and magnitude of winter and spring runoff may play a substantial role in determining the temporal and spatial distribution of spawning in any given year. Water temperature and photoperiod also influence the timing of spawning.

Historically, splittail could be found in the upper reaches of the Sacramento River. Today, Red Bluff Diversion Dam appears to be a complete barrier to upstream movement (CDFG 1989). The presence of splittail in the Sacramento River and its tributaries (including the Lower American River) is believed to be largely restricted to their upstream and downstream movements associated with spawning. Juvenile splittail are not believed to use the Sacramento River or its tributaries for rearing to a great extent (USFWS 1994a). Downstream emigration into the Delta is believed to peak during the period April through August (Meng and Moyle 1995).

Low numbers of splittail have been collected in the Lower American River. CDFG has conducted fish sampling surveys on the Lower American River annually from 1991 through 1995 (Brown et al. 1991; Snider and McEwan 1993; Snider and Keenan 1994; Snider and Titus 1994; Snider and Titus 1996). The fish sampling surveys were conducted from approximately January through June, when adult and larval splittail would likely be in the river. Splittail were collected in very low numbers, primarily at the lowest sampling station located downstream of U.S. Interstate Business 80 (RM 4) (Brown et al. 1992). All splittail captured in 1991 were young-of-the-year. Only two splittail have been captured above RM 9.

Hardhead - Hardhead is a large (occasionally exceeding 600 mm SL), native cyprinid species that generally occurs in large, undisturbed low- to mid-elevation rivers and streams of the region (Moyle 1976). They are widely distributed throughout the Sacramento-San Joaquin river system. Hardhead mature following their second year. Spawning migrations, which occur in the spring, into smaller tributary streams are common. The spawning season may extend into August in the foothill streams of the Sacramento and San Joaquin river basins. Spawning behavior has not been documented, but hardhead are believed to elicit mass spawning in gravel riffles (Moyle 1976). Little is known about life-stage-specific temperature requirements of hardhead; however, temperatures ranging from approximately 65°F to 75°F are believed to be suitable (Cech et al. 1990). Hence, this species has greater thermal tolerance compared to that of the anadromous salmonids discussed above.

Delta Smelt - The USFWS listed delta smelt as a threatened species under the ESA in March 1993 (CFR 58 12854), and critical habitat for delta smelt has been designated within the region. Delta smelt also is listed as threatened under the CESA.

Delta smelt is a short-lived, slender-bodied fish endemic to the Delta. Adult size is typically 60-70 mm, although some individuals as large as 120 mm standard length have been recorded (USFWS 1994a). As a euryhaline species, delta smelt can tolerate wide-ranging salinities, but rarely occur in waters with salinities greater than 10-14 ppt. Historically, they have been abundant in low (around 2 ppt) salinity habitats.

Delta smelt occur in open surface waters and shoal areas (USFWS 1994a). They are generally found in the lower reaches of the Sacramento River below Isleton, the San Joaquin River below Mossdale, through the Delta and into Suisun Bay (Moyle 1976; Moyle et al. 1992). Critical habitat for delta smelt is defined (USFWS 1994c) as:

> Areas and all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma Sloughs; and the existing contiguous waters contained within the Delta.

When not spawning, adult Delta smelt tend to concentrate just upstream from the entrapment zone (the saltwater-freshwater interface) (USFWS 1994a), the location of which varies daily, seasonally, and annually in response to tidal action and the volume of freshwater inflow to the Delta. Adults migrate from brackish water areas to freshwater areas to spawn during the winter. The adult migration may begin in October and continue through April, but movement peaks during the period December through April (USFWS 1994a). The adults and young-of-the-year remain in the spawning areas until late summer, when they begin emigrating downstream. In the Sacramento River, delta smelt have been found as far upstream as the confluence with the American River (USFWS 1994a).

Green Sturgeon - Green sturgeon are an anadromous species, migrating from the ocean to freshwater to spawn. They exist in the Sacramento River system, as well as in the Eel, Mad, Klamath, and Smith rivers in the northwest portion of California. Little information is available, however, on the lifestage-specific environmental requirements of this species in the Sacramento River. Adults of this species tend to be more marine than the more common white sturgeon. Nevertheless, spawning populations have been identified in the Sacramento River (Beak

Consultants 1993), and most spawning is believed to occur in the upper Sacramento River. It is further believed that the life history periodicity of green sturgeon in the Sacramento River is similar to that of green sturgeon in the Klamath River system (USFWS 1994a). Fertilization of eggs occurs in the water column of relatively fast-flowing rivers (Emmett et al. 1991 in Moyle et al. 1992). In the Sacramento River, green sturgeon presumably spawn at temperatures ranging from 46°F to 57°F (Beak Consultants 1993). Small numbers of juvenile green sturgeon have been captured and identified each year from 1993 through 1996 in the Sacramento River at the Hamilton City Pumping Plant (RM 206) (Brown, pers. comm., 1996). Lower American River (Gerstung, 1977), Lower American River fish surveys conducted by the CDFG in recent years have not collected green sturgeon (Snider, pers. comm., 1997).

Longfin Smelt - Longfin smelt is a euryhaline species, meaning they can tolerate a wide range of salinities. This is particularly evident in the Delta where they are found in areas ranging from almost pure seawater upstream to areas of pure freshwater. In this system, they are most abundant in San Pablo and Suisun bays (Moyle 1976). They tend to inhabit the middle to lower portion of the water column. The longfin smelt spends the early summer in San Pablo and San Francisco bays, generally moving into Suisun Bay in August. Spawning occurs in the winter months when this species congregates in upper Suisun Bay and the upper reaches of the Delta (Moyle 1976). Young longfin smelt move downstream and back into the bays in April and May (Ganssle 1966).

Longfin smelt primarily feed on opossum shrimp (Order Mysidacea), copepods and other crustaceans (Moyle 1976). Spawning presumably takes place from December through February (Moyle 1976). The majority of adults perish following spawning. The eggs have adhesive properties and are probably deposited on rocks or aquatic plants upon fertilization. Longfin smelt are rarely observed upstream of Rio Vista in the Delta (Moyle et al. 1995).

REGULATORY SETTING FOR FISHERIES RESOURCES

Management of non-anadromous fish and other aquatic biological resources in the direct- and indirect-effect study areas is the responsibility of the USFWS, whereas management of anadromous fish is the responsibility of the NMFS. The CDFG acts as State trustee for aquatic species. Sensitive aquatic resources in the direct and indirect effect study area are regulated by the FESA, as well as the CESA. The CESA is administered by the CDFG.

The NMFS specifies flow and temperature requirements in the upper Sacramento River through its Biological Opinion for winter-run chinook salmon pertaining to the operation of the CVP and the SWP (NMFS 1993).

The USFWS and Reclamation have been directed to jointly implement the Anadromous Fisheries Restoration Program (AFRP) of the CVPIA by the year 2002. The AFRP is designed with the goal to double the historical average (i.e., 1967-1991) production of anadromous fish in the Central Valley by the year 2002 (USFWS 1995b). For a detailed description of the AFRP, and its provisions for flows in the Sacramento and Lower American rivers, see USFWS (1995b).

An EIR shall discuss applicable general and regional plans which may be affected by the proposed project. Where individual actions (projects) run counter to the efforts identified as desirable or approved by agencies in the general or regional plans, the Lead Agencies should address the inconsistency between the proposed action (project) plans and the general and/or regional plans. In the context of fisheries and aquatic resources, the following discussion addresses fisheries management plans and other regulatory initiatives which could be influenced by implementation of the WFP or its alternatives.

Central Valley Project Improvement Act

The Central Valley Project Improvement Act (CVPIA) (Title 34 of P.L. 102-575) amends the authorization of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes of the CVP having equal priority with irrigation and domestic uses of CVP water. It also elevates fish and wildlife enhancement to a level having equal purpose with power generation.

The CVPIA identifies several measures to meet these new purposes. Significant among these is the broad goal of restoring natural populations of anadromous fish (i.e., chinook salmon, steelhead, green and white sturgeon, American shad, and striped bass) in Central Valley rivers and streams to double their recent average levels. The AFRP (Section 3406 (b)) of Title 34 directs the Secretary of Interior [in Subsection (1)] to:

> "... develop within three years of enactment and implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams will be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991 ..."

The USFWS has assumed the lead role in the AFRP. Under USFWS direction, technical teams have assisted in the establishment of components of the AFRP. A key element of the program is instream flow recommendations, including objectives for the Lower American River, upper Sacramento River, and the Delta.

The Secretary of the Interior also is directed under section 3406(b)(2) of Title 34 (P.L. 102-575) to dedicate and manage annually 800,000 AF of CVP yield for the primary purpose of implementing the fish, wildlife, and habitat restoration and measures authorized by that title. Management of the 800,000 AF for fishery and habitat restoration is still under consideration. CVP obligation for flow requirements in the Delta is provided from the 800,000 AF. For more information on the Department of Interior's current policy as to how it intends to comply with the Statutory mandate to dedicate and manage the water dedicated pursuant to Section 3406(b)(2) of the CVPIA, see Department of Interior's Final Administrative Proposal on the Management of Section 3406(b)(2) Water, dated November 20, 1997. Management of Section 3406(b)(2) water is expected to benefit Central Valley anadromous fishes.

Ecosystem Restoration Program Plan of the CALFED Bay-Delta Program

The mission of the CALFED Bay-Delta Program is to develop a long-term comprehensive plan that will restore ecosystem health and improve water management for beneficial uses of the Bay-Delta system. The Program addresses problems in four resource areas: ecosystem quality; water quality; system integrity; and water supply reliability. Programs to address problems in the four resource areas will be designed and integrated to fulfill the CALFED mission.

The goal for ecosystem quality is to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species. The CALFED Ecosystem Restoration Program Plan (ERPP) addresses this goal. The foundation of the Program is restoration of ecological processes that are associated with streamflow, stream channels, watersheds, and floodplains. These processes create and maintain habitats essential to the life history of species dependent on the Delta. In addition, the Program aims to reduce the effects of stressors that inhibit ecological processes, habitats, and species.

Key restoration actions for Sacramento River fisheries being proposed by this Program include the following:

- enhancing river flows;
- restoring the natural river meander process;
- enhancing riparian and riverine habitats;
- maintaining suitable river temperatures for salmonids;
- reducing fish losses at points of water diversion;
- improving anadromous fish passage at existing barriers;
- maintaining and improving water quality;
- improving hatchery and stocking programs; and
- improving management of inland harvest of salmonids.

Such restoration actions, when implemented over the next few decades, are expected to improve Sacramento River fisheries, including salmonid fisheries, over existing conditions. The ERPP establishes similar restoration goals for other major water courses throughout the Central Valley.

Restoring Central Valley Streams: A Plan for Action

In 1993, CDFG published its Restoring Central Valley Streams: A Plan for Action, which was developed to address the protection of anadromous fish habitat in Central Valley streams (CDFG 1993b). This plan identified five priorities for the Lower American River, and establishes them as recommendations. They are:

1) Maintain instream flow releases below Nimbus Dam:

Period	Flow (cfs)
October 15 - February 28	1,750 - 4,000
March 1 - June 30	3,000 - 6,000
July 1 - October 14	1,500

2) Establish minimum fall carryover storage at Folsom Reservoir to maintain suitable year-round stream temperatures;
3) Control rapid flow fluctuations to protect eggs and fry of anadromous fish;
4) Develop a coordinated multi-agency management plan; and
5) Develop and implement a continuing program for the purpose of restoring and replenishing, as needed, spawning gravel lost due to the construction and operation of the CVP dams, bank protection projects, and other actions that have reduced the availability of spawning gravel and rearing habitat in the Lower American River.

Steelhead Restoration Plan for the American River

In 1991, CDFG published its *Steelhead Restoration Plan for the American River*. The Plan has two main objectives (CDFG 1991):

1) Restoring and maintaining naturally produced steelhead as an integral component of the American River ecosystem; and
2) Restoring the population to a level which will sustain a quality steelhead fishery and provide for other non-consumptive uses.

The plan focuses on restoring habitat conditions within the American River, and on supplementing the existing fisheries population with artificially reared fish. The plan also recommends that the overall CVP operations be adjusted to allow for the elimination of drastic flow fluctuations in the American River. To minimize the dewatering of redds, the plan recommends that flows during the incubation period (March through May) be no less than flows during the spawning period (December through February). The plan also states that water temperatures should be no greater than 52°F during spawning, incubation, and emergence (December through May) and no greater than 60°F during fry and juvenile rearing (June through November). In addition, a minimum coldwater pool should be maintained in Folsom Reservoir from June through October.

NMFS Biological Opinion for Winter-Run Chinook Salmon

On February 12, 1993, the NMFS issued a long-term Biological Opinion regarding the operational impacts of the CVP on winter-run chinook salmon (NMFS 1993). Based on Reclamation's Long-Term Central Valley Project Operations Criteria and Plan (CVP-OCAP) and biological assessment of impacts, the Biological Opinion concluded that the proposed long-term operations of the CVP and SWP would likely jeopardize the continued existence of winter-run chinook salmon and identified Reasonable and Prudent Alternatives to avoid jeopardy. NMFS agreed to reinitiate immediate re-consultation on the Biological Opinion when the Principles for Agreement for the Bay-Delta Plan (i.e., Bay-Delta Water Quality Control Plan) were originally signed on December 15, 1994. This revised Biological Opinion for winter-run chinook salmon has yet to be issued.

USFWS Biological Opinion for Delta Smelt

With the signing of the Principles for Agreement for the Bay-Delta Plan, the USFWS agreed to initiate immediate re-consultation on the Biological Opinion it had issued on February 4, 1994, which addressed the effects of the combined operations of the CVP and SWP on delta smelt for the period February 15, 1994, through February 15, 1995. In that opinion, the USFWS had concluded that the proposed operations of the CVP and SWP would result in jeopardy; therefore, Reasonable and Prudent Alternatives (RPA) were included in the Biological Opinion consisting of specific operational criteria that the CVP and SWP would implement (USFWS 1994, 1995).

On March 6, 1995, the USFWS issued a revised Biological Opinion for delta smelt. This opinion states that the proposed long-term combined CVP and SWP operations, as modified by the Biological Opinion for winter-run chinook salmon, the Principles for Agreement, and the Bay-Delta Plan (draft at the time) are not likely to jeopardize the continued existence of the threatened delta smelt or adversely modify its critical habitat. The opinion identifies the water quality standards along with the operational constraints that are to provide benefits to delta smelt.

4.5.2 IMPACT ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

IMPACT ASSESSMENT METHODOLOGY

Model Simulations and Output

This impact assessment compares conditions in various waterbodies of the region under the WFP to conditions in these same waterbodies under existing conditions (also referred to as the "Base Condition"). To provide a quantitative basis from which to assess potential impacts to fisheries resources and aquatic habitats within both the direct-effect study area (i.e., Folsom Reservoir, Lake Natoma, and the Lower American River) and indirect-effect study area (i.e., Shasta and Trinity reservoirs, Sacramento River, and Delta), extensive hydrologic, water temperature, and salmon mortality modeling was performed for these waterbodies. As described in Subsection 4.1.4, Hydrologic Evaluation Methodology and Modeling Assumptions, four hydrologic modeling studies were conducted for the 70-year (1922-1991) period of record; two at existing hydrologic conditions, and two under 2030 hydrologic conditions. For a detailed description of these four modeling studies, see Subsection 4.1.4.

Based on the hydrologic modeling output from each of these four studies, temperature modeling was conducted for a 69-year (1922-1990) period of record to characterize water temperatures in the Sacramento River and Lower American River under each simulated condition. River temperature output were then input into Reclamation's chinook salmon mortality models to characterize temperature-induced losses of early lifestages of chinook salmon under each simulated condition.

The specific hydrologic, water temperature, and salmon mortality modeling output used for assessing potential impacts to fisheries resources and aquatic habitats from implementing the WFP are identified below for each water body potentially affected by its implementation.

1. **Folsom Reservoir**
   - Mean end-of-month storage (TAF)
   - Mean end-of-month water surface elevation (feet above mean sea level (ft msl))
   - Mean monthly change in surface elevation (feet)
   - Mean end-of-month area of littoral (i.e., nearshore) habitat (acres)

2. **Lake Natoma**
   - Mean monthly temperature below Nimbus Dam (°F)

3. **Lower American River**
   - Mean monthly flows (cfs) at:
     - Watt Avenue (RM 9.5)
     - Mouth (RM 0)
   - Mean monthly river temperatures (°F) at:
     - Nimbus Dam
     - Watt Avenue
     - Mouth
   - Annual early lifestage fall-run chinook salmon survival

4. **Shasta and Trinity Reservoirs**
   - Mean end-of-month storage (TAF)
   - Mean end-of-month water surface elevations (feet above mean sea level (ft msl))
   - Mean monthly change in reservoir surface elevation (feet)
   - Mean monthly area of littoral (i.e., nearshore) habitat (acres)

5. **Sacramento River**
   - Mean monthly flows (cfs) at:
     - Keswick Dam (RM 301)
     - Freeport (RM 46)
   - Mean monthly river temperatures (°F) at:
     - Keswick Dam
     - Bend Bridge (RM 241)
     - Freeport
   - Annual early lifestage chinook salmon survival for:
     - fall-run
     - late-fall-run
     - winter-run
     - spring-run

6. **Sacramento-San Joaquin Delta**
   - Mean monthly Delta outflow (cfs)

C-090233

- Location of X2 (km)
- Mean monthly export/inflow ratio (%)

With the exception of early lifestage salmon survival, modeling output provided mean monthly values for each of the parameters identified above for each year of the 70-year hydrologic period of record modeled for river flows and reservoir storage and elevation, and the 69-year hydrologic period of record modeled for river water temperatures. Output from the salmon mortality models provided estimates of annual (rather than mean monthly) losses of emergent fry from egg potential (i.e., all eggs brought to the river by spawning adults), which is presented in terms of survival.

Application of Modeling Output

Reclamation's models used in this analysis (i.e., PROSIM, reservoir temperature models, American and Sacramento river temperature models, and the lower American and Sacramento river salmon mortality models) are tools that have been developed for comparative planning purposes, not for predicting actual river conditions at specific locations at specific times. The 70-year and 69-year periods of record for PROSIM and temperature modeling, respectively, provide an index of the kinds of changes that would be expected to occur with implementation of a specified set of operational conditions. Reservoir storage, river flows, water temperature and salmon survival output for the period modeled should not be interpreted or used as definitive absolutes depicting actual river conditions that will occur in the future. Rather, output for the with-project condition can be compared to that for without-project conditions to determine/provide:

1) if reservoir storage or river flows and temperatures would be expected to change with implementation of the project;
2) the months in which potential reservoir storage and river flow and temperatures changes could occur;
3) a relative index of the magnitude of change that could occur during specific months of particular water year types, and whether the relative magnitude anticipated would be expected to result in impacts to fisheries resources within the regional area; and
4) the relative degree to which alterations in operations of Folsom Dam and Reservoir, as directed by the principles of coldwater pool management, could eliminate or minimize temperature increases under the WFP.

The models used, although mathematically precise, should be viewed as having "reasonable detection limits". Establishing reasonable detection limits is useful to those using the modeling output for impact assessment purposes, and prevents making inferences: 1) beyond the capabilities of the models; and 2) beyond our ability to actually measure changes. Although data from the models are output to the nearest 100 AF, tenth of a ft in elevation, tenth of a cfs, tenth of a degree Fahrenheit, and tenth of a percent in salmon mortality, these values were rounded when interpreting differences for a given parameter between two modeling simulations. For example, two simulations having river flows at a given location within 5% of each other were considered to be essentially equivalent. Hence, only occasions where modeled flows differed by more than 5% or more were assessed for their biological significance. Because the models provide reservoir storage data on a monthly time-step, measurable differences in reservoir storage were evaluated similarly. Similar rounding of modeled output was performed for other output parameters in order to assure the reasonableness of the impact assessments. Because of their importance regarding assessing impacts to listed and proposed-listed salmonid resources, definition of measurable differences in modeled temperatures and salmon mortality are discussed at greater length below.

Commonly used field temperature monitoring equipment (e.g., in situ temperature loggers, thermometers, electronic meters) have a total error of measurement of 0.2°F or more. Thus, modeled differences in temperature of 0.2°F or less could not be consistently detectable in the river by actual monitoring of river temperatures. In addition, as mentioned above, output from Reclamation's river temperature models provides a "relative index" of river temperatures under the various operational conditions modeled. Output values indicate whether the temperatures would be expected to increase, remain unchanged, or decrease, and provide insight regarding the relative magnitude of potential changes under one operational condition compared to another. Therefore, for the purposes of this impact assessment, only differences in temperature which could actually be consistently detected in the field were addressed with regard to their biological significance; modeled temperature changes that were within 0.2°F between modeled simulations were considered to represent no measurable change. Temperature differences of 0.3°F or more were assessed for their biological significance.

Assessment Methodologies

The utility of modeling output for assessing potential impacts of the WFP is greatly affected by numerous assumptions upon which each modeling simulations was based. Changes in one or more key modeling assumptions could sufficiently change modeling output to warrant changes in one or more impact determinations.

The impact assessment methodologies defined below are discussed in terms of comparing the modeled output for the Base Condition, to output from a second simulation depicting these same conditions with the additional surface water diversions identified in the WFP. Hence, throughout this methodology section, reference will be made to comparing modeled output from the "WFP" to that under the "Base Condition." Because numerous other actions could occur in the future, along with the additional diversions of the WFP, and because future CVP/SWP operational criteria and policy are uncertain at this time, the WFP vs. Base Condition comparison was developed as the best way to assess the "project-specific" impacts of the additional diversions identified under the WFP.

The same basic assessment approach was used for assessing cumulative impacts (i.e., 2030 w/WFP vs. Base Condition, discussed in the Cumulative Impacts Chapter), and for quantitatively comparing two future (2030) conditions (i.e., 2030 w/WFP vs. No Project-Constrained, discussed in the Alternatives Chapter). However, because great uncertainty exists regarding future CVP/SWP operational criteria and policy and, therefore, key modeling assumptions pertaining to these criteria and policies, modeling output from 2030-level simulations were assessed with less reliance on specific quantitative estimation.

Folsom Reservoir

Warmwater Fisheries - Because Folsom Reservoir's warmwater fish species (e.g., black bass, sunfish, crappie, and catfish) utilize the warm upper layer of the reservoir and nearshore littoral habitats throughout most of the year, seasonal changes in reservoir storage, as it affects reservoir water surface elevation (feet msl), and the rates at which water surface elevations change during specific periods of the year, can directly affect the reservoir's warmwater fisheries resources. Reduced water surface elevations can reduce the availability of nearshore littoral habitats used by warmwater fishes for spawning and rearing, thus reducing spawning and rearing success and subsequent year-class strength. In addition, decreases in reservoir water surface elevation during the primary spawning period for nest-building, warmwater fishes (i.e., March through July) may result in reduced initial year-class strength through warmwater fish nest "dewatering."

To assess potential elevation-related impacts to the warmwater fisheries of Folsom, Shasta, and Trinity reservoirs, the following two-phased approach was used. First, a relationship between reservoir water surface elevation and acres of nearshore littoral habitat containing submerged structure (e.g., submerged macrophytes and/or inundated terrestrial vegetation) was developed. Using this relationship, the mean number of acres of littoral habitat was estimated for each month of the primary spawning and rearing period of the year (i.e., March through September) under the WFP and compared to that modeled for the Base Condition.

Second, the magnitude of change (ft) in reservoir water surface elevation occurring each month of the primary spawning period for nest-building fishes (i.e., March through July) was determined under the WFP and compared to that modeled for the Base Condition. A recent study by CDFG, which examined the relationship between reservoir elevation fluctuation rates and nesting success for black bass, suggests that a reduction rate of 0.15, 0.18, and 0.39 m/day or greater would result in 100% nest mortality (or 0% nest survival) for largemouth bass, smallmouth bass, and spotted bass, respectively (Lee et al. 1998). However, CDFG reservoir biologists suggest that, on the average, a nest survival rate of at least 20% is necessary to maintain the long-term population levels of high-fecundity, warmwater fishes (D. Lee, CDFG, pers. comm., 1998). Utilizing nest survival curves developed by CDFG (Lee et al. 1998), reservoir fluctuation criteria were developed that would provide a minimum nest survival rate of approximately 20% for largemouth bass, the bass species found by CDFG to be most sensitive to reservoir elevation fluctuations.

It was determined that a reduction rate of 9 feet per month would represent an approximate water level decrease of 0.3 ft/day (0.09 m/day) during a nesting event, which would correlate to an approximate nest survival rate of 20% for largemouth bass (Lee et al. 1998). Thus, a monthly decrease in mean Folsom Reservoir water surface elevation of 9 feet or more per month was selected as the threshold above which spawning success of nest-building, warmwater fishes (e.g., black bass, sunfish, crappie and catfish) could potentially result in long-term population declines. To evaluate impacts to warmwater fishes, the number of occurrences that reservoir reductions greater than 9 ft per month could occur under the WFP were compared to the number of occurrences that were modeled to occur under the Base Condition.

Criteria for reservoir elevation increases (i.e., "nest flooding" events) are not recommended by the CDFG. Due to overall fishery benefits, greater reservoir elevations that would be associated with rising water levels would offset negative impacts due to nest flooding (Lee et al. 1998). Thus, the likelihood of spawning-related impacts due to nest flooding is not addressed for reservoir fisheries.

Coldwater Fisheries - During the period of the year when Folsom Reservoir is thermally stratified (i.e., April through November), coldwater fishes within the reservoir reside primarily within the reservoir's metalimnion and hypolimnion where water temperatures remain suitable. Reduced reservoir storage (TAF) during this period of the year could reduce the reservoir's coldwater pool volume, thereby reducing the quantity of habitat available to coldwater fish species during these months. Reservoir coldwater pool size generally decreases as reservoir storage decreases, although not always in direct proportion due to the influence of reservoir basin morphometry. Thus, to assess potential storage-related impacts to coldwater fish habitat availability in Folsom Reservoir, end-of-month storage modeled for each year of the 70-year period of record under the WFP was compared to end-of-month storage under the Base Condition for each month of the April through November period of the year. Substantial reductions in reservoir storage were considered to result in substantial reductions in coldwater pool volume and, therefore, habitat availability for coldwater fishes. Impacts to the coldwater fisheries were further assessed by determining whether seasonal changes in reservoir storage, and associated changes in water surface elevation, would be expected to indirectly affect coldwater fish species by adversely affecting the productivity of their primary prey species (e.g., threadfin shad and wagasauki).

Lake Natoma

No storage- or elevation-related impacts to fishery resources of Lake Natoma are expected to occur because, as a regulating afterbay of Folsom Reservoir, its monthly storage and elevation will be affected little, if at all, by the WFP. Consequently, no quantitative assessment of potential storage- or elevation-related impacts to fishery resources in this water body was warranted.

Because the additional diversions under the WFP could alter the temperature of water released from Folsom Dam, and because Lake Natoma's temperature at any given time is largely dictated by the temperature of water released from Folsom Dam, these additional diversions could change seasonal water temperatures within Lake Natoma. The small changes in lake temperatures that could occur would not be expected to adversely affect the lake's warmwater fisheries. Conversely, increases in lake temperatures could adversely affect coldwater species such as rainbow trout stocked by the CDFG. To assess the potential impacts of altered lake temperatures to fishery resources within the lake, mean monthly temperatures of water released from Nimbus Dam were determined for the WFP and compared to mean monthly temperatures under the Base Condition for each month of the year. Temperatures of water released from

Nimbus Dam were used as an "index" to represent the relative changes in Lake Natoma water temperatures that could occur under the WFP, relative to the Base Condition.

Nimbus Hatchery

Because the additional diversions under the WFP could alter Lake Natoma water temperatures during some months, and because the Nimbus Hatchery diverts its water supply directly from Lake Natoma throughout the year, implementation of the WFP could change hatchery water temperatures during some months of the year. Nimbus Hatchery production remains relatively unaffected when hatchery temperatures remain below 60°F. However, increased disease and mortality of hatchery-reared fish often occurs when temperatures exceed 60°F. Losses from these factors become a particular problem when hatchery water temperatures exceed 65°F for extended periods. Water temperatures exceeding 68°F for even short periods (e.g., days) are particularly detrimental to hatchery fish held at high densities, and could require the hatchery to release and/or transfer most or even all of its fish to prevent unacceptably high mortality (B. Barngrover, CDFG, pers. comm., 1997).

To assess potential temperature-related impacts to Nimbus Hatchery operations, mean monthly temperatures of water released from Nimbus Dam under the WFP were modeled and compared to those under the Base Condition for each month of the year. The number of years of the 69 years modeled that mean monthly Nimbus release temperatures would exceed the index thresholds of 60°F, 65°F, and 68°F under the WFP was determined and compared to the frequency of exceedance of these temperature index thresholds under the Base Condition. In addition, for each month of the year, the mean temperature of water released from Nimbus Dam for the years exceeding each of these temperature index thresholds was determined.

Lower American River

The additional diversions under the WFP could affect Lower American River flows and water temperatures during portions of the year. The Lower American River is the water body within the study area expected to experience the greatest impacts to fisheries resources under the WFP. In addition, a number of fish species of primary management concern utilize the Lower American River during one or more of their lifestages. For these reasons, species-specific impact assessments were warranted for this water body. However, because it would be unreasonable to attempt to assess potential impacts to all species of fish using the Lower American River, species-specific impact analyses were restricted to the following five species of primary management concern:

1) fall-run chinook salmon;
2) steelhead;
3) splittail;
4) American shad; and
5) striped bass.

The species identified above are of primary management concern due either to the importance of their commercial and/or recreational fisheries (i.e., chinook salmon, steelhead, American shad, and striped bass) and/or because they are a species currently listed or proposed for listing under the federal Endangered Species Act (i.e., steelhead, chinook salmon and splittail). Because the five species selected for species-specific assessments include species sensitive to changes in both river flow and water temperature throughout the year, an evaluation of impacts to these species is believed to reasonably encompass the range of potential impacts to Lower American River fisheries resources that could occur under the WFP.

Potential impacts resulting from changes in river flows and water temperatures were evaluated for each of the five species of primary management concern. Because these species are known to use the Lower American River during discrete time periods associated with specific lifestages, potential impacts are evaluated using species-specific assessment parameters, where appropriate. The impact assessment methodologies used to assess potential flow- and temperature-related impacts to the five indicator species are described by species, below.

Fall-run Chinook Salmon - To assess flow-related impacts to fall-run chinook salmon spawning and incubation, mean monthly flows at Watt Avenue (RM 9.4) under the WFP were compared to mean monthly flows at Watt Avenue under the Base Condition for each month of the October through February period of the year. Watt Avenue represents the river location above which approximately 98% of fall-run chinook salmon spawning occurs annually. This assessment also accounted for flow-related impacts to the portion of annual year-classes rearing in the upper river during these months. Changes in flows during the period March through June also were assessed at Watt Avenue to further address potential impacts to fry and juvenile life stages rearing during these months. Flows at the mouth were compared between modeling simulations to assess flow-related impacts to adult immigration and juvenile emigration. Flows adequate for rearing purposes, as assessed by Watt Avenue flows, were assumed to be adequate for emigration as well. In addition, the frequency with which specified flow levels for the Lower American River could be met was determined under the WFP, and compared to that under the Base Condition.

Temperature-related impacts to Lower American River fall-run chinook salmon were evaluated through two distinct assessments focusing on distinct lifestages and periods, including: 1) spawning/incubation and initial rearing (October through February); and 2) upper river juvenile rearing and emigration (March through June) using the multi-step analysis described below.

Spawning/Incubation, and Initial Rearing (October through February)

First, the 69-year average river temperatures for each month of the October-February period that would occur at Nimbus Dam or Watt Avenue under the WFP were compared to the 69-year average temperatures for each of these months, at these same locations, under the Base Condition. Because river temperatures generally warm with increasing distance downstream during October, and because 98% of all spawning occurs upstream of Watt Avenue, the most conservative assessment of thermal impacts to chinook salmon spawning and incubation during October is based on Watt Avenue temperatures. Therefore, all temperature assessments for the month of October are based on temperatures at Watt Avenue. Conversely, because river temperatures generally cool with increasing distance downstream during the period November through January, and because river temperatures generally change little between Nimbus Dam and Watt Avenue during February, temperature impact assessments for spawning and incubation during the months November through February are based on temperatures at Nimbus Dam, thereby providing the most conservative assessment.

Second, the number of years (of the 69 years modeled) that mean monthly water temperatures would exceed 56°F and 60°F at Nimbus Dam or Watt Avenue was determined for each month of the October through February period. The number of years that exceeded these temperatures under the WFP were then compared to the number of years exceeding these index thresholds under the Base Condition.

Third, for each month of the October through February period, the mean river temperature at Nimbus Dam or Watt Avenue for the years (of the 69 years modeled) exceeding the 56°F and 60°F index thresholds was determined under the WFP and compared to those under the Base Condition.

Finally, Reclamation's Lower American River Fall-run Chinook Salmon Mortality Model was used to further assess potential temperature-related impacts to the early lifestage of chinook salmon. Annual early lifestage survival (the inverse of mortality) estimated for the WFP was compared to that estimated for the Base Condition for each year of the 69-year period of record modeled. Model output represents the percentage of potential emergent fry produced, based on all eggs brought to the river by spawning adults, that would survive under the temperature regime that would occur under each model simulation. The model calculates temperature-induced mortality (i.e., the percentage of potential emergent fry lost due to temperature-induced mortality of pre-spawned eggs, fertilized eggs incubating in the gravel, and pre-emergent fry). Losses for each of these three early life stages are then tallied by the model and output as a percent loss (i.e., mortality) from egg potential (i.e., all eggs brought to the river by immigrating adults) for each year modeled. The inverse of these calculated percent losses (i.e., survival) is discussed for impact assessment purposes.

Juvenile Rearing and Emigration (March through June)

The same methodology was used to evaluate potential temperature-related impacts to fall-run chinook salmon juvenile rearing and emigration from the upper river with the following modifications:

- the period of assessment was March through June;
- the number of years (of the 69 years modeled) that mean monthly water temperatures would exceed the index thresholds of 60°F and 65°F was determined for Watt Avenue;
- mean river temperatures for the years (of the 69 years modeled) that were shown to exceed the 60°F and 65°F index thresholds were determined for Watt Avenue; and
- Reclamation's Salmon Mortality Model was not used because it does not assess mortality beyond the emergent fry lifestage.

The temperature index thresholds are different for the two periods of assessment because juvenile fall-run chinook salmon can tolerate water temperatures up to 65°F without substantial adverse impacts, whereas incubating eggs and pre-emergent fry incur substantial reductions in survival (i.e., up to approximately 50% in 12 days and 25% in 14 days, respectively) when river water temperatures are 60°F. Because the majority of fall-run chinook salmon and steelhead rearing is believed to occur above Watt Avenue (RM 9.5), and because river temperatures generally increase between Nimbus Dam and Watt Avenue during the March through June period of the year, use of Watt Avenue temperatures for assessing temperature-related impact to juvenile chinook salmon during this period of the year provided the most conservative assessment.

Steelhead - Because environmental conditions required by steelhead are not significantly different from those required by fall-run chinook salmon, flow- and temperature-related impact determinations for steelhead for the period October through June were based on the same modeling output used to assess impacts to fall-run chinook salmon during this period of the year. However, because steelhead rear within the Lower American River year-round, additional flow and temperature impact assessments were made for the months of the year not addressed by the fall-run chinook salmon assessments (i.e., July through September).

Flow-related impacts to steelhead during the July through September period of the year were assessed via the same methods used to assess flow-related impacts to fall-run chinook salmon during the October through June period of the year.

Temperature-related impacts to steelhead juvenile rearing during the July through September period were assessed via the same methods used to assess temperature-related impacts to fall-run chinook salmon juvenile rearing and emigration during the March through June period of the year. In addition, the number of years exceeding 70°F for each model simulation, as well as the mean temperature for the years exceeding this index threshold, also was determined. Because no steelhead mortality model has been developed for the Lower American River, no steelhead mortality modeling could be performed as a part of the assessment for this species.

In addition to the assessments described above for chinook salmon and steelhead, both flow- and temperature-related impacts to immigration and emigration through the lower portion of the river were assessed for these species, based on flows and temperatures at the mouth.

Splittail - Splittail may spawn in the Lower American River in very low numbers, with the majority of splittail spawning that could occur taking place in the lower sections of the river (i.e., downstream of RM 12). Consequently, altered river flows under the WFP could impact the availability of potential splittail spawning habitat within the Lower American River by reducing the amount of riparian vegetation that would be inundated during the splittail spawning season (i.e., February through May).

The Lower American River from RM 5 to the mouth is largely influenced by the water surface elevation of the Sacramento River. Therefore, Sacramento River stage, more often than Lower American River flows, controls the water surface elevations here, and the extent to which splittail spawning habitat, particularly inundated riparian vegetation, along this lower reach of the river channel would be available. Conversely, river stage in the portion of the river between RM 8 and RM 12, which is characterized by abundant backwater habitat, is controlled primarily by Lower American River flows. The frequency and duration of riparian vegetation flooding in this area and, therefore, the quality and quantity of potential splittail spawning habitat has the potential to be impacted by reduced flows that could occur due to the additional WFP diversions.

To assess flow-related impacts to potential splittail spawning habitat availability, the relationship between river flow and the acreage of flooded riparian habitat between RM 8 and RM 9 (recently developed by SAFCA) was used to calculate the mean monthly acreage of potential splittail spawning habitat in this reach of river during each month of the February through May period, for each of the 70 years modeled. Using river flows at Watt Avenue (RM 9.4), the number of acres of flooded riparian habitat between RM 8 and RM 9 was determined under the WFP, and for the Base Condition, and these values compared for assessment purposes. The acreages calculated and compared served as a relative "index" for assessing how the availability of potential splittail spawning habitat (i.e., inundated riparian vegetation) in the Lower American River may change with changes in flows at Watt Avenue.

Splittail reportedly spawn at water temperatures from 48°F to 68°F (Caywood 1974; Wang 1986). To evaluate potential temperature-related impacts to splittail, the number of years (of the 69 years modeled) that mean monthly water temperatures at Watt Avenue and the mouth would be within this preferred range during the period February through May was determined under the WFP and compared to that under the Base Condition. For the purposes of assessing temperature-related impacts to splittail, river temperatures at Watt Avenue and the mouth effectively represent the range of river temperatures that splittail would encounter when using the lower portion of the river for spawning and initial rearing.

American Shad - The flow-related impact assessments conducted for fall-run chinook salmon and steelhead described above provided for an evaluation of the relative change in mean monthly flows in the Lower American River under the WFP for all months of the year. Consequently, findings from these assessments were used, in part, for assessing flow-related impacts to American shad as well.

Because the majority of American shad spawning migrations into the Lower American River occur during May and June, changes in river flows during these months warrant further assessment for this species. The relative number of adult American shad entering the Lower American River during May and June is believed to be largely influenced by flows at the mouth. Snider and Gerstung (1986) recommended flow levels of 3,000-4,000 cfs during May and June as sufficient "attraction flows" to sustain the American shad fishery in the Lower American River. Impacts to American shad attraction flows were assessed by determining the number of years (of the 70 years modeled) during which May and June flows at the mouth would be less than 3,000 cfs under the WFP, compared to that determined for the Base Condition.

To evaluate potential water temperature-related impacts to American shad spawning, mean monthly water temperatures under the WFP were determined and compared to those under the

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Base Condition for the months of May and June. A conservative approach for assessing potential water temperature impacts was to assume that American shad may spawn throughout the river and, therefore, to evaluate water temperature conditions at Nimbus Dam and the mouth. Specifically, the number of years (of the 69 years modeled) that mean May and June river temperatures at Nimbus Dam and the mouth would be within the preferred range for American shad spawning (i.e., 60°F-70°F) was determined under the WFP and compared to that under the Base Condition.

Striped Bass - Although no study to date has definitively determined whether striped bass spawn in the Lower American River, it is believed that little, if any, striped bass spawning occurs there (DeHaven 1978, in Snider and Gerstung 1986). Nevertheless, the Lower American River is utilized by juvenile striped bass for rearing and supports a striped bass sport fishery.

The flow-related impact assessments conducted for fall-run chinook salmon and steelhead address all months of the year. Hence, potential flow-related impacts to striped bass, as they pertain to juvenile rearing habitat availability, were assessed using the same data produced to assess flow-related impacts to fall-run chinook salmon and steelhead.

In addition to juvenile rearing considerations, the number of adult striped bass entering the Lower American River during the summer is believed to vary with flow levels and food production. Snider and Gerstung (1986) suggested that flows of 1,500 cfs at the mouth during May and June would be sufficient to maintain the striped bass sport fishery in the Lower American River. Hence, potential flow-related impacts to the striped bass sport fishery were assessed by determining the number of years (of the 70 years modeled) that flows at the mouth would be less than 1,500 cfs in May and June under the WFP, compared to the number of years this would occur during these months under the Base Condition.

Optimal water temperatures for juvenile striped bass rearing range from approximately 61°F to 73°F (USFWS 1988). Therefore, to evaluate potential water temperature-related impacts to striped bass juvenile rearing, the number of years (of the 69 years modeled) that mean monthly river temperatures at Nimbus Dam and the mouth would be within the preferred range of 61°F to 73°F for juvenile rearing was determined under the WFP and compared to that under the Base Condition.

DIRECT DIVERSION (SCREENING) IMPACTS

Anadromous fish in the Lower American River may be subject to additional risk of entrainment and/or impingement due to increased diversions at the E.A. Fairbairn and Sacramento River Water Treatment Plant intake structures located on the Lower American River and Sacramento River, respectively.

NMFS and CDFG have established guidelines for screening diversion facilities to minimize fish entrainment and impingement. Entrainment occurs when a fish passes through the screen mesh or through gaps in the screen structure. To avoid entrainment of juvenile salmonids, screen criteria require a screen mesh size of 1.75 mm or less (for slotted openings) where steelhead fry

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are present. Impingement occurs when a fish is pressed against the screen face. The approach velocity and the sweeping velocity influence the probability of a fish becoming impinged when a screen is encountered. The approach and sweeping velocity are those water velocities acting perpendicular and parallel to the screen face, respectively. According to the fish screening criteria established by NMFS and CDFG for diversions in water courses having juvenile anadromous salmonids, the approach velocity must not exceed 0.33 fps at any point along the screens, and the sweeping velocity must be at least twice the approach velocity.

The City of Sacramento has undertaken a Fish Screen Replacement Project to upgrade the fish screens at the E.A. Fairbairn and Sacramento River Water Treatment Plant intake structures. The City's Fish Screen Replacement Project is designed to protect fish populations by bringing the fish screens into compliance with current criteria. The first phase of this project, which includes environmental documentation and preliminary engineering design, is being completed in accordance with a federal grant under Public Law 101-575, Title XXXIV, Section 3406(b)(21). The second phase of this project, which includes final design and permit acquisition, will be completed in cooperation with, and assistance from, the Category III program of CALFED. The new fish screens are expected to be operational within the next few years, prior to implementation of the increased diversions under the WFP. Therefore, no additional analyses for direct diversion (screening) impacts was warranted.

Shasta and Trinity Reservoirs

Coldwater Fisheries - Potential storage-related impacts to the coldwater fisheries of Shasta and Trinity reservoirs were assessed using the same methods described above for Folsom Reservoir.

Warmwater Fisheries - Potential elevation-related impacts to the warmwater fisheries of Shasta and Trinity reservoirs were assessed using the same methods described above for Folsom Reservoir.

Keswick Reservoir

No storage- or elevation-related impacts to the fishery resources of Keswick Reservoir are expected to occur because, as a regulating afterbay of Shasta Reservoir, its monthly storage and elevation will be affected little, if at all, by the WFP. Consequently, no quantitative assessment of potential storage- or elevation-related impacts to fishery resources in this water body was warranted. Similarly, the WFP would not be expected to substantially alter the temperatures of water within Keswick Reservoir. Consequently, no quantitative assessment of potential temperature-related impacts to fishery resources within this reservoir was warranted.

Sacramento River

The additional diversions under the WFP could potentially alter seasonal Sacramento River flows, which could change the relative habitat availability for Sacramento River fishes. To assess such flow-related impacts to upper Sacramento River fishes, mean monthly flows released from Keswick Dam (RM 301), as modeled for the 70-year period of record under the WFP, were compared to releases from Keswick Dam under the Base Condition for each month of the year. Potential flow-related impacts to lower Sacramento River fishes were assessed in the same manner, except that this assessment used modeled flows at Freeport (RM 46).

Additional diversions under the WFP could potentially alter Sacramento River water temperatures seasonally during some years. Changes in Sacramento River water temperatures that could occur under the WFP would not be expected to be sufficiently large to adversely affect any fish species utilizing the upper Sacramento River, with the possible exceptions of chinook salmon and steelhead. Elevated river temperatures could reduce spawning and rearing success of these anadromous salmonids because of their low thermal tolerance. For this reason, an assessment of changes to upper Sacramento River water temperatures focused on these fish species. Moreover, because: 1) the thermal requirements of chinook salmon and steelhead are very similar; 2) the NMFS Biological Opinion for winter-run chinook salmon (NMFS 1993) has established quantitative temperature criteria for the upper Sacramento River to protect winter-run; and 3) Reclamation has developed a Sacramento River early lifestage chinook salmon mortality model applicable to all four runs of chinook salmon, this assessment focused quantitatively on chinook salmon. Impact findings for the four runs of chinook salmon provide a technical basis from which to infer whether steelhead would be impacted by seasonal changes in river temperatures.

A three-phased temperature assessment was performed to evaluate potential temperature-induced impacts to the anadromous salmonid resources of the Sacramento River. First, mean monthly river temperatures at Keswick Dam (RM 301), the upstream extent of anadromous fish immigration, under the WFP were compared to mean monthly temperatures at this river location under the Base Condition for each month of the year.

Second, the number of years of the 69-year period modeled that river temperatures at Keswick Dam and Bend Bridge (RM 256) would exceed the temperature criteria identified by NMFS in its Biological Opinion for winter-run chinook salmon (NMFS 1993) was determined under the WFP and compared to the number of years that these criteria would be exceeded under the Base Condition. The NMFS criteria used for this component of the assessment are as follows:

- daily average river temperature not in excess of 56°F at Bend Bridge from 15 April through September 30;
- daily average river temperature not in excess of 60°F at Bend Bridge from 1 October through 31 October;

Although the NMFS (1993) temperature criteria are stated as daily averages, the available hydrologic and water temperature models allow only for mean monthly temperature analyses and output. Consequently, this assessment was based on mean monthly water temperature data output from Reclamation's existing models.

Finally, Reclamation's Sacramento River Chinook Salmon Mortality Model was used to estimate annual, early lifestage losses (from egg potential) for fall-run, late-fall-run, winter-run, and spring-run chinook salmon populations. Temperature input to the Sacramento River Salmon

Mortality Model consists of mean monthly temperatures at nine locations between Shasta Dam and Vina Bridge. Mortality estimates for each of the four runs were modeled under the WFP, which were then compared to modeled mortality estimated for each run under the Base Condition. Potential impacts to the four chinook salmon runs in the Sacramento River were evaluated using the same criteria established for the Lower American River Salmon Mortality Model (see above).

The first component of this assessment only was conducted for the Freeport location to assess potential temperature-related impacts to fish utilizing the lower Sacramento River.

Delta

Increased surface water diversion demands under the WFP could alter the quantity of freshwater flowing into and through the Delta. The abundance and distribution of several fish species of management concern that rely heavily upon the Delta for one or more of their lifestages, including delta smelt (federally threatened), splittail (federally proposed for threatened status), longfin smelt (State species of special concern), and striped bass (recreationally important), can be affected by total Delta outflow, the location of X2, and export/inflow ratio.

To evaluate potential impacts to Delta fishery resources, changes in mean monthly Delta outflow for the 70-year hydrologic period of record under the WFP were determined for each month of the year and compared to mean monthly Delta outflows under the Base Condition. The frequency and magnitude of differences in Delta outflow were evaluated relative to life history requisites for Delta fishes. In addition, changes in mean monthly X2 position and Delta export/inflow ratios were determined for all months of each year, with an emphasis on the February through June period.

Impacts to delta smelt, splittail, striped bass, and other Delta fishery resources were considered adverse if hydrology under the WFP showed a substantial decrease in mean monthly Delta outflow, relative to hydrology under the Base Condition, during one or more months of the February through June period of the year, if a substantial shift in the mean monthly X2 position occurred, or if Delta export/inflow ratios were increased to where allowable export limits would be exceeded.

Significance Criteria

The specific significance criteria described below have been developed for use in assessing potential impacts to aquatic resources resulting from additional surface water diversions under the WFP. Application of these significance criteria to findings determined from modeled output was used to make impact significance determinations. WFP-related impacts to fisheries and aquatic habitats were considered to be significant if the WFP or its alternatives would:

- Reduce or degrade habitat used by a State or Federal special-status species, including habitat designated as critical habitat to an extent that could cause a reduction in species abundance. Special-status species are defined as those that are currently listed as endangered or threatened under the federal and/or State ESA and species formally proposed for federal and/or State listing as threatened or endangered;

- Result in: 1) additional years when the temperature criteria established by NMFS for the protection of winter-run chinook salmon in the upper Sacramento River would be violated; and 2) a substantial reduction in the estimated early lifestage survival for Sacramento River winter-run chinook salmon in that year; or 3) violate the intent of the NMFS winter-run Biological Opinion as shown by a substantial decrease in early lifestage survival for any year;

- Cause substantial reductions in early lifestage survival for fall-run, late-fall-run, or spring-run chinook salmon over the 69-year simulated period of record;

- Substantially interfere with or prevent the immigration or emigration of any anadromous fish species within any water body affected by the WFP;

- Cause a reduction in habitat quantity (e.g., river flows, Shaded Riverine Aquatic Cover, reservoir storage, or acres of reservoir littoral habitat) and/or habitat quality (e.g., temperature) of sufficient magnitude and frequency such that it could adversely affect a species 'long-term population levels in one or more of the water bodies assessed.

4.5.3 WATER FORUM PROPOSAL IMPACTS

This impact assessment identifies the hydrologic and water temperature-related impacts to fisheries resources within water bodies of the direct and indirect effect study areas that could result from implementing the WFP. Impact assessments are performed according to the impact assessment methodologies discussed above. Each potential impact is assigned a number, and is given a brief narrative title (underlined text), which is followed by a summary of impact assessment findings and the impact determination. Supporting data and its interpretation are provided below each impact determination.

Regarding the use of modeling output, it should be noted that the comparisons made under each numbered impact in this section are comparisons between the WFP and existing conditions (also referred to as the "Base Condition"). For the purposes of this assessment, Reclamation's proposed temperature control device (TCD) for the urban water intake at Folsom Dam was included in the WFP simulation, but not in the Base Condition simulation. This was done because the TCD is a reasonably foreseeable action that is expected to be in-place by or before Water Forum diversions increase to the levels modeled under the WFP, and because it does not physically exist today (i.e., is not a part of the Base Condition).

Long-term (i.e., 70 years for hydrologic parameters and 69 years for temperatures and salmon survival estimates) average values modeled for each month under the WFP and the Base Condition are summarized in tabular form in this section. Hydrologic, water temperature, and salmon mortality modeling output for individual years that were used to generate these long-term means, as well as numerous other statistical parameters generated from modeled data, can be found in Appendix I. This appendix is organized by sections that are numbered consistent with the impacts assessed in this section. For example, the assessment for Impact 4.5-1 is the first impact that relies on Folsom Reservoir storage data output from the PROSIM model. Thus, these output data are found in Section 1 of Appendix I. Finally, temperature and flow exceedance plots presented in this section, as well as similar plots for other river locations not presented in the EIR, are contained in Appendix I.

Folsom Reservoir

Coldwater Fishery

Impact 4.5-1

Impacts to Folsom Reservoir's Coldwater Fisheries. *Additional diversions from Folsom Reservoir under the WFP would reduce reservoir storage by 10% or more, relative to the Base Condition, infrequently during the period April through August and occasionally during the period September through November. However, anticipated reductions in reservoir storage would not be expected to adversely affect the reservoir's coldwater fisheries because: 1) coldwater habitat would remain available within the reservoir during all months of all years; 2) physical habitat availability is not believed to be among the primary factors limiting coldwater fish populations; and 3) anticipated seasonal reductions in storage would not be expected to adversely affect the primary prey species utilized by coldwater fishes. This would be a* ***less-than-significant*** *impact.*

Additional diversions from Folsom Reservoir under the WFP would result in seasonal changes in end-of-month storage during most years. Seasonal changes in storage could result in corresponding changes in physical habitat availability for the reservoir's coldwater fish species. Lower reservoir storage could, to some degree, reduce the amount of space available for coldwater species to use during the April through November period, when strong thermal stratification occurs within the reservoir. Conversely, higher storage could increase the availability of coldwater fish habitat in the reservoir.

During the April through November period of the year, under the WFP, reductions in the 70-year average end-of-month storage would range from approximately 2% (14.1 TAF) in April to about 5% (23.7 TAF) in October, relative to mean monthly storage levels under the Base Condition (Table 4.5-1). Reductions in reservoir storage of 10% or more during individual years, relative to the Base Condition, would occur infrequently during the period April through August, and would occur occasionally during the period September through November. Storage reductions of the magnitude anticipated from changes in use of surface and groundwater defined in the WFP would not result in significant adverse effects on coldwater fisheries because the availability of physical habitat is not a primary limiting factor for these fishes. Food availability is a key factor affecting coldwater fish populations in the reservoir. However, the seasonal changes in reservoir storage expected to occur under the WFP would not be expected to have substantial, if any, effects on the population dynamics of threadfin shad or wakasagi, which are the primary prey species for the reservoir's coldwater fish populations.

Table 4.5-1 70-Year Average Storage in Folsom Reservoir for Each Month of the April Through November Period of the Year				
Month	Average Storage (TAF)		Average Relative Change (%)	Average Absolute Change (TAF)
	Base Condition	WFP		
April	666.9	652.8	-2.5	-14.1
May	772.7	753.9	-2.8	-18.8
June	726.4	703.3	-3.6	-23.1
July	642.7	628.5	-2.7	-14.2
August	564.6	549.4	-2.7	-15.2
September	502.7	483.9	-3.8	-18.8
October	457.7	434	-5.2	-23.7
November	431.6	410.9	-4.8	-20.7

Source: SWRI, 1998.

Warmwater Fishery

Impact 4.5-2

*__Impacts to Folsom Reservoir's Warmwater Fisheries.__ Additional diversions from Folsom Reservoir under the WFP would frequently reduce reservoir storage (and thus water levels) during the critical spawning and rearing period (i.e., March through September), which could reduce the availability of littoral (nearshore) habitat containing vegetation. Modeling output indicates that long-term average reductions in littoral habitat availability of up to 34% could occur in September. Average reductions in littoral habitat availability of this magnitude could result in increased predation on young-of-the-year warmwater fishes, thereby reducing initial year-class strength of warmwater fishes in many years. Unless willows and other nearshore vegetation become established at lower reservoir elevations in the future in response to seasonal reductions in water levels, population declines for largemouth bass and other warmwater species could be expected to occur. Reduced littoral habitat availability would be a **potentially significant** impact to Folsom Reservoir warmwater fisheries.*

Changes in the Seasonal Availability of Littoral Habitat

Additional diversions from Folsom Reservoir under the WFP would result in seasonal changes in end-of-month water surface elevation during most years. During the March through September period of the year, reductions in the 70-year average end-of-month reservoir surface elevation would range from approximately 1.7 feet in March and April to 2.5 feet in June, relative to that under the Base Condition (Table 4.5-2).

Table 4.5-2
70-Year Average Water Surface Elevation in Folsom Reservoir for Each Month of the March Through September Period of the Year

Month	Average Water Surface Elevation (feet msl)		Average Relative Change[1] (%)	Average Absolute Change[1] (feet)
	Base Condition	WFP		
March	416.0	414.3	-0.4	-1.7
April	429.7	428.1	-0.4	-1.7
May	439.9	437.9	-0.5	-2.0
June	435.1	432.6	-0.6	-2.5
July	426.1	424.4	-0.4	-1.8
August	417.6	415.8	-0.4	-1.8
September	411.0	408.6	-0.6	-2.4

[1] Change under the WFP, relative to the Base Condition. Values reported represent the average change for the 70 individual years modeled, rather than the difference between the 70-year average elevation for each month under the two alternatives.

Source: SWRI, 1998.

Changes in water surface elevation during the March through September period would result in corresponding changes in the availability of reservoir littoral habitat containing inundated terrestrial vegetation (e.g., willows). The 70-year average amount of littoral habitat potentially available to warmwater fishes for spawning and/or rearing in Folsom Reservoir would decrease during all months of the period March through September. Long-term average reductions in the availability of littoral habitat were estimated to be as little as approximately 5% during May, approximately 12-13% in March and August, and about 34% during September (Table 4.5-3).

The reductions in littoral habitat availability during the March through July period would not be expected to result in significant adverse impacts to initial year-class production of basses and sunfishes on a long-term basis. Conversely, the average loss of approximately one-third of the reservoir's available littoral habitat containing vegetative structure during September would be expected to substantially reduce year-class strength of warmwater fishes during most years through resultant increases in predation losses of young-of-the-year fishes.

The acres of lost littoral habitat presented in Table 4.5-3 represent a most-conservative assessment by not accounting for the potential encroachment of willows to lower elevations within the reservoir in response to seasonal reductions in reservoir elevation due to the additional Water Forum diversions. Should this occur in the future, the relative magnitude of this impact would be reduced. However, the degree to which willows and other nearshore vegetation will become established at lower reservoir elevations in the future in response to seasonal reductions in water levels is uncertain.

Table 4.5-3
70-Year Average Number of Acres of Littoral Habitat in Folsom Reservoir For Each Month of the Primary Spawning and Rearing Period for Warmwater Fishes

Month	Average Amount of Littoral Habitat[1]		Average Relative Change[2] (%)	Average Absolute Change[2] (acres)
	Base Condition	WFP		
March	885	772	-12.8	-113
April	1,914	1,807	-5.6	-107
May	2,652	2,529	-4.7	-124
June	2,342	2,180	-6.9	-162
July	1,730	1,619	-6.4	-111
August	1,090	958	-12.2	-133
September	529	349	-34.1	-181

[1] Nearshore areas (in acres) containing flooded terrestrial vegetation (e.g., willows) and/or submerged aquatic macrophytes that are used by warmwater fishes for spawning and juvenile rearing.

[2] The average changes were calculated based on the 70-year average number of acres of littoral habitat under WFP and the Base Condition, rather than by calculating an average based on changes occurring in each of the 70 individual years.

Source: SWRI, 1998.

Changes in the Monthly Rates of Water Surface Elevation Fluctuation

Changes in Folsom Reservoir operations under the WFP would generally alter the rates at which reservoir surface elevations change during each month of the primary warmwater fish spawning period of the year (i.e., March through July). For the purposes of this assessment, adverse impacts to spawning due to nest dewatering are assumed to have the potential to occur when reservoir elevation decreases by more than 9 feet within a given month (see the impact assessment methodology section, above).

Under the WFP, the potential for nest dewatering would occur in 3 additional years during June (4% more often), but would occur in 1 less year (1% less often) during April and 4 fewer years (6% less often) during July. The probability of a significant dewatering event occurring would remain unchanged under the WFP, relative to the Base Condition, for the months of March and May (Table 4.5-4; Appendix I). Overall, changes in the potential for significant nest dewatering events to occur during the March through July warmwater fish spawning period would not be expected to have substantial adverse effects on annual year-classes of warmwater fishes in Folsom Reservoir.

Table 4.5-4
70-Year Average Reservoir Surface Elevations and Rates of Elevation Fluctuation in Folsom Reservoir for Each Month of the Primary Spawning Period for Warmwater Fishes

Month	Average Reservoir Surface Elevation (feet msl)		Average Relative Change (%)	Average Absolute Change (feet msl)	No. Years w/Monthly Elevation Increase ≥ 20 ft	
	Base	WFP			Base	WFP
March	416.0	414.3	-0.4	-1.7	0	0
April	429.7	428.1	-0.4	-1.7	1	0
May	439.9	437.9	-0.5	-2.0	0	0
June	435.1	432.6	-0.6	-2.5	15	18
July	426.1	424.4	-0.4	-1.8	30	26

Source: SWRI, 1998.

Lake Natoma

Impact
4.5-3

Impacts to The Warmwater and Coldwater Fisheries of Lake Natoma. *Operations of Folsom Dam and Reservoir under the WFP would have minimal, if any, impact to Lake Natoma's seasonal storage, rates of elevation fluctuation, or temperature. Any changes to these lake parameters that could occur under the WFP would be expected to be minor and, therefore, would not adversely affect the lake's warmwater or coldwater fisheries. This would be a* ***less-than-significant*** *impact.*

Because Lake Natoma serves as a regulating afterbay of Folsom Reservoir, it commonly experiences daily/weekly fluctuations in water surface elevations of approximately 4 to 7 feet. Hydrologic changes associated with the WFP would not cause substantial changes in seasonal lake storage or water surface elevation fluctuations. Therefore, changes in use of surface and ground water defined in the WFP would not directly affect the fisheries resources of Lake Natoma.

The 69-year average temperature of water released from Nimbus Dam under the WFP would be essentially equivalent to that under the Base Condition from December through May, but would be reduced by 0.5°F to 1.5°F during the June through November period of the year (Table 4.5-5; Appendix I). These findings suggest that long-term average conditions in Lake Natoma could be somewhat improved for coldwater fishes during the June through November period, with temperatures being affected little during the remainder of the year. Spatial and temporal changes in water temperatures within Lake Natoma would not be expected to be sufficiently large to adversely affect the lake's warmwater fisheries.

Table 4.5-5 69-Year Average Water Temperatures at Nimbus Dam (RM 23) for Each Month of the Year				
Month	Mean Monthly Water Temperature (°F)		Average Relative Change[1] (%)	Average Absolute Change[1] (°F)
	Base Condition	WFP		
October	60.0	59.1	-1.6	-1.0
November	57.0	56.5	-0.8	-0.5
December	50.0	49.8	-0.4	-0.2
January	46.5	46.4	-0.2	-0.1
February	48.3	48.3	-0.1	0
March	52.1	52.0	-0.2	-0.1
April	56.4	56.5	0	0
May	60.5	60.6	0.1	0.1
June	64.3	63.4	-1.4	-0.9
July	67.2	65.7	-2.2	-1.5
August	67.5	66.6	-1.3	-0.9
September	67.9	67.3	-1.0	-0.7

[1] Change under the Water Forum Agreement, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average temperature values for each month under the two alternatives.

Source: SWRI, 1998.

Nimbus Fish Hatchery

Impact
4.5-4

Temperature Impacts to Nimbus Fish Hatchery Operations and Fish Production. *Operations of Folsom Dam and Reservoir under the WFP would generally have little effect on May temperatures below Nimbus Dam, and would typically result in equivalent or colder temperatures during the June through September period, relative to the Base Condition. Improved water temperatures would result from a Folsom Dam urban water intake structure temperature control device, and optimal coldwater pool management. On a long-term basis, the frequent and substantial temperature reductions that would occur during the June through September period (when hatchery temperatures reach seasonal highs annually) would more than offset the less frequent adverse impacts that would occur in some years. This would potentially benefit hatchery operations and resultant fish production in most years. Overall, this would be a* ***less-than-significant*** *impact.*

Under the WFP, the 69-year average temperature of water released from Nimbus Dam would remain essentially equivalent to that under the Base Condition during May, but would decrease by 0.7°F to 1.5°F during each month of the June through September period of the year (Table 4.5-5; Appendix I).

Nimbus release temperatures under the WFP would exceed 60°F in one additional year (1% more often) during May, two fewer years (3% less often) during June, with the frequency of exceeding 60°F remaining unchanged during the July through September period. The mean temperature for the years exceeding this index threshold would not change measurably in May, but would be reduced by nearly 1°F in June (Table 4.5-6; Appendix I).

Table 4.5-6
Number of Years of the 69 Years Modeled That Water Temperatures at Nimbus Dam (RM 23) Would Exceed Specified Temperature Thresholds

Month	60°F		65°		68°F		70°F	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP
Oct	28 (63.0)[1]	19 (64.2)	8 (65.9)	5 (66.5)	0	0	0	0
Nov	1 (61.0)	1 (60.9)	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	8 (62.3)	7 (62.5)	0	0	0	0	0	0
May	29 (63.0)	30 (63.0)	4 (68.4)	8 (67.3)	3 (69.5)	3 (69.6)	1 (70.6)	2 (70.4)
Jun	69 (64.3)	67 (63.5)	23 (66.9)	16 (66.2)	4 (69.2)	2 (69.9)	1 (70.4)	1 (70.4)
Jul	69 (67.2)	69 (65.7)	64 (67.4)	40 (67.3)	19 (69.5)	15 (69.4)	4 (71.4)	3 (71.0)
Aug	69 (67.5)	69 (66.6)	65 (67.7)	48 (67.7)	22 (70.0)	17 (70.4)	9 (71.7)	7 (71.8)
Sep	69 (67.9)	69 (67.3)	69 (67.9)	63 (67.5)	27 (69.4)	25 (69.0)	8 (70.5)	3 (70.5)

[1] Value in parentheses represents the mean water temperatures for the years exceeding the specified index threshold.

Source: SWRI, 1998.

Nimbus release temperatures would exceed 65°F in 4 additional years (6% more often) during May, 7 fewer years (10% less often) in June, 24 fewer years (34% less often) in July, 17 fewer years (24% less often) in August, and in 6 fewer years (9% less often) in September. The mean temperature for the years exceeding the 65°F index threshold under the WFP would remain essentially equivalent or would be measurably reduced relative to that under the Base Condition (Table 4.5-6; Appendix I).

Similarly, with the exception of the 70°F index threshold in May, the frequency with which temperatures below Nimbus Dam would exceed the index thresholds of 68°F and 70°F would be reduced under the WFP, relative to the Base Condition. In addition, the average temperature for the years exceeding these thresholds would generally remain equivalent to, or be reduced, relative to that under the Base Condition (Table 4.5-6; Appendix I).

In addition, temperature increases (ranging up to 3.8°F) would occur in individual years during the May through September period under the WFP, when temperatures already exceed 65°F under the Base Condition. However, temperature decreases (ranging up to 5.1°F) would occur much more frequently under the WFP, when temperatures under the Base Condition exceed 65°F.

On a long-term average basis, temperature decreases under the WFP more than offset infrequent temperature increases. This is shown most clearly by graphical plots showing the probability with which temperatures under the WFP and the Base Condition exceed specified levels below Nimbus Dam, based on the 69-year period of record modeled (see Figures 4.5-17, 4.5-18, 4.5-22 through 4.5-24 at the end of this section).

Lower American River

Flow- and temperature-related impacts are discussed separately below by species and lifestage. Organizationally, flow- and temperature-related impacts to fall-run chinook salmon are discussed first (Impact 4.5-5), followed by impact discussions for steelhead (Impact 4.5-6), splittail (Impact 4.5-7), American shad (Impact 4.5-8), and finally striped bass (Impact 4.5-9). Flow- and temperature-related impacts to fall-run chinook salmon and steelhead are discussed together.

Impact **4.5-5**

Fall-run Chinook Salmon. *Operations of Folsom Dam and Reservoir under the WFP would result in periods of reduced flows in the lower American River during the October through December spawning period, when flows under the Base Condition would be 2,500 cfs or less. Further flow reductions occurring at already low flow levels could result in increased redd superimposition and eventual lower year-class strength. Improved water temperature (resulting from a Folsom Dam urban water intake structure temperature control device and optimal coldwater pool management) and improved early life-stage survival, will benefit chinook salmon spawning success, as well as other life-stages. However, because of the broad, programmatic nature of the WFP, the extent to which these actions (combined with other future actions such as spawning gravel management, revised flow ramping rate criteria, etc.) will interact to counterbalance flow reductions is uncertain, as is the manner in which these actions will be implemented, managed, and coordinated without a comprehensive Habitat Management Plan for the Lower American River. Consequently, the overall effects of the WFP on chinook salmon year-class strength also is uncertain, and therefore, is considered to be a* ***potentially significant*** *impact.*

Impact **4.5-6**

Lower American River Steelhead. *Operations of Folsom Dam and Reservoir under the WFP would, on a long-term average basis, measurably reduce river temperatures during all months of the June through September rearing period. Reductions in the 69-year average temperature at Watt Avenue of 0.5°F would occur during June, August, and September, with a reduction of 0.8°F expected during July. This would provide significant thermal benefits to steelhead over-summering in the Lower American River during most years. Conversely, flow reductions of 20% or greater, when flows under the Base Condition would* *be at or below the maximum AFRP requirement for the month, would occur approximately 4% to 33% of the time during one or more months of the April through September period. Such flow reductions could reduce the quantity and/or quality of juvenile rearing habitat in some of these years. Because steelhead in the Lower American River are believed to be more limited by over-summering temperatures than flows, the frequent and substantial temperature reductions would be expected to offset the flow reductions, on a long-term basis. Consequently, the combined temperature and flow changes under the WFP would not be expected to adversely affect the long-term population trends of steelhead in the Lower American River. This would be a* ***less-than-significant*** *impact.*

Flow-Related Impacts to Fall-Run Chinook Salmon and Steelhead Adult Immigration (September through March)

Flow-related impacts to chinook salmon adult immigration would primarily be dictated by the volume of flow at the mouth during the September through December period of the year, when Lower American River chinook salmon adults immigrate through the Sacramento River in search of their natal stream to spawn. The same would be true for steelhead during the December through March period of the year. Lower bypass flows at the mouth are of concern primarily because reduced flow could result in insufficient olfactory cues for immigrating adult salmonids, thereby making it more difficult for them to "home" to the Lower American River. Insufficient bypass flows could, therefore, result in higher rates of straying to other rivers. The relative and absolute changes in flow volume that would be expected to occur at the mouth under the WFP indicate that such changes in flow at the mouth would not be of concern regarding physical passage of adults immigrating into the Lower American River.

Under the WFP, the 70-year average flow at the mouth would decrease during all months of the September through March period, with decreases ranging from approximately 128 cfs (4%) in January to about 314 cfs (12.5%) in September, relative to the Base Condition (Table 4.5-7).

Although the 70-year average flow at the mouth during September would be reduced by approximately 300 cfs under the WFP, the 70-year average Sacramento River flow at Freeport also would be reduced by approximately 250 cfs during this month. Similarly, Sacramento River flow reductions at Freeport would be similar to or greater than those at the mouth of the Lower American River during all other months of the fall-run chinook salmon and steelhead adult immigration period (i.e., October through March).

Under the WFP, the greatest reduction in the 70-year average proportion of Sacramento River flow immediately downstream of the mouth that would be composed of American River water during the combined primary period of upstream adult immigration for chinook salmon and steelhead would be 2.0%, which would occur in September. Hence, although mean monthly Lower American River flows at the mouth under the WFP would decrease somewhat during each month of this period, relative to the Base Condition, these reductions would not be expected to adversely impact the homing ability of immigrating adult fall-run chinook salmon or steelhead.

Table 4.5-7
70-year Average Flow (cfs) at the Mouth (RM 0) for Each Month of the Year

Month	Mean Monthly Flows (cfs)		Average Relative Change[1] (%)	Average Absolute Change[1] (cfs)
	Base Condition	WFP		
October	2,006	1,858	-7.9	-148
November	2,606	2,434	-7.5	-172
December	3,575	3,426	-6.1	-149
January	4,255	4,127	-4.5	-128
February	4,809	4,629	-5.5	-180
March	3,892	3,740	-3.9	-152
April	3,467	3,242	-8.2	-225
May	3,860	3,591	-8.5	-269
June	3,906	3,543	-12.1	-363
July	2,992	2,392	-21.5	-600
August	2,612	2,176	-16.4	-437
September	2,303	1,989	-12.5	-314

1 Change under the Water Forum Proposal, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average flow for each month under the two alternatives.

Source: SWRI, 1998.

The 69-year average water temperatures under the WFP would be equivalent to or colder than those under the Base Condition at the mouth and at Freeport during all months of the September through March period. Measurable decreases in the 69-year average temperature could occur during September, October, and November (Table 4.5-8).

Although Reclamation's Lower American River Temperature Model does not account for the influence of Sacramento River water intrusion on water temperatures at the mouth, this bias would be similar among alternatives. Therefore, the remaining temperature assessments are based on temperatures modeled at the mouth of the Lower American River.

The 69-year average water temperature at the mouth would be expected to exceed 65°F in all years under both the WFP and the Base Condition during September, and would exceed 70°F in 1 less year (1% less often) under the WFP (Table 4.5-9). During October, the number of years that temperatures at the mouth would exceed 56°F would remain unchanged. Mean monthly water temperatures would exceed 60°F in 6 fewer years (9% less often) under the WFP, relative to the Base Condition. Mean November water temperatures at the mouth would exceed 56°F in 7 fewer years (10% less often) under the WFP, relative to the Base Condition. Temperatures at the mouth would always remain below 56°F under the WFP during the months December through February, and in all but 5 years modeled during March (Table 4.5-9).

Table 4.5-8
69-year Average Water Temperatures at the Mouth (RM 0) of the Lower American River and at Freeport (RM 46) on the Sacramento River for Each Month of the March Through June Rearing and Emigration Period

Month	Mean Monthly Water Temperature (°F)				Average Relative Change [2] (%)		Average Absolute Change [2] (° F)	
	LAR Mouth		Freeport					
	Base	WFP	Base	WFP	Mouth	Freeport	Mouth	Freeport
October	60.6	59.9	60.6	60.5	-1.1	-0.2	-0.7	-0.1
November	56.0	55.6	52.5	52.5	-0.8	-0.2	-0.4	-0.1
December	48.8	48.6	46.1	46.0	-0.5	-0.1	-0.2	0
January	46.0	45.9	44.8	44.8	-0.2	0	-0.1	0
February	48.9	48.9	49.2	49.3	0	0	0	0
March	53.1	53.0	54.0	54.0	-0.1	0	0	0
April	57.9	58.0	59.9	59.9	0.2	0.1	0.1	0.1
May	62.3	62.4	65.4	65.5	0.2	0.1	0.1	0.1
June	66.6	66.3	69.8	69.8	-0.4	0	-0.3	0
July	70.0	69.6	73.0	73.0	-0.6	0	-0.4	0
August	69.8	69.5	71.8	71.7	-0.4	0	-0.3	0
September	68.6	68.2	68.3	68.3	-0.6	-0.1	-0.4	-0.1

1 Freeport is located at RM 46 on the Sacramento River, approximately 14 miles downstream of the Lower American River§ confluence.

2 Change under the Water Forum Proposal, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average temperature values for each month under the two alternatives.

Source: SWRI, 1998.

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Table 4.5-9
Number of Years of the 69 Years Modeled That Water Temperatures at the Mouth (RM 0) Would Exceed Specified Temperature Thresholds

Month	56°F		60°F		65°F		70°F	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP
Oct	69 (60.6)[1]	69 (59.9)	31 (62.7)	25 (62.8)	5 (65.7)	4 (65.6)	0	0
Nov	34 (57.0)	27 (56.8)	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	4 (57.7)	5 (57.6)	0	0	0	0	0	0
Apr	46 (59.4)	47 (59.4)	14 (62.8)	14 (62.9)	1 (65.5)	2 (65.3)	0	0
May	69 (62.3)	69 (62.4)	50 (63.4)	51 (63.5)	11 (67.6)	10 (68.4)	2 (70.7)	3 (70.8)
Jun	69 (66.6)	69 (66.3)	69 (66.6)	69 (66.3)	46 (68.1)	43 (68.1)	12 (71.2)	7 (72.3)
Jul	69 (70.0)	69 (69.6)	69 (70.0)	69 (69.6)	69 (70.0)	69 (69.6)	26 (72.2)	28 (72.2)
Aug	69 (69.8)	69 (69.5)	69 (69.8)	69 (69.5)	69 (69.8)	69 (69.5)	27 (71.7)	25 (72.0)
Sep	69 (68.6)	69 (68.2)	69 (68.6)	69 (68.2)	69 (68.6)	69 (68.2)	8 (70.7)	7 (70.7)

[1] Values in parentheses represent the mean water temperatures for the years exceeding the specified index threshold.

Source: SWRI, 1998

Temperature probability plots demonstrate that water temperatures at the mouth under the WFP would be similar to or lower than temperatures under the Base Condition throughout the September through March fall-run chinook salmon and steelhead adult immigration period (Figures 4.5-6 through 4.5-10, and 4.5-15 at the end of this section).

Based on these findings, September through March water temperatures in the lower portion of the Lower American River under the WFP would be expected to have long-term beneficial effects on fall-run chinook salmon adult immigration, and would have no adverse effect on steelhead adult immigration.

Flow- and Temperature-Related Impacts to Fall-run Chinook Salmon Spawning and Incubation (October through February)

Flow-Related Impacts

All flow-related impacts to fall-run chinook salmon spawning and incubation were based on flows at Nimbus Dam and Watt Avenue, with a greater emphasis placed on flows at Nimbus

Dam for two reasons. First, aerial redd surveys conducted by CDFG in recent years have shown that 98% of all spawning occurs upstream of Watt Avenue, and 88% of spawning occurs upstream of RM 17 (located just upstream of Ancil Hoffman Park). Hence, the majority of spawning occurs upstream of the diversions made by the City of Carmichael and Arcade Water District, which occur downstream of RM 17. Second, AFRP minimum flow requirements developed for the Lower American River, as defined in the Department of Interior's Final Administrative Proposal on the Management of Section 3406(b)(2) Water, dated November 20, 1997, are requirements to be met below Nimbus Dam.

The 70-year average flows below Nimbus Dam under the WFP would be reduced during each month of the October through February period, relative to flows under the Base Condition. These flow reductions would range from a low of about 4% (126 cfs) in January to a high of about 6% (147 cfs) in November (Table 4.5-10). The additional diversions that would occur between Nimbus Dam and Watt Avenue under the WFP range from approximately 10 cfs to 30 cfs, depending on the month of the year. Hence, changes in long-term average flows under the WFP for each month of the October through February period are essentially the same at Watt Avenue (Table 4.5-11) as those reported above for Nimbus Dam.

Flow reductions at Nimbus Dam in excess of 10%, when flows under the Base conditions would be 2,500 cfs or lower, would occur 25% of the time in October, 29% of the time in November, 28% of the time in December, 34% of the time in January, and 24% of the time in February. Reductions in excess of 20%, when flows under the Base conditions would be 2,500 cfs or lower, would occur 7% of the time in October and November, 10% of the time in December, 5% of the time in January, and 3% of the time in February (Appendix I; Figures 4.5-1 through 4.5-5 at the end of this section). To put this information into context, it should be noted that flows would be 2,500 cfs or lower under the Base Condition 97% of the time in October, 84% of the time in November, 74% of the time in December, 63% of the time in January, and 54% of the time in February, based on the 70-year period of record modeled. Findings are essentially the same at Watt Avenue (Appendix I; Figure 4.5-1 through 4.5-5).

Analytical interpretation of probability of occurrence data (i.e., exceedance) inherently incorporates elements of risk assessment, including the probability of an event occurring, and the magnitude of the effect if that event were to occur. For example, a flow reduction of 500 cfs when flows were 2,500 cfs may have a similar probability of occurrence as a 500 cfs reduction when flows under the Base Condition were 1,000 cfs; however, the magnitude of effect of the latter situation would be more severe, particularly when considering that the Base Condition flows are already limiting habitat availability.

Flow reductions anticipated to occur under the WFP would reduce the probability that mean monthly October flows below Nimbus Dam would be 2,000 cfs or higher by approximately 9%. The probability that flows would exceed 2,000 cfs also would be reduced by approximately 4% in November, December, and February, and by about 5% in January (Table 4.5-12).

Table 4.5-10 70-year Average Flow (cfs) at Nimbus Dam (RM 23) for Each Month of the Year				
Month	Mean Monthly Flows (cfs)		Average Relative Change[1] (%)	Average Absolute Change[1] (cfs)
	Base	WFP		
October	2,139	2,040	-5.0	-99
November	2,713	2,566	-5.9	-147
December	3,665	3,521	-5.6	-144
January	4,337	4,211	-4.2	-126
February	4,883	4,719	-4.5	-164
March	3,991	3,849	-3.6	-142
April	3,595	3,413	-5.8	-182
May	4,028	3,819	-5.8	-209
June	4,101	3,817	-8.4	-285
July	3,201	2,685	-16.4	-517
August	2,817	2,460	-11.4	-357
September	2,479	2,223	-8.9	-257

[1] Change under the Water Forum Agreement, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average flow values for each month under the two alternatives.

Source: SWRI, 1998.

Table 4.5-11 70-Year Average Flow (cfs) at Watt Avenue (RM 9.5) for Each Month of the Year				
Month	Mean Monthly Flows (cfs)		Average Relative Change[1] (%)	Average Absolute Change[1] (cfs)
	Base	WFP		
October	2,089	1,979	-5.8	-110
November	2,684	2,537	-6.0	-147
December	3,651	3,508	-5.7	-144
January	4,329	4,203	-4.2	-126
February	4,869	4,707	-4.6	-162
March	3,968	3,826	-3.6	-142
April	3,546	3,355	-6.4	-192
May	3,941	3,724	-6.3	-217
June	4,008	3,715	-9.2	-293
July	3,112	2,577	-17.9	-536
August	2,730	2,354	-12.9	-377
September	2,399	2,132	-9.9	-267

[1] Change under the Water Forum Proposal, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average flow values for each month under the two alternatives.

Source: SWRI, 1998.

Table 4.5-12
Number of Years That Mean Monthly Flows at Nimbus Dam Would Be Within Defined Flow Ranges

Month	X≥2,500		2,500>X≥2,000		2,000>X≥1,750		1,750>X≥800		800>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
October	37	33	9	10	15	14	7	8	2	5
	X≥2,500		2,500>X≥2,000		2,000>X≥1,750		1,750>X≥1,200		1,200>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
November	39	35	8	9	14	13	5	6	4	7
December	43	40	6	6	12	11	5	6	4	7
January	32	33	25	20	6	8	4	6	3	3
February	32	31	24	22	4	4	8	9	2	4
	X≥4,500		4,500>X≥3,000		3,000>X≥2,000		2,000>X≥1,500		1,500>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
March	18	17	18	19	21	18	8	11	5	5
April	20	17	16	15	24	25	2	4	8	9
May	21	17	24	26	15	16	4	4	6	7
	X≥4,500		4,500>X≥3,000		3,000>X≥2,000		2,000>X≥500		500>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
June	24	21	21	23	12	10	11	14	2	2
	X≥2,500		2,500>X≥1,500		1,500>X≥500		500>X			
	Base	WFP	Base	WFP	Base	WFP	Base	WFP		
July	43	36	20	19	6	14	1	1	—	
	X≥2,500		2,500>X≥2,000		2,000>X≥1,000		1,000>X≥500		500>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
August	43	35	6	8	12	16	4	5	5	6
	X≥2,500		2,500>X≥1,500		1,500>X≥500		500>X			
	Base	WFP	Base	WFP	Base	WFP	Base	WFP		
September	27	25	29	29	13	15	1	1	—	

Source: SWRI, 1998.

The findings above indicate that, during the October through December period (when the majority of fall-run chinook salmon spawning occurs annually), implementation of the WFP could commonly reduce flows, and the initial year-class size of lower American River fall-run chinook salmon could potentially be reduced (due to increased redd superimposition) during some of the years when lower spawning flows are provided.

Temperature-Related Impacts

Under the WFP, the 69-year average water temperature at Watt Avenue would decrease from 60.4°F under the Base Condition to 59.6°F (average decrease of 0.8°F) during October and from 57.0°F to 56.5°F (average decrease of 0.5°F) during November at Nimbus Dam. During the December through February period, the 69-year average water temperature at Nimbus Dam would not change measurably under the WFP compared to the Base Condition (Table 4.5-13).

Table 4.5-13
69-Year Average Water Temperatures at Nimbus Dam (RM 23) or Watt Avenue (RM 9.5)

Month	Mean Monthly Water Temperature (°F)		Average Relative Change[1] (%)	Average Absolute Change[1] (%)
	Base	WFP		
October	60.4	59.6	-1.3	-0.8
November[2]	57.0	56.5	-0.8	-0.5
December[2]	50.0	49.8	-0.4	-0.2
January[2]	46.5	46.4	-0.2	-0.1
February[2]	48.3	48.3	-0.1	0
March	52.7	52.7	-0.1	-0.1
April	57.4	57.5	0.1	0.1
May	61.7	61.8	0.2	0.1
June	65.9	65.4	-0.7	-0.5
July	69.1	68.3	-1.1	-0.8
August	69.0	68.6	-0.7	-0.5
September	68.3	67.8	-0.7	-0.5

1 Change under the Water Forum Proposal, relative to Base Condition. Values reported represent the average change for the 69 years modeled, rather than the difference between the 69-year average temperature values for each month under the two alternatives.

2 Values reported for the period November through February are for the Nimbus Dam site, with values reported for all other months being for the Watt Avenue location.

Source: SWRI, 1998.

Mean October water temperatures at Watt Avenue would be below 60°F (the temperature at which fall-run chinook salmon initiate spawning) in 8 additional years (12% more often) under the WFP compared to the Base Condition. Mean November water temperatures would be below 56°F in an additional 5 years (7% more often) under the WFP, relative to the Base Condition. Mean monthly river temperatures at Watt Avenue would be below 56°F in all 69 years modeled, during each month of the November through February period (Table 4.5-14).

Table 4.5-14
Number of Years of the 69 Years Modeled That Water Temperatures at Nimbus Dam (RM 23) or Watt Avenue (RM 9.5) Would Exceed Specified Temperature Thresholds

Month	56°F		60°F		65°F		70°F	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP
Oct	69 (60.4)	66 (59.8)	30 (62.8)	22 (63.3)	5 (65.9)	5 (65.7)	0	0
Nov[2]	56 (57.4)	51 (57.2)	1 (61.0)	1 (60.9)	0	0	0	0
Dec[2]	0	0	0	0	0	0	0	0
Jan[2]	0	0	0	0	0	0	0	0
Feb[2]	0	0	0	0	0	0	0	0
March	4 (57.0)	5 (57.0)	0	0	0	0	0	0
April	43 (59.0)	44 (59.0)	13 (62.4)	13 (62.5)	0	0	0	0
May	69 (61.7)	69 (61.8)	44 (63.1)	46 (63.1)	8 (67.8)	9 (68.2)	2 (70.6)	3 (70.4)
June	69 (65.9)	69 (65.4)	69 (65.9)	69 (65.4)	37 (67.9)	35 (67.6)	4 (71.5)	5 (71.9)
July	69 (69.1)	69 (68.3)	69 (69.1)	69 (68.3)	69 (69.1)	69 (68.3)	20 (71.7)	15 (72.0)
Aug	69 (69.0)	69 (68.6)	69 (69.0)	69 (68.6)	69 (69.0)	69 (68.6)	16 (71.9)	17 (72.1)
Sep	69 (68.3)	69 (67.8)	69 (68.3)	69 (67.8)	69 (68.3)	69 (67.8)	5 (70.8)	3 (71.1)

1 Values in parentheses represent the mean water temperatures for the years exceeding the specified index threshold.
2 Values reported for the period November-February are for the Nimbus Dam site, with values reported for all other months being for the Watt Avenue location.

Source: SWRI, 1998.

Mean October river temperatures at Watt Avenue under the WFP would be essentially equivalent to or lower than those under the Base Condition, with measurable temperature reductions occurring about 75% of the time (Figure 4.5-6; Appendix I). November river temperatures at Watt Avenue would nearly always be lower under the WFP compared to those under the Base Condition (Figure 4.5-7; Appendix I).

Finally, the 69-year average annual early lifestage survival (percent survival of emergent fry from egg potential) for fall-run chinook salmon would be increased from 84.1% under the Base Condition to 86.3 under the WFP, an average increase of 2.2%. Substantial decreases in survival would not occur in any individual years. Conversely, substantial increases in early lifestage survival would commonly occur.

Based on these findings, temperature changes in the river under the WFP during the October through February period would have beneficial effects on spawning and incubation of fall-run chinook salmon.

Flow- and Temperature-Related Impacts to Steelhead Spawning and Incubation (December through March)

No flow- or temperature-related impacts to steelhead spawning or incubation would be expected to occur under the WFP. For quantitative flow data supporting this impact determination, see Tables 4.5-10, 4.5-11, and 4.5-12; Figures 4.5-3 through 4.5-5 and 4.5-11; and Appendix I. For the quantitative temperature data supporting this impact determination, see Tables 4.5-13 and 4.5-14; Figures 4.5-8 through 4.5-10 and 4.5-15; and Appendix I.

Flow- and Temperature-related Impacts to Fall-run Chinook Salmon and Steelhead Juvenile Rearing (March through June)

Flow-Related Impacts

Because the majority of juvenile salmonid rearing is believed to occur upstream of Watt Avenue, because the WFP identifies increased diversions upstream of Watt Avenue in the future, and because depletions generally exceed tributary accretions to the river throughout the March through June period (generally making flows at Watt Avenue lower than those at Nimbus Dam), all flow-related impacts to fall-run chinook salmon rearing are based on flows at Watt Avenue, thereby providing the most conservative assessment.

Under the WFP, the 70-year average flow at Watt Avenue would be reduced in all months of the March through June period, with reductions ranging from approximately 4% (142 cfs) in March to about 9% (293 cfs) in June (Table 4.5-11).

In general, under the WFP, the probability of mean monthly flows exceeding 4,500 cfs would not change substantially during the March through June period, relative to the Base Condition. However, when flows would be at or below 4,500 cfs under the Base Condition, which is the wet-year flow objective in the AFRP for this period, flow reductions would commonly occur. Reduction in excess of 20% would occur in 3 years (5% of the time) in March, 4 years (8%) in April, 2 years (4%) in May, and 7 years (15%) in June (Appendix I; Figures 4.5-11 through 4.5-14).

When flows under the Base Condition are 2,000 cfs or less (the dry/critical flow objective in the AFRP), measurable flow reductions would only occasionally occur during March, but more substantial flow reductions would more frequently occur during April through June. Over the long-term, flow reductions under WFP wouldn't be expected to substantially alter the quantity of rearing habitat, partly because the primary period of emigration occurs from mid-February through early March. However, flow reductions when flows are already at relatively low levels (i.e., = 2,000 cfs) may adversely affect salmon rearing success during those years.

Table 4.5-15
Number of Years That Mean Monthly Flows at Watt Avenue Would Be Within Defined Flow Ranges

Month	X≥2,500		2,500>X≥2,000		2,000>X≥1,750		1,750>X≥800		800>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
October	2	1	40	35	4	7	22	22	2	5
	X≥2,500		2,500>X≥2,000		2,000>X≥1,750		1,750>X≥1,200		1,200>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
November	12	10	32	28	7	9	14	15	5	8
December	22	20	26	24	5	5	13	14	4	7
January	28	28	16	16	17	12	6	11	3	3
February	32	32	9	7	16	15	11	12	2	4
	X≥4,500		4,500>X≥3,000		3,000>X≥2,000		2,000>X≥1,500		1,500>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
March	15	14	19	19	16	15	13	15	7	7
April	18	15	16	15	18	17	9	13	9	10
May	17	14	24	25	18	19	3	3	8	9
	X≥4,500		4,500>X≥3,000		3,000>X≥2,000		2,000>X≥500		500>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
June	24	20	18	23	13	8	12	14	3	5
	X≥2,500		2,500>X≥1,500		1,500>X≥500		500>X			
	Base	WFP	Base	WFP	Base	WFP	Base	WFP		
July	43	34	14	16	10	15	3	5	—	
	X≥2,500		2,500>X≥2,000		2,000>X≥1,000		1,000>X≥500		500>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
August	39	35	8	5	13	16	4	7	6	7
	X≥2,500		2,500>X≥1,500		1,500>X≥500		500>X			
	Base	WFP	Base	WFP	Base	WFP	Base	WFP		
September	27	22	18	17	23	29	2	2	—	

Source: SWRI, 1998.

Temperature-Related Impacts

Under the WFP, the 69-year average water temperature at Watt Avenue would not change measurably during any month of the March through May period, but would be reduced from 65.9°F to 65.4°F (average decrease of 0.5°F) during June (Table 4.5-13). Neither the probability of exceeding temperature index thresholds of 56°F, 60°F, 65°F, and 70°F nor the average temperature for the years exceeding these thresholds would change substantially under the WFP, relative to the Base Condition, for any month of the March though June period (Table 4.5-14).

Under the WFP, mean March water temperatures would be equivalent to those under the Base Condition, and would always be below 58°F. Hence, temperatures during March would not be of concern for juveniles rearing in the river (Figure 4.5-15; Appendix I). April temperature under the WFP would remain at or below 65°F, and would remain essentially equivalent to those under the Base Condition (Figure 4.5-16; Appendix I). May temperatures would remain equivalent to those under the Base Condition approximately 95% of the time, but would be elevated in the warmest 5% of the years (Figure 4.5-17; Appendix I). Similarly, temperature increases would occur under the WFP during 5% of the years during June. However, substantial temperature decreases would occur during June under the WFP about 50% of the time, with large temperature decreases (approaching 2°F) occurring about 20% of the time (Figure 4.5-18; Appendix I).

With the possible exception of adverse effects that could occur in the 5% direst years during May, temperature changes under the WFP during the March through May period would have minimal effects on juvenile rearing above Watt Avenue. Changes in river temperatures during June would, on a long-term basis, have a beneficial effect on juvenile rearing.

The temperature changes discussed above for the March through June period would affect juvenile emigration upstream of Watt Avenue in a manner similar to effects on rearing. Temperature-related impacts to fish emigrating through the lower river (i.e., downstream of Watt Avenue) are assessed based on temperatures at the mouth (see discussion below).

Flow-Related Impacts to Fall-Run Chinook Salmon and Steelhead Juvenile Emigration (February through June)

The primary period of fall-run chinook salmon juvenile emigration occurs from February through June, with the majority of juvenile steelhead emigration occurring during this same period. Generally little, if any, emigration occurs during July and August. Flow-related impacts to salmonid immigration (discussed above) addressed flow changes in February and March. The changes in flows under the WFP during February and March would not be sufficient to adversely affect juvenile fall-run chinook salmon or steelhead emigration. Hence, this discussion focuses primarily on the April through June period of the year.

Adequate flows for emigration from the portion of the river above Watt Avenue would be met by flows which were previously discussed under this impact section (see discussions regarding juvenile rearing). Bypass flows at the mouth are used to assess potential flow-related impacts to salmonid emigration through the lower river (i.e., below Watt Avenue).

Under the WFP, the 70-year average flow at the mouth would decrease somewhat during all months of the April through June period. The magnitude of decrease in the 70-year average flows would range from approximately 8% (225 cfs) in April to about 12% (363 cfs) in June (Table 4.5-7).

Under the WFP, the probability of mean monthly flows exceeding 4,500 cfs at the mouth would not change substantially during any month of the April through June period, relative to the probability of exceeding these same flow levels under the Base Condition (Table 4.5-16). However, flow reductions at the mouth in excess of 10%, when flows under the Base conditions would be 4,500 cfs or lower, would occur frequently during each of these months. Flow reductions of 20% or more would occur infrequently during April and May, but more frequently during June (Appendix I). Flows under the WFP would never be reduced to levels that would physically block emigration from the river, when such flow levels would not exist under the Base Condition.

Higher flows and turbidity have been shown to result in higher rates of downstream juvenile emigration. However, much of this information comes from findings associated with large pulse flows following significant precipitation events, not relatively small changes in flow on the order of 10-20%. Moreover, high flow and turbidity levels, although known to trigger emigration events, are not necessary for successful emigration of a salmonid year-class from the river. In fact, emigrating fish are more likely to be adversely affected by events when flows are high, then ramped down quickly (resulting in isolation and stranding) than they are by lower flows that are held at a constant rate. Adverse changes in flow ramping rates would not be expected to occur under the WFP. Consequently, although substantial flow reductions would occur periodically under the WFP during the April through June period, relative to flows under the Base Condition, resultant flows would not be expected to adversely affect the success of juvenile salmonid emigration.

Temperature-Related Impacts to Fall-Run Chinook Salmon and Steelhead Juvenile Emigration (February through June)

With the possible exception of a small percentage of fish that may rear near the mouth of the Lower American River, impacts of river temperatures at the mouth to fall-run chinook salmon and steelhead would be limited to the [up to] several days that it takes emigrants to pass through the lower portion of the river and into the Sacramento River in route to the Delta. Water temperatures near the mouth during the primary emigration period (i.e., February through June) are often largely affected by intrusion of Sacramento River water, which is not accounted for by Reclamation's Lower American River Temperature Model. Consequently, actual temperatures near the mouth would likely be somewhere between temperatures modeled for the mouth and temperatures modeled for the Sacramento River at Freeport (RM 46), located 14 miles downstream of the Lower American River's confluence. For this reason, the 69-year average temperatures for each month are presented for both of these locations (see Table 4.5-8).

Table 4.5-16
Number of Years That Mean Monthly Flows at the Mouth Would Meet or Exceed Water-Year Type-Specific Flow Objectives Specified by the AFRP[1] and F-Pattern[2]

Month	Wet X≥2,500		Above and Below Normal 2,500>X≥2,000		Dry and Critical 2,000>X≥1,750		Critical Relaxation 1,750>X≥800		Other 800>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
October	2	1	40	35	4	7	22	22	2	5
	X≥2,500		2,500>X≥2,000		2,000>X≥1,750		1,750>X≥1,200		1,200>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
November	11	9	32	28	4	7	15	18	8	8
December	17	17	30	25	2	5	14	16	7	7
January	26	24	17	14	14	15	10	14	3	3
February	32	29	4	3	21	21	8	11	5	6
	X≥4,500		4,500>X≥3,000		3,000>X≥2,000		2,000>X≥1,500		1,500>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
March	14	14	20	19	16	14	9	12	11	11
April	15	13	19	17	17	17	10	13	9	10
May	16	12	25	27	18	19	3	3	8	9
	X≥4,500		4,500>X≥3,000		3,000>X≥2,000		2,000>X≥500		500>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
June	21	18	21	21	13	10	12	16	3	5
	X≥2,500		2,500>X≥1,500		1,500>X≥500		500>X			
	Base	WFP	Base	WFP	Base	WFP	Base	WFP		
July	41	31	15	19	11	13	3	7	—	
	X≥2,500		2,500>X≥2,000		2,000>X≥1,000		1,000>X≥500		500>X	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP	Base	WFP
August	38	32	8	7	14	16	4	4	6	11
	X≥2,500		2,500>X≥1,500		1,500>X≥500		500>X			
	Base	WFP	Base	WFP	Base	WFP	Base	WFP		
September	26	20	18	18	24	30	2	2	—	

1 AFRP = Anadramous Fish Restoration Program of the Central Valley Project Improvement Act (CVPIA) (USFWS 1995)

2 F = pattern = flow regime developed for the Lower American River developed by the Water Forum. F-pattern uses the same flow objectives as those defined in the AFRP.

Source: SWRI, 1998.

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The 69-year average water temperatures expected to occur at the mouth during February and March have been discussed previously under impacts to adult salmonid immigration. The 69-year average April and May temperatures would not be expected to change measurably under the WFP, relative to the Base Condition (Table 4.5-8; Figures 4.5-16 and 4.5-17; Appendix I). Conversely, the 69-year average water temperature at the mouth could potentially decrease by as much as 0.3°F in June under the WFP (Table 4.5-8).

The probability of exceeding specified temperatures at the mouth during February and March have also been previously discussed. Mean April temperatures at the mouth would be expected to exceed the 56°F and 65°F index thresholds in 1 additional year (1% more often) under the WFP, with no change in the number of years that 60°F is exceeded (Table 4.5-9). Likewise, mean May temperatures at the mouth would only be expected to exceed 60°F in 1 additional year (1% more often), 65°F in 1 less year (1% less often), and 70°F in 1 additional year (1% more often). In June, the frequency with which mean monthly temperatures at the mouth would exceed the 65°F index threshold would decrease by 3 years (4% less often), with the 70°F index threshold exceeded in 5 fewer years (7% less often) (Table 4.5-9; Appendix I).

Temperature probability plots show that water temperatures at the mouth under the WFP would generally be essentially equivalent to those under the Base Condition during February, March, and April (e.g., Figures 4.5-15 and 4.5-16; Appendix I). In May, water temperatures at the mouth would generally be somewhat higher under the WFP, relative to the Base Condition, during about 8% of the years, but would be essentially equivalent the remainder of the time (Figure 4.5-17; Appendix I). In June, temperatures under the WFP would be somewhat elevated in about 3% of the years, but would be essentially equivalent to or colder than those under the Base Condition the remainder of the time and substantially cooler nearly 20% of the time (Figure 4.5-18; Appendix I).

Based on the findings discussed above, water temperatures under the WFP would not be of concern regarding emigration during the February through April period. Increases in water temperatures at the mouth that would be expected to occur in some years under the WFP would not occur with sufficient frequency to adversely affect emigration of fall-run chinook salmon or steelhead during May or June; the more frequent and substantial reductions in temperatures at the mouth during June would have beneficial effects on late-emigrating juvenile fall-run chinook salmon and steelhead.

Flow-related Impacts to Steelhead Rearing (Year-round)

The remainder of this section will assess flow-related impacts to juvenile steelhead rearing that would occur during the period July through September, when fall-run chinook salmon are not in the river.

Under the WFP, the 70-year average flow at Nimbus Dam would decrease from approximately 3,201 cfs (under the Base Condition) to 2,685 cfs in July, from 2,817 cfs to 2,460 cfs in August, and from 2,479 cfs to 2,223 cfs in September. This represents 70-year-average flow reductions of approximately 16% (517 cfs) in July, 11% (357 cfs) in August, and 9% (257 cfs) in September (Table 4.5-10). Findings are essentially the same at Watt Avenue (Table 4.5-11).

Flows at Nimbus Dam would be at or above 1,500 cfs 11% less often during July, 9% less often during August, and 3% less often during September (Table 4.5-12). Similarly, flows would be at or above 1,500 cfs at Watt Avenue 10% less often during July and August and 8% less often during September (Table 4.5-12).

Flow reductions at Nimbus Dam in excess of 10%, when flows under the Base conditions would be 2,500 cfs or lower, would occur 62% of the time in July and 44% of the time in August and September. Reductions in excess of 20%, when flows under the Base conditions would be 2,500 cfs or lower, would occur 27% of the time in July, 33% of the time in August, and 12% of the time in September (Appendix I; Figures 4.5-19 through 4.5-21). To put this information into context, flows would be 2,500 cfs or lower under the Base Condition 39% of the time in July and August, and 61% of the time in September, based on the 70-year period of record modeled. Findings are essentially the same at Watt Avenue (Appendix I; Figures 4.5-19 through 4.5-21).

Based on the findings discussed above, flow reductions under the WFP could reduce the quality and/or quantity of juvenile steelhead rearing habitat in some years, relative to that which would occur under the Base Condition.

Temperature-related Impacts to Steelhead Rearing (Year-round)

Under the WFP, the 69-year average temperatures at Watt Avenue would be reduced by 0.8°F during July, 0.5°F during August, and 0.5°F during September, relative to that under the Base Condition (Table 4.5-13). The probability of exceeding the 70°F index threshold would decrease by 5 years (7% less often) in July, increase by 1 year (1% more often) in August, and decrease by 2 years (3% less often) in September (Table 4.5-14). The average temperature for the years exceeding the 70°F threshold would not change substantially under the WFP, relative to that under the Base Condition.

July temperatures under the WFP would be essentially equivalent to or colder than those under the Base Condition 90-95% of the time. Substantial temperature decreases would occur during July under the WFP about 75% of the time (Figure 4.5-22; Appendix I).

Substantial temperature decreases would occur at Watt Avenue during August under the WFP about 65% of the time (Figure 4.5-23; Appendix I). Substantial temperature decreases would occur at Watt Avenue during September under the WFP about 65% of the time (Figure 4.5-24; Appendix I).

Based on the findings discussed above, temperature changes under the WFP would, on a long-term average basis, have a beneficial effect on steelhead summer rearing in the Lower American River.

Splittail

Impact 4.5-7

Flow- and Temperature-Related Impacts to Splittail (February through May).
*Operations of Folsom Dam and Reservoir under the WFP would typically reduce, to some degree, the amount of riparian vegetation inundated between RM 8 and 9 (which serves as an index for the lower portion of the river) under the Base Condition. However, with few exceptions, substantial amounts of inundated riparian vegetation would remain under the WFP in years when such habitat would occur under the Base Condition. In addition, flow changes under the WFP would have little effect on the availability of in-channel spawning habitat availability, or the amount of potential spawning habitat available from the mouth up to RM 5 - the reach of the river influenced by Sacramento River stage. Also, the frequency with which suitable temperatures for splittail spawning below Watt Avenue would not change substantially under the WFP, relative to the Base Condition. Given the uncertainty as to the magnitude and extent of splittail spawning in the Lower American River, and the actual amount of potential spawning habitat at specific flow rates throughout the river, the effects of flow reductions from the February through May period also are uncertain and, therefore, represent a **potentially significant** impact.*

Under the WFP, the 70-year average flows at Watt Avenue would be reduced by about 5-6% (142-217 cfs) during each month of the February through May period, relative to flows under the Base Condition (Table 4.5-11).

Using flows at Watt Avenue, the acreage of riparian vegetation inundated between RM 8 and 9 was investigated for the Base Condition and the WFP. These values were used as an index of the relative amount of inundated riparian vegetation that would occur in the lower portion of the river for a given flow rate. The amount of riparian habitat inundated in this portion of the river under the WFP would remain unchanged in 47 years (67% of the time) during February, 56 years (80% of the time) during March and May, and 57 years (81% of the time) during April. However, it should be noted that in most of these years, no riparian vegetation would be inundated under either the WFP or the Base Condition.

With the exception of one year in March when the amount of inundated riparian habitat would increase, the amount of such habitat between RM 8 and 9 would be reduced to some degree under the WFP in the years when riparian habitat would be inundated under the Base Condition. Reductions of more than 20% in the relative amount of inundated habitat between RM 8 and 9 would occur in 2 years during February and March, and 5 years in April and May under the WFP, relative to that which would be inundated under the Base Condition. Based on the number of years when riparian habitat would be inundated under the Base Condition, these habitat reductions of 20% or more would occur in 9% of the years in February, 14% of the years in March, 38% of the years in April, and 33% of the years in May that such habitat would exist under the Base Condition. Nevertheless, in most of these years, substantial amounts of inundated riparian habitat would remain available under the WFP. Complete (i.e., 100%) losses of available habitat would occur in 1 year during March and April, and in 3 years during May. Increases in the availability of inundated riparian vegetation would occur in 1 year during March.

The number of years that mean monthly water temperatures at Watt Avenue would be within the preferred range for splittail spawning of 48°F to 68°F would remain unchanged during March and April, but would be reduced by 2 years (3% less often) during February and May.

American Shad

Impact
4.5-8

<u>Flow- and Temperature-Related Impacts to American Shad (May and June).</u>
Operations of Folsom Dam and Reservoir under the WFP would increase the frequency with which mean monthly flows at the mouth would be below the target attraction flow of 3,000 cfs by 3% in May and 4% in June. Because American shad spawn opportunistically where suitable conditions are found, potentially attracting fewer adult spawners into the Lower American River in a few years would not be expected to adversely impact annual American shad production within the Sacramento River system. Flow reductions under the WFP in May and June could reduce the number of adult shad attracted into the river during some years. Because annual production of American shad within the Sacramento River system would not be affected, and because direct impacts to the Lower American River sport fishery would be less than substantial in most years, any flow-related impacts to American shad are considered to be less than significant. In addition, because the frequency with which suitable temperatures for American shad spawning would not differ substantially between the WFP and the Base Condition, and because river temperatures under the WFP would nearly always remain suitable for American shad rearing, temperature-related impacts to American shad also are considered to be less than significant. Overall, this would be a ***less-than-significant*** *impact.*

Changes in Lower American River flows that could be expected to occur during May and June under the WFP have been discussed previously under Impact 4.5-5 (Figures 4.5-16 and 4.5-17; Appendix I). In addition to this analysis, further analysis was performed to determine the probability that lower American River flows at the mouth would be below 3,000 cfs, the flow level defined by CDFG as that which would be sufficient to maintain the sport fishery. Under the WFP, mean monthly flows would be below the 3,000 cfs attraction flow at the mouth in 2 additional years (3% more often) during May and 3 additional years (4% more often) during June.

The number of years that mean monthly water temperatures at Nimbus Dam would be within the preferred range for American shad spawning of 60°F to 70°F would not change in May and would decrease by 2 years (3% less often) in June. Conversely, the number of years that mean monthly temperatures would be within this range at the mouth would increase by one year (1% more often) in May and by 5 years (7% more often)in June. Lower American River water temperatures under the WFP would remain suitable for American shad rearing (Tables 4.5-5 and 4.5-6; Figures 4.5-20 and 4.5-21; Appendix I).

Striped Bass

Impact
4.5-9

Flow- and Temperature-Related Impacts to the Striped Bass Sport Fishery (May and June). *Operations of Folsom Dam and Reservoir under the WFP would increase the frequency with which mean monthly flows at the mouth would be below the target flow of 1,500 cfs by 1% in May and 10% in June. Because flows at the mouth that are believed to be sufficient to maintain the striped bass fishery would be met or exceeded in most years during both May and June, and because substantial changes in the strength of the striped bass fishery would not be expected to occur in all years when mean May and/or June flows fall below 1,500 cfs, flow-related impacts to the striped bass fishery that could potentially occur under the WFP are considered to be less than significant. In addition, because the frequency with which suitable temperatures for juvenile striped bass rearing in the Lower American River would differ little between the WFP and the Base Condition during May and June, temperature-related impacts to juvenile striped bass rearing are also considered to be less than significant. Overall, this would be a* ***less-than-significant*** *impact.*

Changes in Lower American River flows that could be expected to occur during May and June under the WFP have been discussed previously under Impact 4.5-5 (Figures 4.5-16 and 4.5-17; Appendix I). In addition to this previous analysis, further analysis was performed to determine the probability that Lower American River flows at the mouth would be below 1,500 cfs, the flow level defined by CDFG as that which would be sufficient to maintain the sport fishery. Under the WFP, mean monthly flows in the Lower American River would be below the 1,500 cfs attraction flow threshold at the mouth during 1 additional year (1% more often) during May and 7 additional years (10% more often) during June, relative to the Base Condition.

The number of years that mean monthly water temperatures at Nimbus Dam would be within the preferred range for striped bass juvenile rearing of 61°F to 73°F would decrease by 2 years (3 % less often) in May and 5 years (7% less often) in June. Similarly, the number of years that mean monthly temperatures would be within this range at the mouth would decrease by 1 year (1 % less often) in May and would not change in June(Appendix I).

Shasta and Trinity Reservoirs

Coldwater Fisheries

The additional diversion demand on the American River system and the Sacramento River under the WFP would require modifications to the operation of Shasta and Trinity reservoirs in order to best meet CVP/SWP deliveries and Delta water quality standards. Seasonal changes in reservoir storage could result in corresponding changes in physical habitat availability for the reservoir's coldwater fish species. Lower reservoir storage could reduce, to some degree, the amount of space available for coldwater species to use during the April through November period when thermal stratification occurs within these reservoirs. Conversely, higher storage could increase the availability of coldwater fish habitat in the reservoir. Potential impacts to coldwater fisheries in Shasta and Trinity reservoirs resulting from changes in storage are discussed separately below.

Impact 4.5-10

Impacts to Shasta Reservoir's Coldwater Fisheries. *Hydrologic conditions with the WFP would not result in substantial reductions in reservoir storage throughout the April through November period of the year. Because changes to Shasta Reservoir storage would not be substantial, because physical habitat availability is not believed to be among the primary factors limiting coldwater fish populations within the reservoir, and because anticipated changes in seasonal storage would not be expected to result in substantial adverse effects on the primary prey base utilized by the reservoir's coldwater fish populations, seasonal reductions in storage expected to occur under WFP would have* ***less-than-significant*** *impacts to Shasta Reservoir's coldwater fisheries.*

Table 4.5-17
Changes in the 70-Year Average Storage in Shasta and Trinity Reservoirs for Each Month of the April Through November Period

Month	Reservoir	Mean Mo. Storage (TAF)		Average Relative Change[1] (%)	Average Absolute Change[1] (TAF)
		Base	WFP		
April	Shasta	3,847.7	3,848.4	0	0.7
	Trinity	1,942.5	1,941.7	0	-0.8
May	Shasta	3,899.9	3,899.5	0	-0.5
	Trinity	1,978.7	1,977.8	-0.1	-0.9
June	Shasta	3,675.1	3,676.2	0.1	1.1
	Trinity	1,913.3	1,911.5	-0.1	-1.8
July	Shasta	3,257.9	3,257.5	0.1	-0.4
	Trinity	1,743.9	1,741.3	-0.2	-2.6
August	Shasta	2,843.5	2,841.1	0	-2.4
	Trinity	1,600.5	1,598.8	-0.1	-1.7
September	Shasta	2,716.6	2,714.1	0	-2.5
	Trinity	1,519.9	1,519.2	0	-0.7
October	Shasta	2,704.3	2,702.6	0.1	-1.8
	Trinity	1,484.4	1,484.2	0	-0.2
November	Shasta	2,738.1	2,738.0	0.1	-0.1
	Trinity	1,497.8	1,497.2	0	-0.6

[1] Change under the Water Forum Proposal, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average storage for each month under the two alternatives.

Source: SWRI, 1998.

Hydrologic conditions under the WFP would not substantially change the 70-year average monthly storage in Shasta Reservoir, relative to the Base Condition, during any month of the April through November period (Table 4.5-17). Reductions in Shasta storage would be less than 5% in all individual years during all months of this period. The changes in Shasta Reservoir storage expected to occur under the WFP would not be expected to substantially affect the coldwater fishery as the availability of physical habitat is not a primary limiting factor for these fish. In addition, the storage reductions would not adversely affect the population dynamics of the primary prey species for the reservoir's coldwater fish populations (Appendix I).

Impact
4.5-11

<u>Impacts to Trinity Reservoir's Coldwater Fisheries.</u> *Hydrologic conditions with the WFP would not result in substantial reductions in reservoir storage throughout the April through November period of the year. Because changes to Trinity Reservoir storage would not be substantial, because physical habitat availability is not believed to be among the primary factors limiting coldwater fish populations within the reservoir, and because anticipated changes in seasonal storage would not be expected to result in substantial adverse effects on the primary prey base utilized by the reservoir's coldwater fish populations, seasonal reductions in storage expected to occur under WFP would have **less-than-significant** impacts to Trinity Reservoir's coldwater fisheries.*

Under the WFP, reductions in the 70-year average monthly storage in Trinity Reservoir would be less than 1% during all months of the April through November period (Table 4.5-17). Reductions in Trinity Reservoir storage would be less than 5% in all individual years during all months of this period. These anticipated changes in mean monthly reservoir storage would not be expected to substantially affect the coldwater fishery as the availability of coldwater fish habitat is not a primary limiting factor for those fish. The minor storage reductions would not adversely affect the population dynamics of the primary prey species utilized by the reservoir's coldwater fish populations (Appendix I).

Warmwater Fishes

Impact
4.5-12

<u>Impacts to Shasta Reservoir's Warmwater Fisheries.</u> *Seasonal changes in reservoir surface elevation under the WFP could result in substantial reductions in reservoir littoral habitat availability in a few years during the period March through September. However, seasonal changes in reservoir surface elevation under the WFP would generally not result in substantial reductions in long-term average reservoir littoral habitat availability during the period March through September (which are the primary spawning and initial rearing months for the reservoir's warmwater fishes of management concern). Thus, these reductions would not be of sufficient magnitude to substantially reduce long-term, average initial year-class strength of the warmwater fish populations of management concern. Consequently, seasonal reductions in littoral habitat availability would constitute a less-than-significant impact to Shasta Reservoir's warmwater Fisheries. Because the frequency with which potential nest dewatering events could occur in Shasta Reservoir under the WFP would not change during any month of the March through July warmwater fish spawning period, impacts to warmwater fish nesting success under the WFP are considered to be less than significant Overall, this would constitute a **less-than-significant** impact.*

Littoral Habitat Availability

The additional diversion demand on the American River system and the Sacramento River under the WFP would not result in substantial changes in the 70-year average end-of-month water surface elevation in Shasta Reservoir during the March through September period (Table 4.5-18). During the March through September period (when warmwater fish spawning and initial rearing occurs), reductions in average end-of-month elevation of greater than 1 ft would occur infrequently during March, April and May, occasionally during June, and regularly during July, August and September.

Table 4.5-18
70-Year Average Water Surface Elevation (feet msl) in Shasta and Trinity Reservoirs for Each Month of the March Through September Period of the Year

Month	Reservoir	Avg. Water Surface Elevation		Average Relative Change[1] (%)	Average Absolute Change[1] (feet)
		Base	WFP		
March	Shasta	1,026.6	1,026.6	0	0
	Trinity	2,322.7	2,322.7	0	0
April	Shasta	1,037.1	1.037.1	0	0
	Trinity	2,333.8	2,333.7	0	0
May	Shasta	1,038.7	1,038.7	0	0
	Trinity	2,335.7	2,335.6	0	-0.1
June	Shasta	1,030.0	1,030.1	0	0.1
	Trinity	2,330.5	2,330.4	0	-0.1
July	Shasta	1,013.1	1,013.2	0	0
	Trinity	2,317.5	2,317.3	0	-0.2
August	Shasta	994.9	994.9	0	0
	Trinity	2,305.7	2,305.6	0	-0.1
September	Shasta	988.8	988.8	0	0
	Trinity	2,299.5	2,299.4	0	0

[1] Change under the Water Forum Proposal, relative to the Base Condition. Values reported represent the average change for the 70 individual years modeled, rather than the difference between the 70-year average elevation for each month under the two alternatives.

Source: SWRI, 1998.

Changes in water surface elevation in Shasta Reservoir during the March through September period would result in corresponding changes in the availability of reservoir littoral habitat containing inundated terrestrial vegetation (e.g., willows and button brush). Such shallow, near-shore waters containing physical structure are important to producing and maintaining strong year-classes of warmwater fishes annually.

Reductions in the 70-year average amount of littoral habitat potentially available to warmwater fishes for spawning and/or rearing in Shasta Reservoir under the WFP would generally be negligible (Table 4.5-19). The maximum reduction in 70-year average amount of littoral habitat would be 1.2% (13 acres) which would occur during September. Substantial reductions in littoral habitat availability could occur occasionally during individuals years of the March through September period. These occasional changes in the availability of littoral habitat, under the WFP, would suggest that such reductions would not be likely to result in long-term adverse effects on the initial establishment of warmwater fish year-classes.

Table 4.5-19
70-Year Average Number of Acres of Littoral Habitat in Shasta and Trinity Reservoirs for Each Month of the Primary Spawning and Rearing Period for Warmwater Fishes

Month	Reservoir	Avg. Amt. of Littoral Habitat[1] (acres)		Average Relative Change[2] (%)	Average Absolute Change[2] (acres)
		Base	WFP		
March	Shasta	5,319	5,321	0	1
	Trinity	2,927	2,923	-0.1	-4
April	Shasta	6,660	6,664	0.1	3
	Trinity	3,645	3,642	-0.1	-4
May	Shasta	6,904	6,902	0	-2
	Trinity	3,816	3,811	-0.1	-4
June	Shasta	5,848	5,853	0.1	5
	Trinity	3,507	3,499	-0.2	-9
July	Shasta	3,833	3,831	0	-2
	Trinity	2,693	2,680	-0.5	-13
August	Shasta	1,748	1,735	-0.7	-13
	Trinity	1,985	1,976	-0.4	-8.5
September	Shasta	1,090	1,077	-1.2	-13
	Trinity	1,578	1,574	-0.2	-4

[1] Nearshore areas containing flooded terrestrial vegetation (e.g., willows, button brush) and/or submerged aquatic macrophytes that are used by warmwater fishes for spawning and juvenile rearing.
[2] Change under the Water Forum Proposal, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average acreage for each month under the two alternatives.

Source: SWRI, 1998.

Potential for Dewatering Events

Changes in CVP/SWP operations under the WFP could alter the rates by which water surface elevations in Shasta Reservoir change during each month of the primary warmwater fish spawning period of the year (i.e., March through July). Modeling results indicate that the frequency with which potential nest dewatering events could occur in Shasta Reservoir would not change under the WFP, relative to that under the Base Condition, during any month of the March through July spawning period (Table 4.5-20).

Table 4.5-20
Differences in the 70-Year Average Reservoir Surface Elevations and Rates of Elevation Fluctuation in Shasta and Trinity Reservoirs

Month	Reservoir	Average Reservoir Surface Elevation (feet msl)		Average Relative Change (%)	Average Absolute Change (ft msl)	Number of Years with Monthly Elevation Increase ≥ 9 feet	
		Base	WFP			Base	WFP
March	Shasta	1,027	1,027	0	0	2	2
	Trinity	2,323	2,323	0	0	0	0
April	Shasta	1,037	1,037	0	0	3	3
	Trinity	2,334	2,334	0	0	0	0
May	Shasta	1,039	1,039	0	0	6	6
	Trinity	2,336	2,336	0	0.1	5	5
June	Shasta	1,030	1,030	0	-0.1	30	30
	Trinity	2,331	2,330	0	-0.1	21	21
July	Shasta	1,013	1,013	0	0	69	69
	Trinity	2,318	2,317	0	-0.2	62	62

Source: SWRI, 1998.

Impact
4.5-13

Impacts to Trinity Reservoir's Warmwater Fisheries. *Under the WFP, substantial reductions in littoral habitat availability would occur infrequently throughout the March through September period. Similarly, the potential for nest dewatering events to occur in Trinity Reservoir would not change under the WFP during the March through July spawning period. Thus, additional surface water diversions under the WFP would result in less-than-significant impacts to the spawning and initial rearing success of Trinity Reservoir's nest-building, warmwater fishes. Based on these findings, implementation of the WFP would result in* ***less-than-significant*** *impacts to Trinity Reservoir warmwater fisheries.*

Littoral Habitat Availability

The additional diversion demand on the American River system and the Sacramento River under the WFP would not result in substantial changes in the 70-year average end-of-month water surface elevation in Trinity Reservoir during the March through September period (Table 4.5-18). During the March through September period (when warmwater fish spawning and initial rearing occurs), reductions in average end-of- month elevation of greater than 1 ft would occur infrequently during March through June, and occasionally during July through September.

Changes in water surface elevation in Trinity Reservoir during the March through September period would result in corresponding changes in the availability of reservoir littoral habitat containing inundated terrestrial vegetation (e.g., willows and button brush). However, reductions in the 70-year average amount of littoral habitat potentially available to warmwater fishes for spawning and/or rearing in Trinity Reservoir, under the WFP, would be negligible (Table 4.5-19). Substantial reductions in littoral habitat availability would occur infrequently in Trinity Reservoir under the WFP, relative to the Base Condition.

Potential for Nest Dewatering Events

Changes in CVP/SWP operations under the WFP could alter the rates at which water surface elevations in Trinity Reservoir change during each month of the primary warmwater fish spawning period of the year (i.e., March through July). However, modeling results indicate that the frequency with which potential nest dewatering events could occur in Trinity Reservoir under the WFP, relative to that under the Base Condition, would not change during any month of the warmwater fish spawning period of the year (i.e., March through July).

Keswick Reservoir

Impact **4.5-14**

Impacts to Keswick Reservoir Fisheries. *Hydrologic conditions with the WFP would have little, if any, effect on seasonal storage, elevation, and temperature of Keswick Reservoir. Any minor changes in storage, elevation, or temperature that could occur would constitute a* ***less-than-significant*** *impact to Keswick Reservoir fishery resources.*

No storage-, elevation-, or temperature-related impacts to the fishery resources of Keswick Reservoir would be expected to occur because, as a regulating afterbay of Shasta Reservoir, its monthly storage, elevation, and temperature would be expected to remain similar under the WFP to that which currently exists under the Base Condition.

Upper and Lower Sacramento River

Impact **4.5-15**

Flow-Related Impacts to Sacramento River Fisheries. *Flow reductions of more than 20% would not occur during any month under the WFP, relative to the Base Condition. Measurable reductions in the 70-year average flows released from Keswick Dam would not occur during any month of the year. In addition, flows released from Keswick Dam would never be below the 3,250 cfs minimum stipulated in the NMFS Biological Opinion for winter-run chinook salmon during the period October through March under the WFP.*

*These findings indicate that flow changes below Keswick Dam that would occur under the WFP would result in less-than-significant impacts to upper Sacramento River fisheries resources. Under the WFP, substantial reductions in lower Sacramento River Flows at Freeport would occur infrequently during all months of the year. Consequently, any flow-related impacts to lower Sacramento River fisheries or migrating anadromous fishes that could occur under WFP are considered to be less than significant. Overall, this constitutes a **less-than-significant** impact.*

Flow-Related Impacts in the Upper Sacramento River

Under the WFP, reductions of more than 10% in releases from Keswick Dam would occur infrequently throughout the entire year (Appendix I). The 70-year average flow released from Keswick Dam would not be substantially reduced during any month of the year (Table 4.5-21).

Table 4.5-21
70-Year Average Flow Released from Keswick Dam (RM 301) for Each Month of the Year

Month	Mean Monthly Release (cfs)		Average Relative Change[1] (%)	Average Absolute Change[1] (cfs)
	Base	WFP		
October	5,430	5,406	-0.2	-24
November	5,779	5,759	-0.2	-20
December	7,853	7,837	-0.1	-16
January	8,983	8,961	-0.1	-22
February	11,063	11,085	0.3	21
March	9,069	9,075	0.2	6
April	7,360	7,350	-0.1	-10
May	8,590	8,612	0	21
June	11,196	11,185	-0.1	-11
July	12,932	12,968	0.3	36
August	11,831	11,850	0.1	19
September	6,452	6,437	-0.2	-15

[1] Change under the Water Forum Proposal, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average flow values for each month under the two alternatives.

Source: SWRI, 1998.

The minimum flow objective for Keswick Dam release stipulated in the NMFS Biological Opinion for the protection of winter-run chinook salmon rearing and downstream passage is 3,250 cfs between 1 October and 31 March. Modeling output shows that mean monthly flows below Keswick Dam would not be below 3,250 cfs in any month of the October through March period in any of the 70 years modeled under either the WFP or the Base Condition.

In addition to direct effects on physical habitat availability for fish using the river, upper Sacramento River flows influence the ability of Glenn-Colusa Irrigation District (GCID) to divert water at the Hamilton City Pumping Plant (HCPP), and the performance of the fish screen at this diversion facility. Channel geometry, water depth (i.e., wetted screen area), and flow conditions all affect fish screen performance and, therefore, water diversion capability at the HCPP. As part of the HCPP Fish Screen Improvement Project, a gradient facility is planned to be constructed in the main channel of the Sacramento River, adjacent to the oxbow where this diversion facility is currently located. The gradient facility is intended to continuously provide adequate water surface elevations at the fish screen, thereby assuring adequate screen performance over a wide range of flows (e.g., 7,000 cfs to more than 50,000 cfs). Overall, the minor changes in upper Sacramento River flows under the WFP, as indicated by changes in releases from Keswick Dam (see Table 4.5-21; Appendix I), would not adversely affect fish screen performance or the ability of GCID to divert target volumes through the HCPP.

Flow-Related Impacts in the Lower Sacramento River

The 70-year average flow at Freeport under the WFP would be reduced by less than 5%, relative to flows under the Base Condition, during all months (Table 4.5-22). Flow reductions of 1% to 10% would occur regularly in individual years during all months. However, flow reductions of more than 10% would occur infrequently, with no flow reduction of 20% or more occurring during any individual year of any month (Appendix I). Therefore, neither physical habitat availability for fishes residing in the lower Sacramento River nor immigration of adult or emigration of juvenile anadromous fishes would be substantially affected under the WFP, relative to the Base Condition.

Impact 4.5-16

<u>Temperature-Related Impacts to Sacramento River Fisheries Resources.</u> *Hydrologic conditions with the WFP would not result in substantial changes to the 69-year average temperature at Keswick Dam or Bend Bridge for any month of the year. Their would also be no change in the number of years exceeding 56°F at Keswick Dam under the WFP during the April through September period. Conversely, increases in water temperatures would result in temperatures at Bend Bridge to exceed 56°F in one additional year during September. However, there would be no change in winter-run chinook salmon early lifestage survival during this year. In addition, their would be no substantial decreases in annual early lifestage survival of fall-run, late fall-run, winter-run, or spring-run chinook salmon in any individual year under the WFP, relative to that under the Base Condition. Therefore, the temperature changes that would occur would not be expected to result in substantial adverse impacts to chinook salmon, or other fish species using the upper Sacramento River. Temperatures in the lower Sacramento River would not be expected to change substantially under the WFP. The number of years that mean monthly temperatures at this location would exceed 56°F, 60°F, and 70°F would be similar under the WFP and the Base Condition during the period March through November. Thus, potential impacts to fish species within the lower Sacramento River would be considered less than significant. Overall, this would be considered a* ***less-than-significant*** *impact.*

Table 4.5-22 70-Year Average Flow at Freeport (RM 46) During Each Month of the Year				
Month	Mean Monthly Flow at Freeport (cfs)		Average Relative Change[1] (%)	Average Absolute Change[1] (cfs)
	Base	WFP		
October	11,981	11,840	-1.2	-142
November	15,776	15,541	-1.3	-235
December	25,015	24,845	-0.8	-170
January	31,682	31,546	-0.4	-136
February	37,837	37,681	-0.5	-155
March	33,418	33,258	-0.5	-160
April	23,643	23,468	-1.1	-176
May	19,243	19,029	-1.3	-214
June	17,950	17,632	-1.8	-318
July	14,517	14,025	-3.4	-492
August	15,220	14,911	-2.2	-309
September	14,336	14,080	-1.8	-256

[1] Change under the Water Forum Agreement, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average flow values for each month under the two alternatives.

Source: SWRI, 1998

Temperature-Related Impacts in the Upper Sacramento River

The 69-year average water temperatures below Keswick Dam under the WFP would not change substantially, compared to the Base Condition, for any month of the year (Table 4.5-23). Under the WFP, 69-year average temperatures at Keswick Dam would remain well below 56°F during all months of the year.

An assessment of the 69 individual years modeled indicates that, with the exception of one year in March, mean monthly temperatures below Keswick Dam during the December through July period would be 56°F or lower in all 69 years modeled under WFP (Appendix I).

Under the WFP, mean monthly temperatures at Keswick Dam would not exceed the 56°F threshold stipulated in the NMFS Biological Opinion for winter-run chinook salmon in any additional years of the July through September period. In addition, under the WFP, the 56°F threshold would be exceeded in only 1 additional year (1% more often) in October and in no additional years in November, relative to that under the Base Condition. Mean monthly temperatures under WFP would be below 60°F during all years during November. Finally, mean October temperatures at Keswick Dam would not exceed the 60°F threshold stipulated for this month in the NMFS Biological Opinion for winter-run chinook salmon in any additional years under the WFP, relative to the Base Condition (Table 4.5-23).

Table 4.5-23
69-Year Average Water Temperatures at Keswick Dam (RM 301) for Each Month of the Year

Month	Mean Monthly Water Temperature (°F)		Average Relative Change[1] (%)	Average Absolute Change[1] (°F)
	Base	WFP		
October	51.7	51.7	0	0
November	52.0	52.1	0.1	0
December	49.0	49.0	0	0
January	45.4	45.4	0	0
February	47.7	47.7	0	0
March	51.3	51.3	0	0
April	51.0	51.0	0	0
May	48.2	48.2	0	0
June	48.1	48.1	0	0
July	49.0	49.0	0	0
August	50.7	50.7	0	0
September	50.0	49.9	-0.1	0

[1] Change under the Water Forum Proposal, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average temperature values for each month under the two alternatives.

Source: SWRI, 1998.

Mean monthly temperatures for the Sacramento River at Bend Bridge (RM 241) would generally exceed the 56°F and 60°F thresholds as frequently under the WFP, relative to that under the Base Condition (Table 4.5-24). With the exception of one year in March and two years in November, mean monthly water temperatures at Bend Bridge would be at or below 56°F under the WFP in all years during the November through March period. Mean monthly temperatures at Bend Bridge would exceed the 56°F threshold stipulated in the NMFS Biological Opinion for winter-run chinook salmon in 1 less year (1% less often) in April, June and October, and 1 additional year (1% more often) in September, with no change in the number of years exceeding 56°F in May, July, and August (Appendix I). There would be no change in the number of years mean October water temperatures at Bend Bridge would exceed the 60°F threshold under the WFP, relative to that under the Base Condition (Table 4.5-24).

Hydrologic conditions with the WFP would not substantially change the 69-year average early lifestage survival for the fall-, late fall-, spring-, and winter-runs of Sacramento River chinook salmon. Substantial decreases in annual early lifestage survival would not occur under the WFP, relative to annual survival estimates under the Base Condition, in any year for any of the four runs of chinook salmon. Substantial increases in annual survival would potentially occur in one year for spring-run, but would not be expected to occur in any year for fall-, late fall, and winter-run (Appendix I). Finally, based on the findings discussed above for chinook salmon and the timing of steelhead spawning, any temperature-related impacts to upper Sacramento River under the WFP would be less than significant.

Table 4.5-24
Number of Years Exceeding Specified Temperature Thresholds at Keswick Dam (RM 301) and Bend Bridge (RM 241)

Month	56°F				60°F			
	Keswick Dam		Bend Bridge		Keswick Dam		Bend Bridge	
	Base	WFP	Base	WFP	Base	WFP	Base Cond.	WFP
Oct	9 (59.8)[1]	10 (59.3)	18 (58.3)	17 (58.4)	5 (61.4)	5 (61.1)	5 (61.0)	5 (60.9)
Nov	5 (57.4)	5 (57.4)	2 (56.8)	2 (56.8)	0	0	0	0
Dec	0	0	0	0	0	0	0	0
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	1 (57.5)	1 (57.5)	1 (57.1)	1 (57.1)	0	0	0	0
Apr	0	0	5 (56.3)	4 (56.3)	0	0	0	0
May	0	0	12 (57.3)	12 (57.4)	0	0	0	0
Jun	0	0	7 (56.9)	6 (57.0)	0	0	0	0
Jul	0	0	10 (57.4)	10 (57.4)	0	0	0	0
Aug	4 (59.5)	4 (59.3)	17 (58.5)	17 (58.4)	1 (63.9)	1 (62.8)	4 (63.5)	4 (63.3)
Sep	6 (62.5)	6 (62.2)	19 (59.6)	20 (59.4)	4 (64.8)	4 (64.9)	6 (64.5)	6 (64.3)

[1] The mean water temperature for years exceeding each threshold is provided in parentheses.

Source: SWRI, 1998.

Temperature -Related Impacts in the Lower Sacramento River

Lower river temperatures are generally not of concern with regard to thermal stress to salmonids except during the June through September period. Recent monitoring of salmonid emigration past Knight's Landing and from the Lower American River shows that late-emigrating juvenile fall-run chinook salmon are passing through the lower Sacramento River in June (CDFG 1995, 1996, 1997; B. Snider, CDFG, pers. comm., 1997). Moreover, emigrating juveniles of late-fall-run, spring-run, and winter-run chinook salmon and steelhead are occasionally found in the lower Sacramento River during one or more months of the June through September period (B. Snider, CDFG, pers. comm., 1997).

Under the WFP, there would be no substantial change in the 69-year average water temperatures at Freeport (RM 46) for all months of the year (Table 4.5-25). Thus, during the June through September period, temperatures under the WFP would essentially be equivalent to those under the Base Condition.

Table 4.5-25
69-Year Average Water Temperatures at Freeport (RM 46) for Each Month of the Year

Month	Mean Monthly Water Temperature		Average Relative Change[3] (%)	Average Absolute Change[3] (°F)
	Base	WFP		
October	60.6	60.5	-0.2	-0.1
November	52.6	52.5	-0.2	-0.1
December	46.1	46.0	-0.1	0
January	44.8	44.8	0	0
February	49.2	49.3	0	0
March	54.0	54.0	0	0
April	59.9	59.9	0.1	0.1
May	65.4	65.5	0.1	0.1
June	69.8	69.8	0	0
July	73.0	73.0	0	0
August	71.8	71.7	0	0
September	68.3	68.3	-0.1	-0.1

[1] Change under the Water Forum Agreement, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average temperature values for each month under the two alternatives.

Source: SWRI, 1998.

Mean monthly river temperatures under WFP would remain below 56°F at Freeport in all years during the period December through February (Appendix I). The number of years that mean monthly temperatures at this location would exceed 56°F, 60°F, and 70°F would be similar under the WFP and the Base Condition during the period March through November (Table 4.5-26). For example, mean monthly river temperatures at Freeport would exceed the 70°F threshold under WFP, relative to that under the Base Condition, in no additional years during July and September, in 1 less year (1% less often) in May and August, and 1 additional year in June (Table 4.5-26; Appendix I). Temperature probability plots further demonstrate that temperatures at Freeport would generally be similar to those under the WFP during all months of the year.

Delta

Impact 4.5-17

Delta Fish Populations. *Under the WFP, substantial reductions in Delta outflow would occur infrequently during the February through June period. Likewise, under the WFP, substantial upstream shifts in the mean monthly position of X2 also would occur infrequently during this period. Finally, Delta export to inflow ratios under the WFP would not exceed the maximum export limits for either the February through June (35% of Delta inflow) or the July through January periods (65% of Delta inflow). Overall this is considered to be a* ***less-than-significant*** *impact to Delta fish populations.*

Table 4.5-26
Number of Years of the 69 Years Modeled That Water Temperatures at Freeport (RM 46) Would Exceed Specified Temperature Thresholds

Month	56°F		60°F		65°F		70°F	
	Base	WFP	Base	WFP	Base	WFP	Base	WFP
Oct	69 (60.6)	69 (60.5)	38 (61.9)	38 (61.8)	1 (65.2)	1 (65.2)	0	0
Nov	1 (56.4)	1 (56.4)	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	10 (57.2)	10 (57.2)	0	0	0	0	0	0
April	66 (60.1)	66 (60.2)	33 (61.9)	35 (61.9)	0	0	0	0
May	69 (65.4)	69 (65.5)	69 (65.4)	69 (65.5)	39 (66.9)	41 (66.8)	2 (70.4)	1 (70.8)
June	69 (69.8)	69 (69.8)	69 (69.8)	69 (69.8)	69 (69.8)	69 (69.8)	33 (71.4)	34 (71.4)
July	69 (73.0)	69 (73.0)	69 (73.0)	69 (73.0)	69 (73.0)	69 (73.0)	68 (73.0)	68 (73.0)
Aug	69 (71.8)	69 (71.7)	69 (71.8)	69 (71.7)	69 (71.8)	69 (71.7)	56 (72.3)	55 (72.3)
Sep	69 (68.3)	69 (68.3)	69 (68.3)	69 (68.3)	67 (68.5)	66 (68.5)	8 (70.7)	8 (70.8)

[1] Value in parentheses represents the mean water temperatures for the years exceeding the specified threshold.

Source: SWRI, 1998.

During the period September through March, reductions in the 70-year average Delta outflow of approximately 0 - 1.1% could occur under the WFP, relative to the Base Condition. Reductions in 70-year average Delta outflow of about 1.1% (85 cfs) would occur during September, with flow reductions being less than 1.0% during all other months (Table 4.5-27).

Delta outflow has been shown to have a substantial effect on a number of fish species relying on Delta habitats for one or more of their life stages. With regard to Delta outflow, the period February through June is believed to be of greatest concern for potential effects to spawning and rearing habitat and downstream transport flows for delta smelt, longfin smelt, splittail, striped bass, salmonids, and other aquatic species in the Delta.

Reductions in Delta outflow of more than 10% under the WFP, relative to the Base Condition, would occur in only one year during March (1% of the time). Flow reductions would be less than 10% in all years during February and April through June (Appendix I).

Table 4.5-27
70-Year Average Delta Outflow (cfs) for Each Month of the Year

Month	Mean Monthly Delta Outflow (cfs)		Average Relative Change[1] (%)	Average Absolute Change[1] (cfs)
	Base	WFP		
October	6,034	6,011	0	-23
November	10,230	10,081	-0.9	-149
December	22,975	22,856	-0.3	-119
January	38,276	38,152	-0.2	-124
February	50,838	50,751	-0.2	-87
March	43,610	43,571	0	-39
April	29,320	29,243	-0.3	-77
May	21,165	21,061	-0.5	-105
June	12,356	12,266	-0.5	-90
July	6,933	6,891	-0.5	-43
August	6,183	6,117	-0.9	-66
September	5,947	5,862	-1.1	-85

1 Change under the Water Forum Agreement, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average flow values for each month under the two alternatives.

Source: SWRI, 1998.

Under the WFP, the greatest upstream shifts in the 70-year average position of X2, relative to its mean monthly position under the Base Condition, would be 0.1 km (Table 4.5-28; Appendix I).

During the February through June period considered important for providing appropriate spawning and rearing conditions and downstream transport flows for various fish species upstream shifts in the position of X2 of more than 1 km would not occur in any year (Appendix I).

In addition, it should be noted that the model simulations conducted for the WFP included conformance with X2 requirements set forth in the SWRCB Interim Water Quality Control Plans, as well as DOI's Final Administrative Proposal for the Management of 3406(b)(2) Water.

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Modeling output also showed that the Delta export to inflow ratios under the WFP would not exceed the maximum export limits for either the February through June (35% of Delta inflow) or the July through January period (65% of Delta inflow) as set by the SWRCB Interim Water Quality Control Plan.

Table 4.5-28
70-Year Average Monthly X2 Position in KM From the Golden Gate Bridge for Each Month of the Year

Month	Mean Monthly X2 Position (km)		Average Relative Change[1] (%)	Average Absolute Change[1] (km)
	Base	WFP		
October	83.5	83.6	0	0
November	81.1	81.2	0.1	0.1
December	76.0	76.0	0.1	0.1
January	70.5	70.6	0.1	0
February	65.5	65.6	0.1	0
March	64.5	64.5	0	0
April	67.1	67.1	0	0
May	69.8	69.9	0.1	0
June	74.5	74.5	0.1	0.1
July	79.3	79.3	0.1	0.1
August	81.7	81.8	0.1	0.1
September	82.9	83.0	0.2	0.1

[1] Change under the Water Forum Proposal, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average X2 values for each month under the two alternatives.

Note: Positive differences represent movement of X2 upstream.

Source: SWRI, 1998.

4.5.4 MITIGATION MEASURES

As previously discussed, the Water Forum Habitat Management Program will be implemented as one of 7 elements of the WFP. This Program will be part of a multi-agency effort to manage and enhance Lower American River fisheries, recreation, and riparian habitats. Additiond participating agencies could include SAFCA, CALFED, USFWS, USBR, Sacramento County, CDFG, NMFS, and Corps. Water Forum participants have made commitments (see Appendix B) to fund, in part, the implementation of this Program. The Water Forum Successor Effort will recommend that this Program be implemented in order to facilitate meeting the co-equal objectives of the Water Forum. By implementing numerous restoration actions (see Appendix B) over the life of the Agreement, this Program would not only minimize potential impacts to

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fisheries resources and recreation due to the WFP, but also would provide additional environmental benefits. The order that individual actions would be implemented will be based on their prioritization, relative to other actions identified under the Program, with implementation occurring as funding becomes available.

In order to comply with CEQA guidelines, specific actions under the Habitat Management Program have been identified that, if implemented, would reduce the relative magnitude and/or frequency of potential impacts to fisheries resources identified in section 4.5.3. These mitigation measures are discussed below.

No mitigation measures are necessary for the following less-than-significant impacts:

- 4.5-1: Impacts to Folsom Reservoir's Coldwater Fisheries
- 4.5-3: Impacts to the Warmwater and Coldwater Fisheries of Lake Natoma
- 4.5-4: Temperature Impacts to Nimbus Fishery Hatchery Operations and Fish Production
- 4.5-6: Lower American River Steelhead
- 4.5-8: Flow- and Temperature-related Impacts to American Shad (May and June)
- 4.5-9: Flow- and Temperature-related Impacts to the Striped Bass Fishery (May and June)
- 4.5-10: Impacts to Shasta Reservoir ' s Coldwater Fisheries
- 4.5-11: Impacts to Trinity Reservoir ' s Coldwater Fisheries
- 4.5-12: Impacts to Shasta Reservoir ' s Warmwater Fisheries
- 4.5-13: Impacts to Trinity Reservoir ' s Warmwater Fisheries
- 4.5-14: Impacts to Keswick Reservoir Fisheries
- 4.5-15: Flow-Related Impacts to Sacramento River Fisheries Resources
- 4.5-16: Temperature-related Impacts to Sacramento River Fisheries
- 4.5-17: Impacts to Delta Fish Populations

Mitigation measures are provided for the following significant impacts:

Impacts to Folsom Reservoir ' s Warmwater Fisheries.

impact **4.5-2** mitigation

Enhance spawning and rearing conditions for warmwater fish. *Encourage establishment of perennial and seasonal vegetation at lower reservoir elevations, place artificial habitat structures in the reservoir at various elevations to compensate for the loss of natural littoral structure (e.g., inundated willows) and minimize reservoir elevation fluctuations that may flood or dewater warmwater fish nests.*

Description

Through plantings and related activities, encourage existing willow and other terrestrial vegetative communities to become established at lower reservoir elevations. Doing so would provide greater availability of physical structure for warmwater fish spawning and rearing in the future when spring reservoir elevations are lower than under current conditions.

Artificial habitat structures (e.g., artificial synthetic structures, submerged brush and debris, fish cribs, etc.) would provide structure in littoral habitats used by warmwater fishes for spawning and early lifestage rearing. Because the majority of the reservoir ' s warmwater fishes spawn in shallow water habitats (i.e., generally less than 10 feet deep), artificial structures would be placed at reservoir elevations that would likely be used by these fishes for spawning and rearing. The location and number of artificial structures placed within the reservoir would increase in proportion to the loss of littoral habitat over time. Implementing habitat structures would help minimize the effects to Folsom Reservoir ' s warmwater fisheries that would be expected to result from increased diversions and resultant reduced water surface elevations in Folsom Reservoir.

While acknowledging operational constraints due to flood control, power production and diversions, work cooperatively with USBR operators to minimize the frequency with which reservoir elevation changes potentially resulting in nest flooding/dewatering events would occur. Monthly/weekly rates of reservoir elevation change will be documented. This information will be compared to timing and average depth of spawning for key nest-building warmwater species in Folsom Reservoir to estimate probabilities of nest flooding/dewatering events.

This measure will be implemented to the degree reasonable and feasible based on its integration into the Habitat Management Program.

Performance Criteria

Place artificial structures in the reservoir to compensate for loss of littoral habitats containing natural structure (e.g., inundated willows). The abundance of representative warmwater species will be monitored periodically through creel surveys and/or through catch-per-unit effort (CPUE) rates for tournament anglers to determine the extent to which warmwater fish utilize the structures. The extent to which this mitigation is to be implemented will be based on the results of these surveys. Frequency and timing of potential nest flooding/dewatering events that facilitate meeting current and future warmwater fish management goals will be determined by CDFG reservoir biologists. More specific performance criteria will be developed in the Habitat Management Program Plan.

Timing

All three activities described above would, to the degree reasonable and feasible, be implemented, monitored, and maintained throughout the effective period of the Water Forum Agreement.

Flow-Related Impacts to Lower American Chinook Salmon.

impact
4.5-5
mitigation

Dry Year Flow Augmentation, Wetland/Slough Complex Restoration/Maintenance, Instream Cover (Woody Debris), Shaded Riverine Aquatic Habitat Project/ Management, and Spawning Habitat Management Components of the Habitat Management Program. *Dry year flow augmentation would be implemented to increase Lower American River flows and potentially minimize flow-related impacts to chinook salmon, particularly during the spawning period during years when impacts would occur. In addition, flow-related impacts could be off-set by improving rearing conditions within the river for fry and juvenile chinook salmon. Improved rearing conditions would contribute to increasing overall chinook salmon production annually. Management of spawning habitat* *for chinook salmon could also contribute annual production. This could be accomplished through implementation of year-round flow-fluctuation criteria, wetland/slough complex restoration/maintenance, instream woody debris, and shaded riverine aquatic habitat protection/management actions of the HMP.*

Description *As identified above, the following actions would be implemented as part of the HMP, which will be adopted as an integral component of the Water Forum Agreement.*

a) Dry Year Flow Augmentation. The Water Forum Successor Effort and the USBR would work together with Placer County Water Agency (PCWA) and the USFWS to augment Lower American River flows, particularly during the spawning period during years when impacts would occur. This measure would be implemented (within the constraints of water availability) during dry and critically dry years. The primary source of water for augmenting flows would be the purchase of American River water from upstream reservoirs operated by PCWA.

b) Flow Fluctuation Criteria. Develop and implement flow fluctuation (i.e., ramping) criteria for the operation of Folsom and Nimbus dams that would reduce the frequency with which rapid flow fluctuations occur in the river. Reducing the occurrence of large, rapid flow reductions would help to minimize losses of chinook salmon due to redd dewatering (fall and winter) and fry and juvenile stranding (winter and spring), especially during periods of low flow. Flow fluctuation criteria would contribute to improving spawning and incubation success, which, in turn, would lead to an overall increase in annual production of chinook salmon. This action would off-set, in part, potential flow-related impacts to chinook salmon.

c) Wetland/Slough Complex Restoration/Maintenance. Restore wetland/slough complexes occurring within habitat transitional zones between river channels, shoreline, and upland habitats. Restoration would involve grading areas for the appropriate elevations and hydrology, as well as planting appropriate vegetation, to achieve desired habitat characteristics. Because wetland/slough complexes are used by juvenile chinook salmon for rearing prior to emigration, restoration and maintenance of these complexes would increase the quantity, and possibly the quality, of rearing habitat available to juvenile chinook salmon. Thus, this action could improve juvenile rearing success prior to emigration, thereby contributing to an overall increase in annual production of chinook salmon. This action would off-set, in part, potential temperature-related impacts to juvenile steelhead.

d) Instream Cover (woody debris). Most large woody debris has been, and continues to be, removed from the Lower American River by the U.S. Army Corps of Engineers to reduce potential hazards to recreationists. Discontinuation of this action in select reaches of the river would allow woody debris to accumulate. Instream woody cover is important for juvenile chinook salmon rearing as it provides structure that can be utilized to escape fish and avian predators. It also provides microhabitats with reduced current velocities where juvenile chinook salmon can feed more effectively. Increasing the amount of instream woody debris at specific sites could improve juvenile rearing success prior to emigration, thereby contributing to an overall increase in annual production. This action would off-set, in part, potential flow-related impacts to juvenile chinook salmon.

e) Shaded Riverine Aquatic Habitat Protection/Management. SRA habitat can be restored along the Lower American River by constructing terraces along shorelines and planting terraces with appropriate herbaceous and woody vegetation. SRA habitat provides feeding and holding areas, escape cover, and local temperature refugia for juvenile chinook salmon. Development and implementation of a shaded riverine aquatic habitat protection/management program would facilitate improving rearing habitat. Thus, protecting and restoring SRA habitat could improve juvenile rearing success, thereby contributing to an overall increase in annual production. This action would off-set, in part, potential flow-related impacts to juvenile chinook salmon.

f) Spawning Habitat Management/Maintenance. Improve spawning habitat in the Lower American River by breaking up and redistributing coarse subsurface deposits and reducing compaction and embeddedness which reduces gravel permeability. Development and implementation of a gravel management program for the Lower American River would facilitate improving spawning habitat for chinook salmon and reducing the deterioration of existing spawning gravel. This habitat improvement would be expected to increase the amount of available spawning habitat, thereby contributing to higher overall spawning and incubation success, and therefore chinook salmon production, annually. This action would off-set, in part, flow-related impacts to juvenile chinook salmon.

Performance Criteria

a) Dry Year Flow Augmentation. Increase flows particularly during the period during dry and critically dry years to the maximum extent feasible, relative to non-augmented conditions. To assess whether flow augmentation is reducing flow-related impacts, flows would be monitored in the Lower American River.

b) Flow Fluctuation Criteria. Reduce the frequency of large, rapid flow-reduction events throughout the year, particularly during the fall spawning and incubation period.

c) Wetland/Slough Complex Restoration/Maintenance. Increase the amount of wetland/slough complex habitat in the Lower American River that is used by early life stages of chinook salmon for rearing prior to emigration.

d) Instream Cover (woody debris). Increase the amount of woody debris within areas of the Lower American River channel that is used by early life stages of chinook salmon for rearing prior to emigration.

e) Shaded Riverine Aquatic Habitat Protection/Management. Protect existing, and increase to the extent feasible, the amount of shaded riverine aquatic habitat within the Lower American River.

f) Spawning Habitat Management. Restore armored gravels to conditions that will encourage chinook salmon to use restored areas for spawning.

Timing

a) Dry Year Flow Augmentation. Flow augmentation would occur during the spawning period October through December, during dry and critically dry years. This measure would be implemented, as necessary, throughout the effective period of the Water Forum Agreement.

b) Flow Fluctuation Criteria. Flow fluctuation criteria would be developed and implemented for the effective period of the Water Forum Agreement.

c) Wetland/Slough Complex Restoration/Maintenance. Wetland/Slough complex restoration/management would be conducted throughout the effective period of the Water Forum Agreement, as warranted by the success of initial projects to be initiated during the first two years of the Agreement.

d) Instream Cover (woody debris). Instream cover (woody debris) would be allowed to accumulate in the Lower American River throughout the effective period of the Water Forum Agreement.

e) Shaded Riverine Aquatic Habitat Protection/Management. Shaded riverine aquatic habitat protection/management would be conducted throughout the effective period of the Water Forum Agreement, as warranted by the success of initial projects to be implemented within the first two years of the Agreement.

f) Spawning Habitat Management. Spawning habitat management would be conducted throughout the effective period of the Water Forum Agreement.

Flow- and Temperature-Related Impacts to Splittail (February through May)

impact
4.5-7
mitigation

Flow Fluctuation Criteria, Wetland/Slough Complex Restoration/Maintenance, and Shaded Riverine Aquatic Habitat Management Components of the Habitat Management Program. *Wetland/slough complex restoration/ maintenance and shaded riverine aquatic (SRA) habitat management would be implemented to minimize the effect of project-related flow reductions on Lower American River splittail spawning and rearing. In addition, such impacts could be additionally off-set by reducing the likelihood of splittail losses due to fry and juvenile stranding caused by rapid flow fluctuations. Reducing such losses would increase overall annual production of splittail in the Lower American River. This could be accomplished by implementing the flow fluctuation criteria action of the HMP.*

Description *As identified above, the following actions would be implemented as part of the HMP, which will be adopted as an integral component of the Water Forum Agreement.*

a) Wetland/Slough Complex Restoration/Maintenance. Restore wetland/slough complexes occurring within habitat transitional zones between river channels, shoreline, and upland habitats. Restoration would involve grading areas for the appropriate elevations and hydrology, as well as planting appropriate vegetation, to achieve desired habitat characteristics. Because wetland/slough complexes are used by splittail for spawning, restoration and maintenance of these complexes would increase the quantity, and possibly the quality, of spawning habitat available to splittail. Wetland/slough complex restoration/maintenance would reduce flow-related impacts to splittail spawning.

b) Shaded Riverine Aquatic Habitat Protection/Management. SRA habitat can be restored along the Lower American River by constructing terraces along shorelines and planting *terraces with appropriate herbaceous and woody vegetation. SRA habitat provides spawning and rearing areas for splittail. Development and implementation of a shaded riverine aquatic habitat protection/management program would facilitate increasing splittail spawning and rearing habitat availability within the Lower American River. Thus, protecting and restoring SRA habitat could improve splittail spawning and juvenile rearing success, thereby contributing to an overall increase in annual production of splittail. This action would off-set, in part, potential flow-related impacts to splittail.*

c) Flow Fluctuation Criteria. Develop and implement flow fluctuation (i.e., ramping) criteria for the operation of Folsom and Nimbus dams that would reduce the frequency with which rapid flow fluctuations occur in the river. Reducing the occurrence of large, rapid flow reductions would help to minimize losses of splittail due to fry and juvenile stranding during the February through May period. Flow fluctuation criteria would contribute to improving early life-stage rearing success, thereby contributing to an overall increase in annual production of splittail. This action would off-set, in part, potential flow-related impacts to splittail.

Performance Criteria

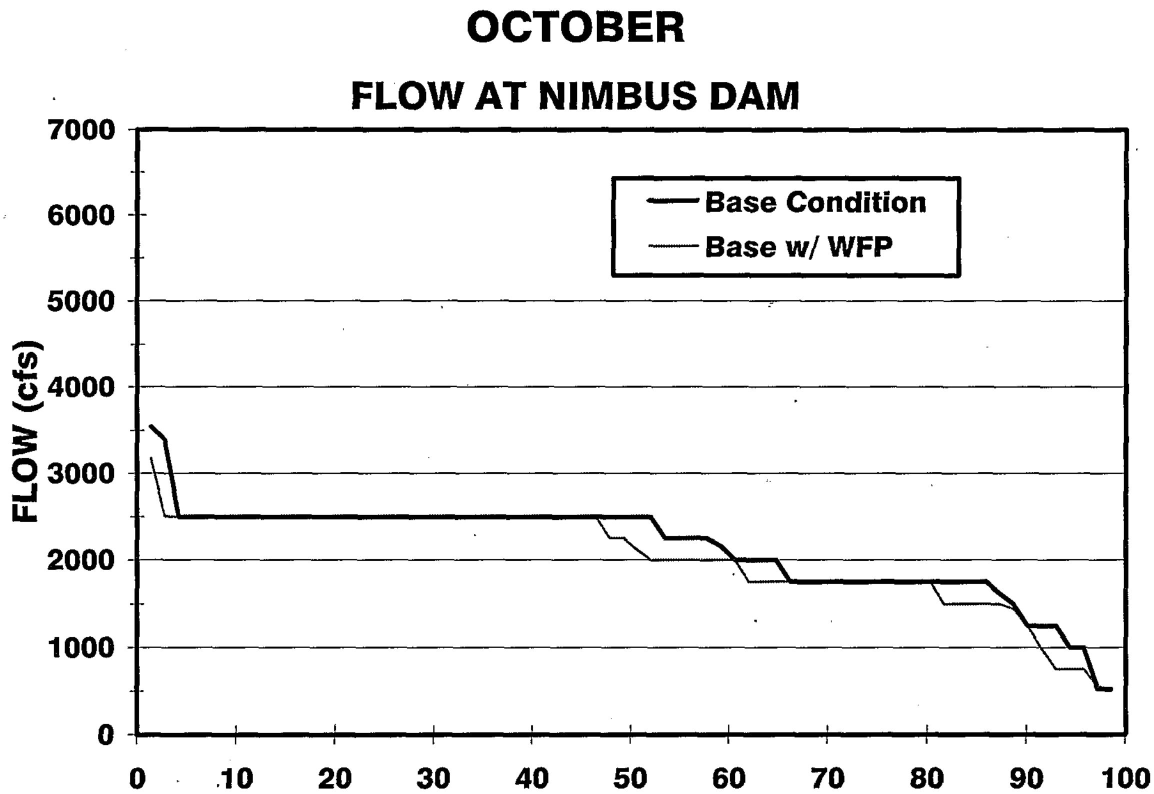
a) Wetland/Slough Complex Restoration/Maintenance. Increase the amount of wetland/slough complex habitat in the Lower American River that is used by splittail for spawning and rearing.

b) Shaded Riverine Aquatic Habitat Protection/Management. Protect existing, and increase to the extent feasible, the amount of shaded riverine aquatic habitat within the Lower American River.

c) Flow Fluctuation Criteria. Develop and implement flow fluctuation (i.e., ramping) criteria for the operation of Folsom and Nimbus dams that would reduce the frequency with which rapid flow fluctuations occur in the river. Reducing the occurrence of large, rapid flow reductions would help to minimize losses of splittail due to fry and juvenile stranding during the February through May period. Flow fluctuation criteria would contribute to improving early life-stage rearing success, thereby contributing to an overall increase in annual production of splittail. This action would off-set, in part, potential flow-related impacts to splittail.

4.5.5 LEVEL OF SIGNIFICANCE AFTER MITIGATION

Because of the scientific uncertainty associated with whether the mitigation measures introduced would fully mitigate for the impacts identified, and/or because of the uncertainty associated with their implementation, all impacts would remain potentially significant.



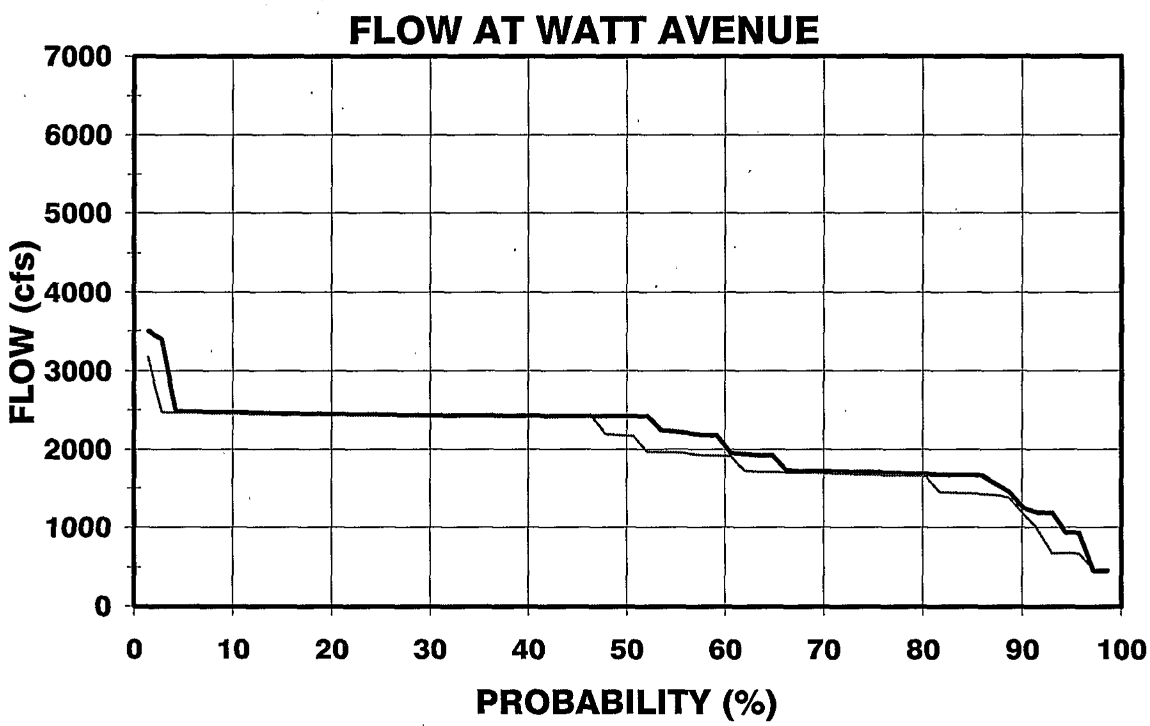


Figure 4.5-1. Probability that mean October flow in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

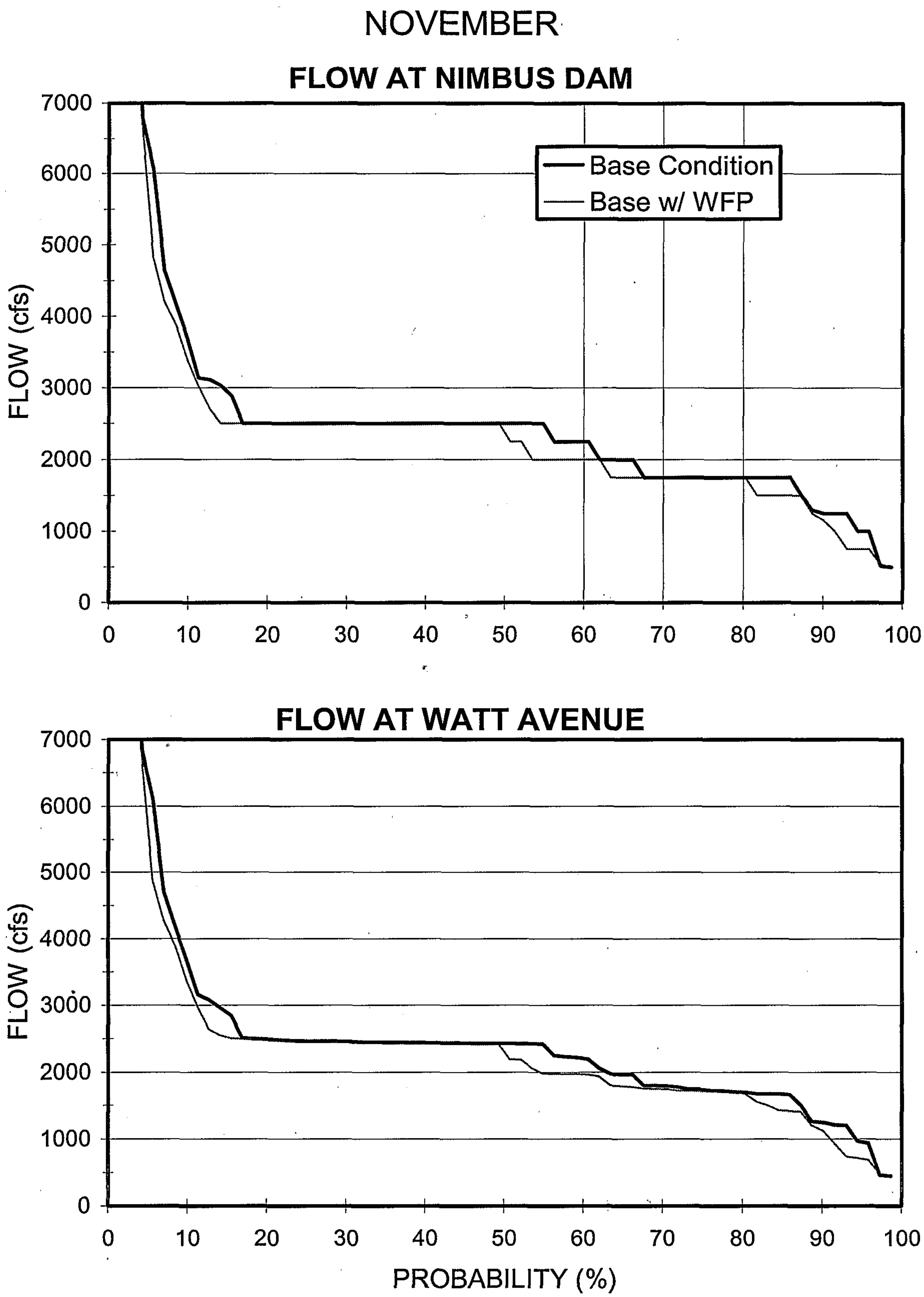


Figure 4.5-2. Probability that mean November flow in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

DECEMBER

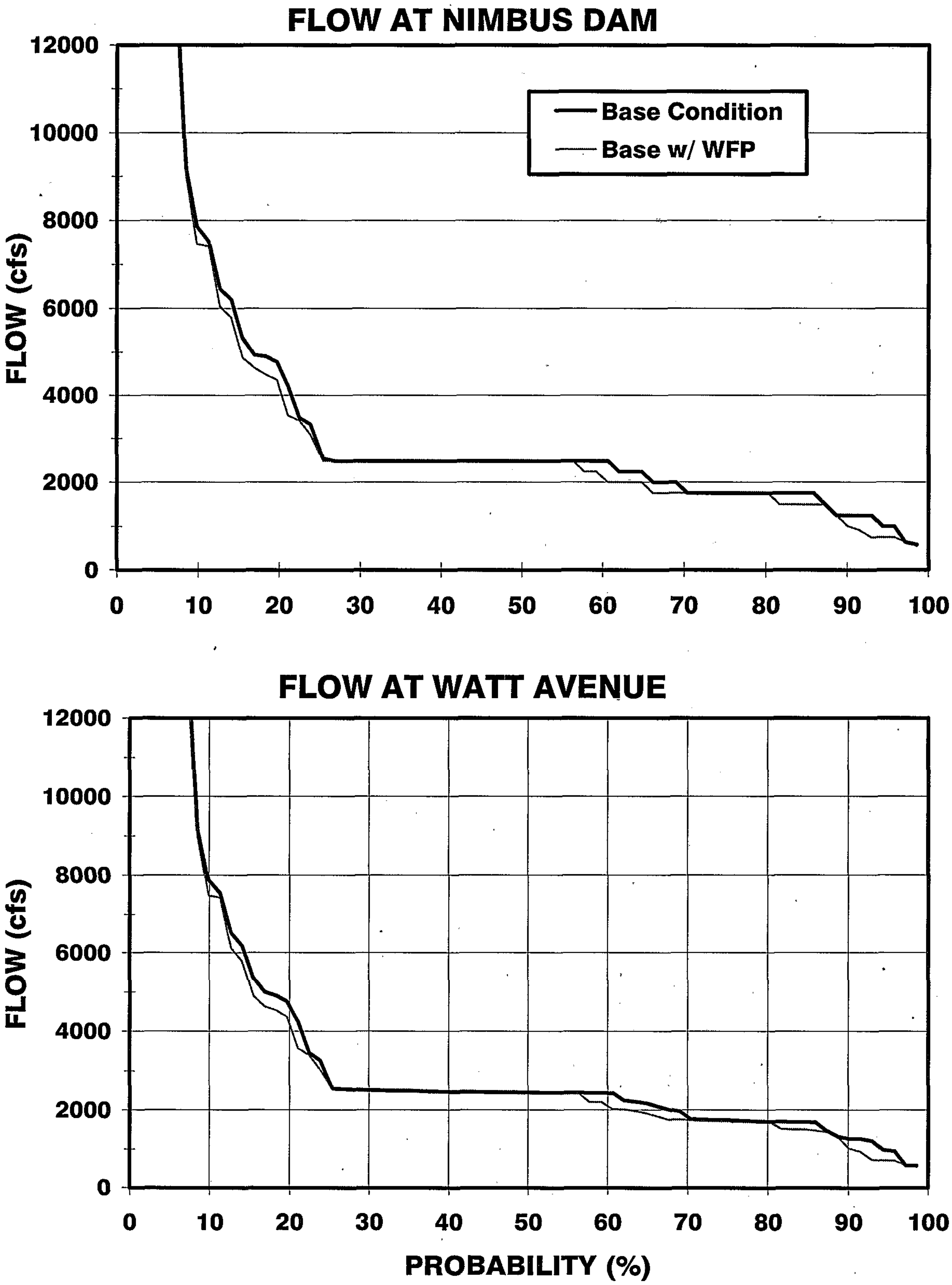


Figure 4.5-3. Probability that mean December flow in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

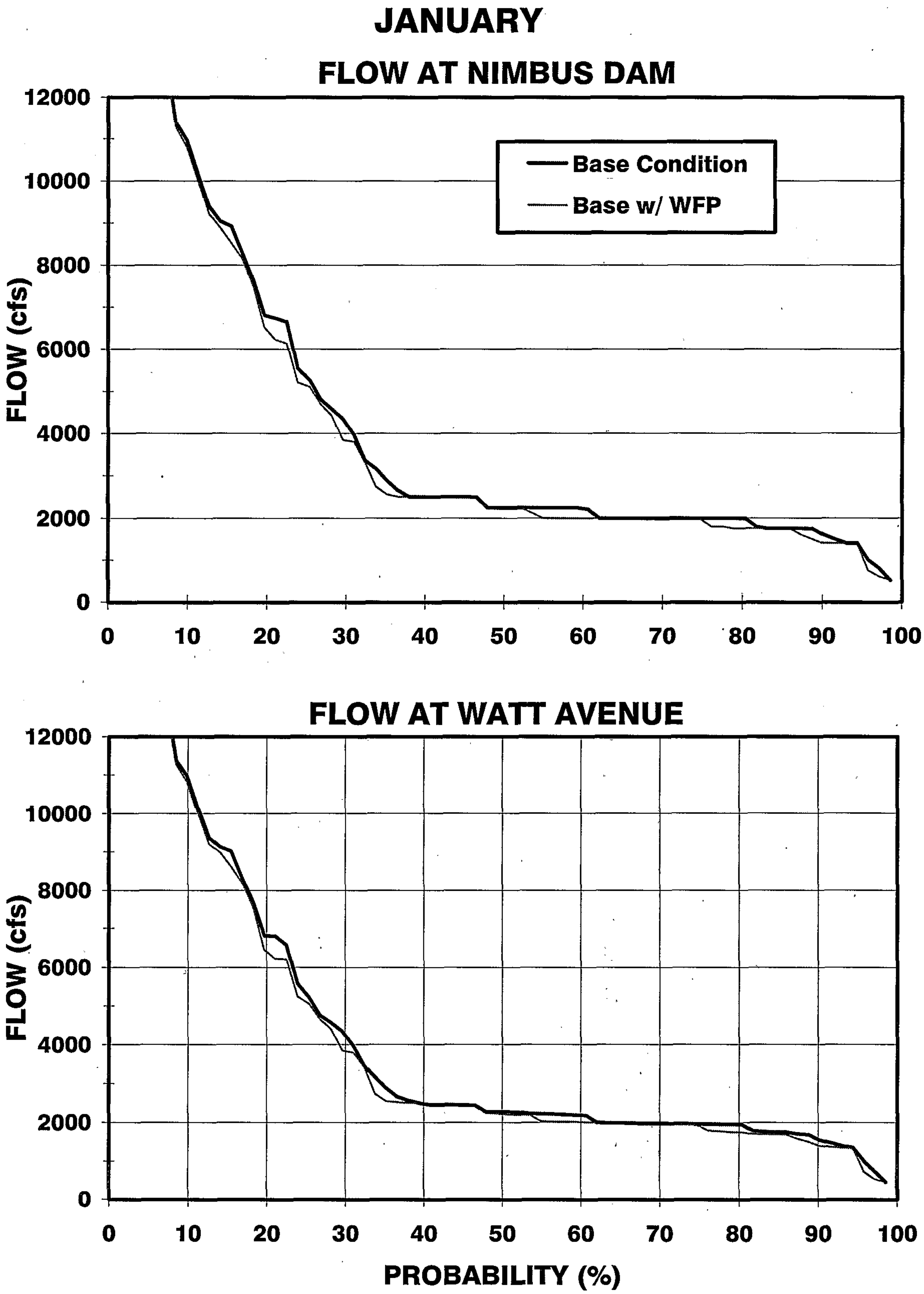


Figure 4.5-4. Probability that mean January flow in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

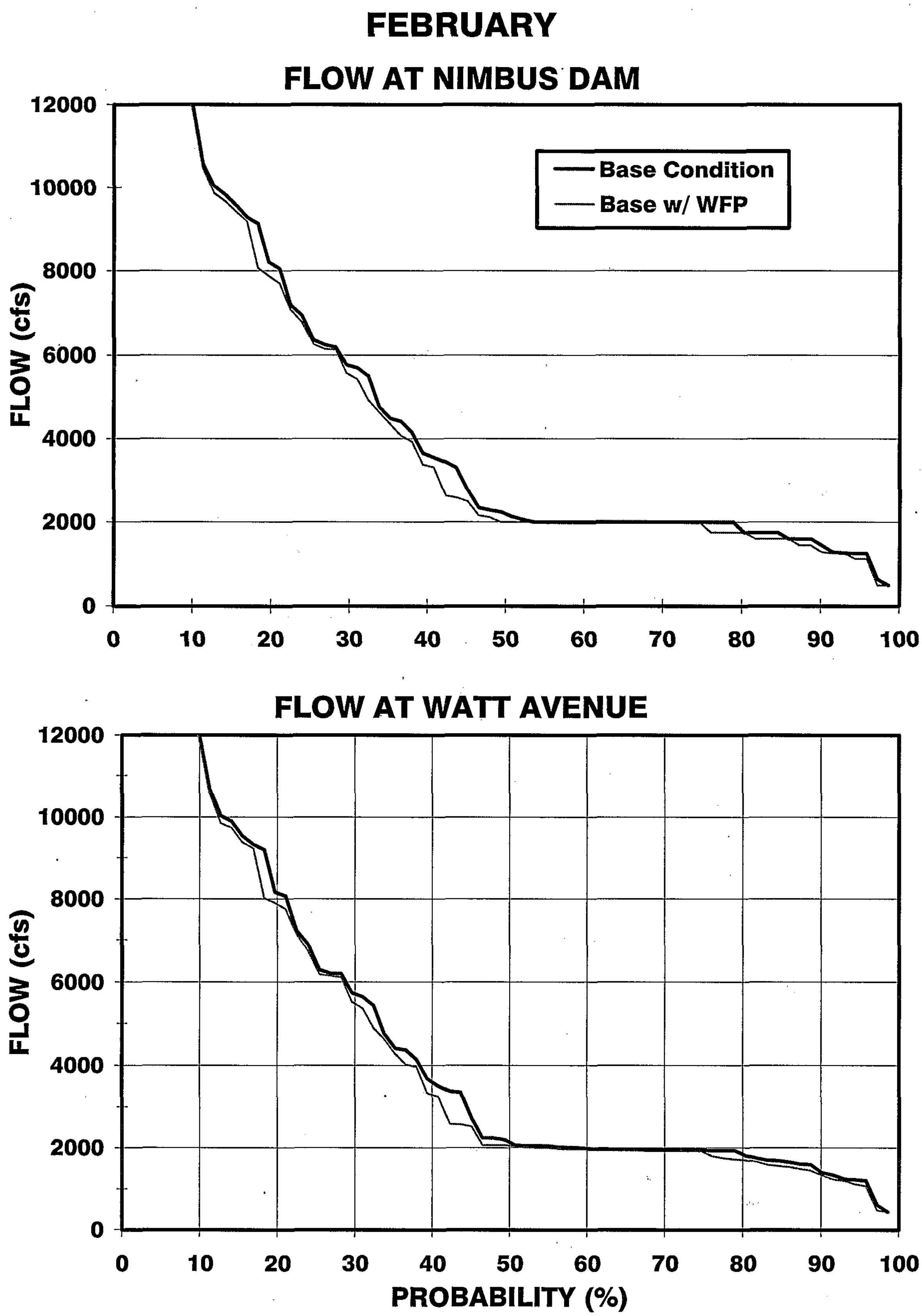


Figure 4.5-5. Probability that mean February flow in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

OCTOBER

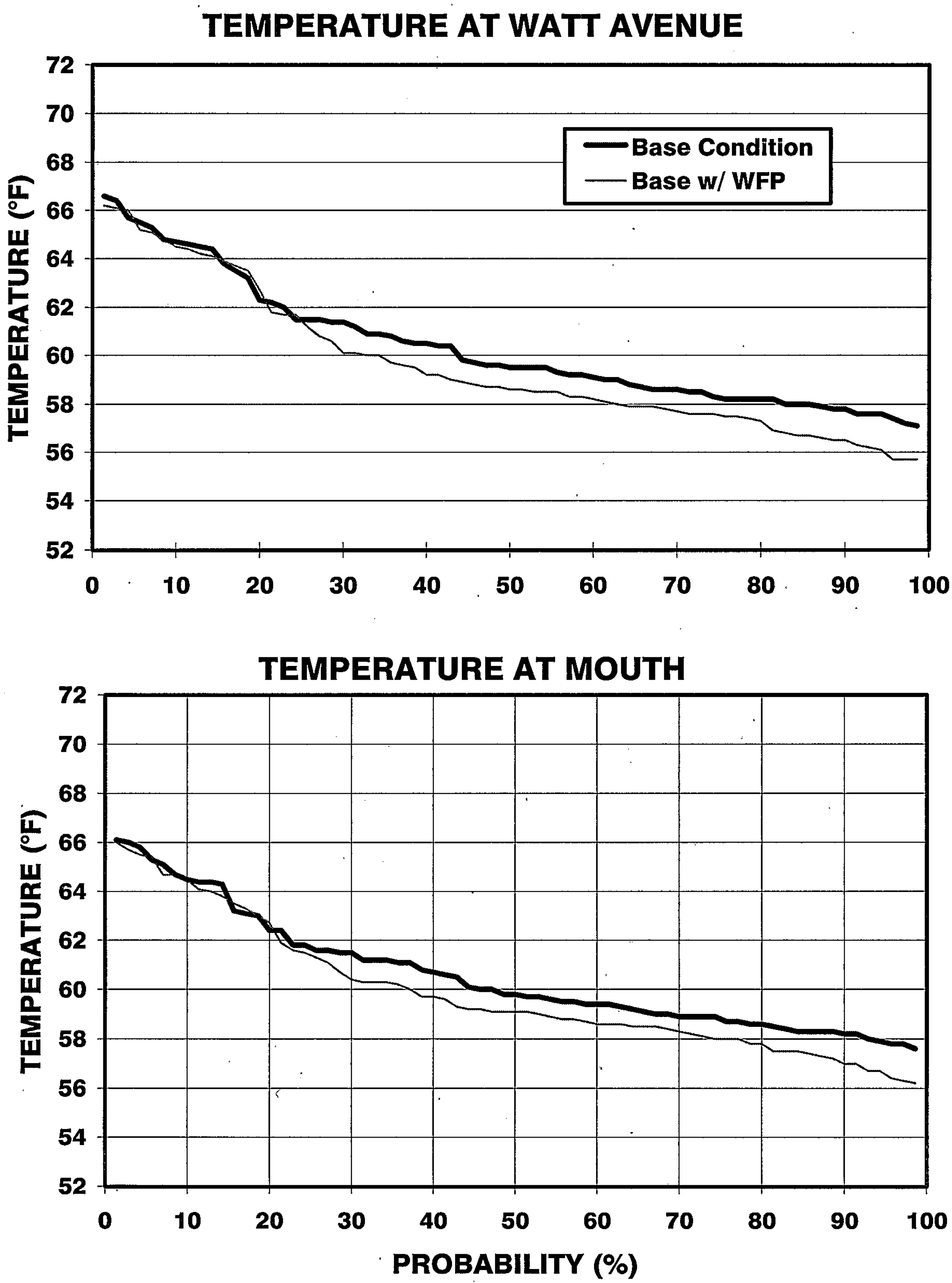


Figure 4.5-6. Probability that mean October temperature in the Lower American River would exceed specified levels at Watt Avenue and the Mouth.

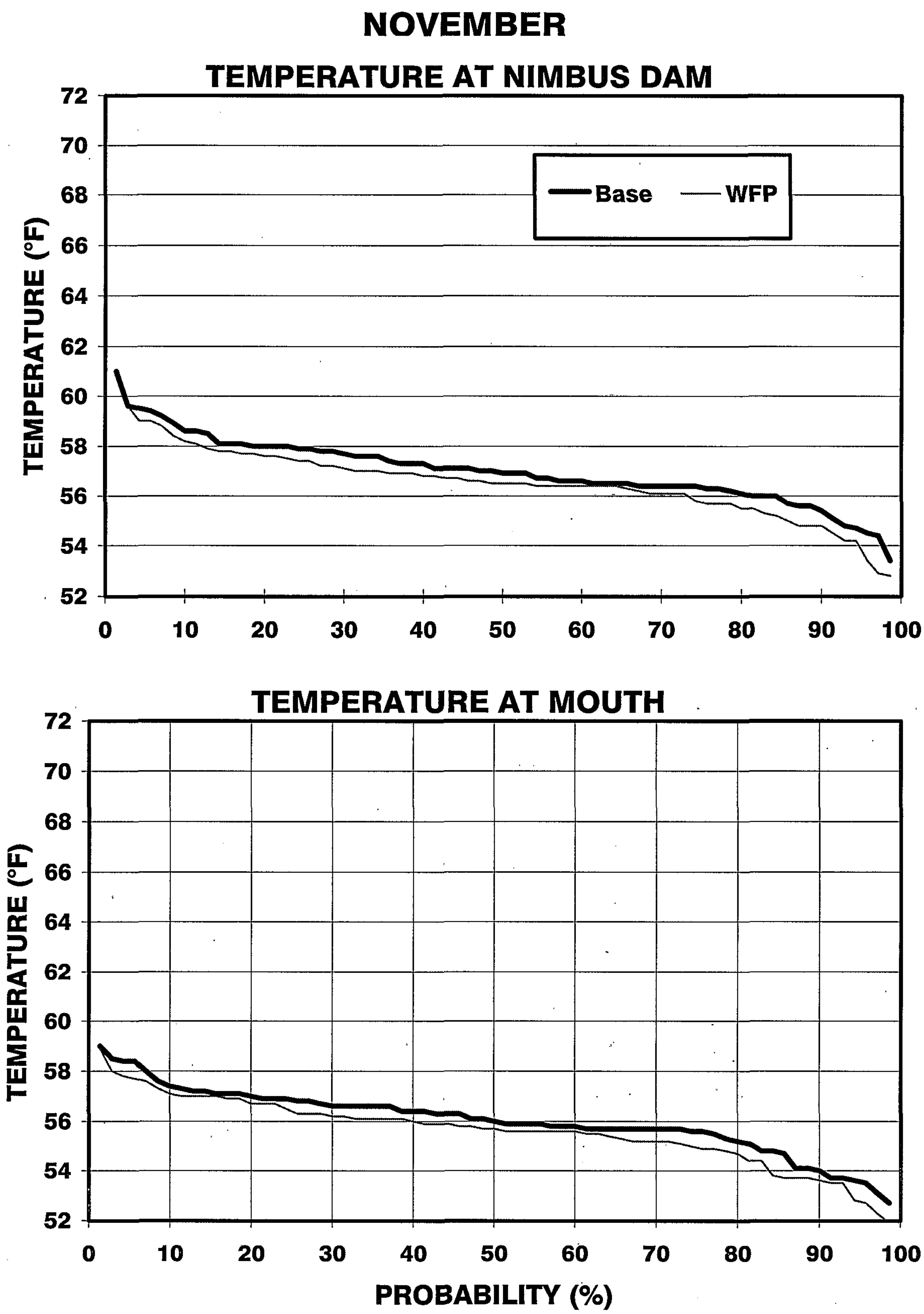
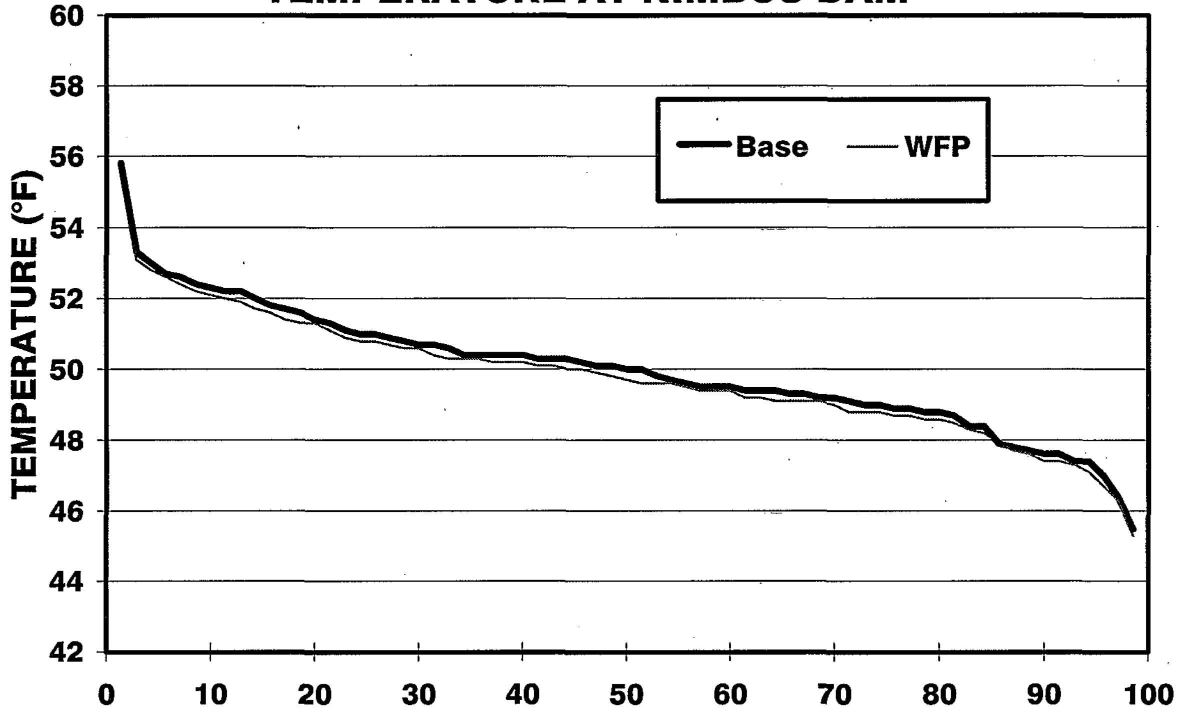


Figure 4.5-7. Probability that mean November temperature in the Lower American River would exceed specified levels at Nimbus Dam and at the Mouth.

DECEMBER

TEMPERATURE AT NIMBUS DAM



TEMPERATURE AT MOUTH

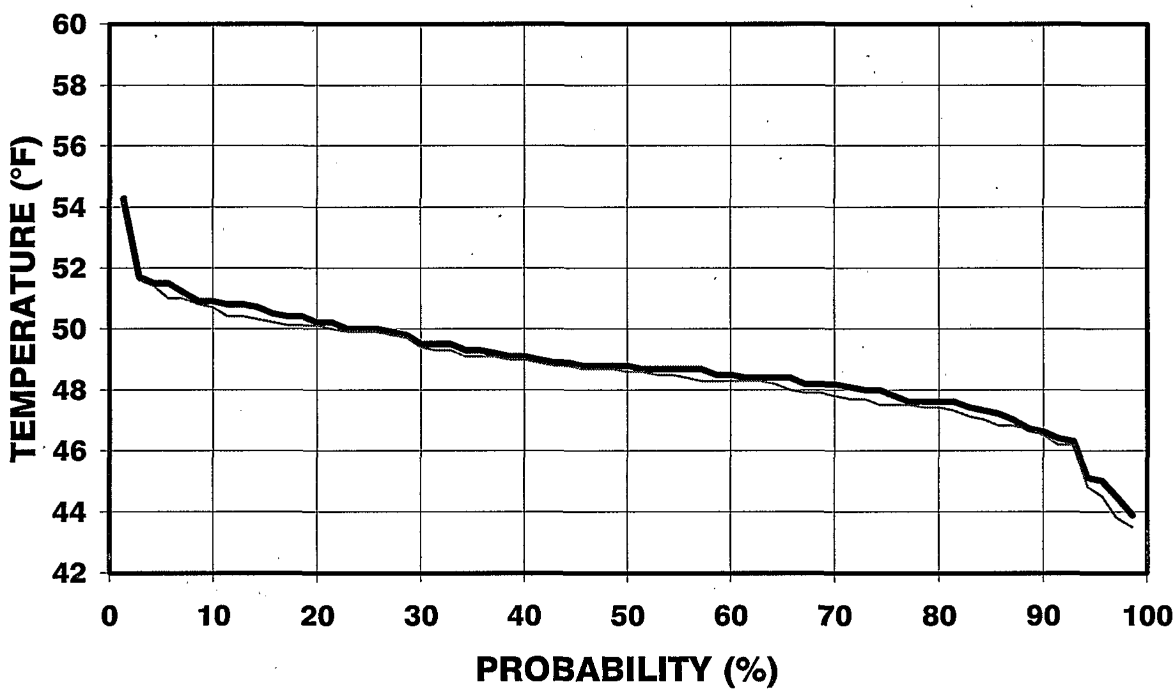


Figure 4.5-8. Probability that mean December temperature in the Lower American River would exceed specified levels at Nimbus Dam and at the Mouth.

JANUARY

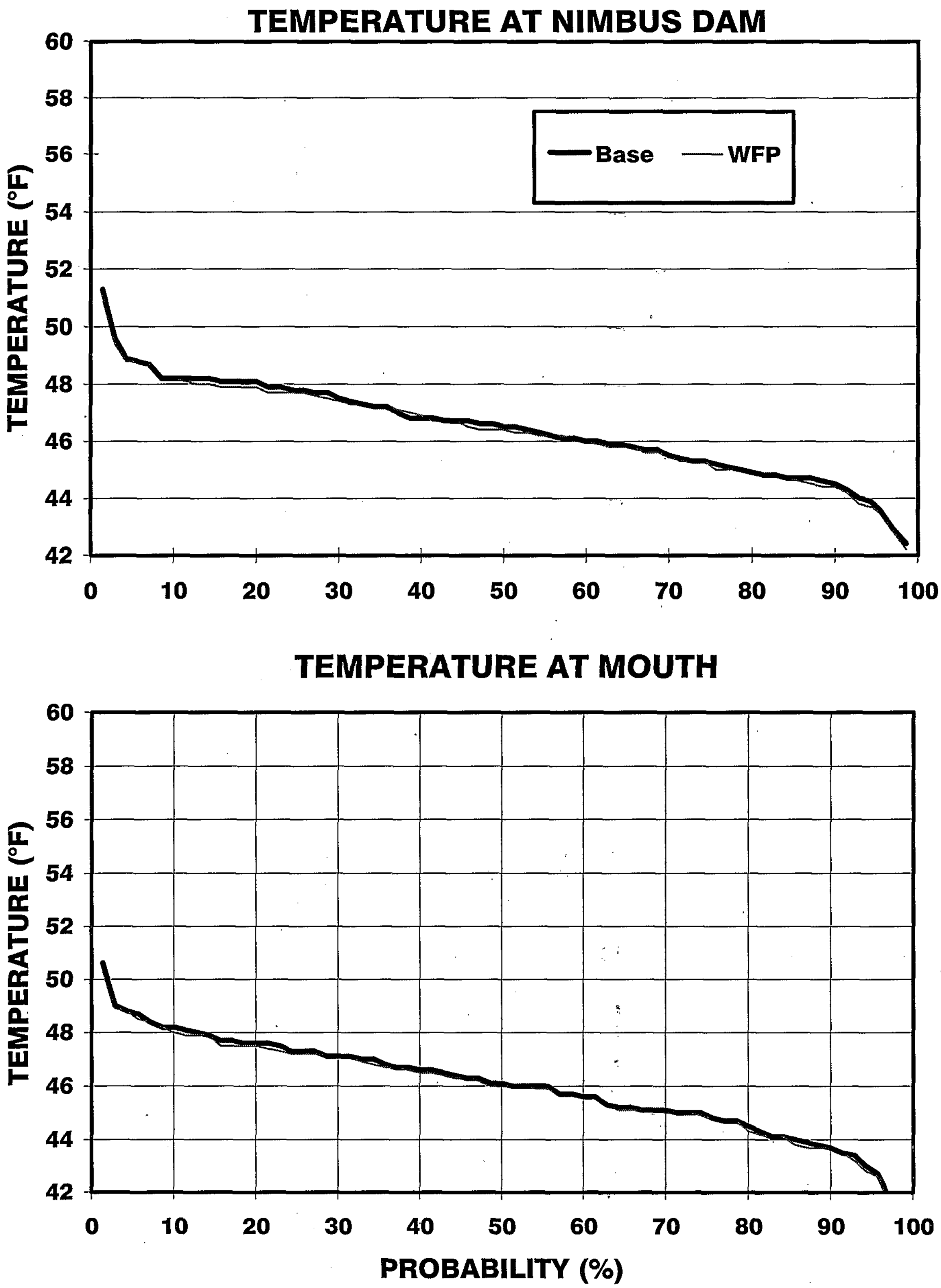


Figure 4.5-9. Probability that mean January temperature in the Lower American River would exceed specified levels at Nimbus Dam and at the Mouth.

C-090304

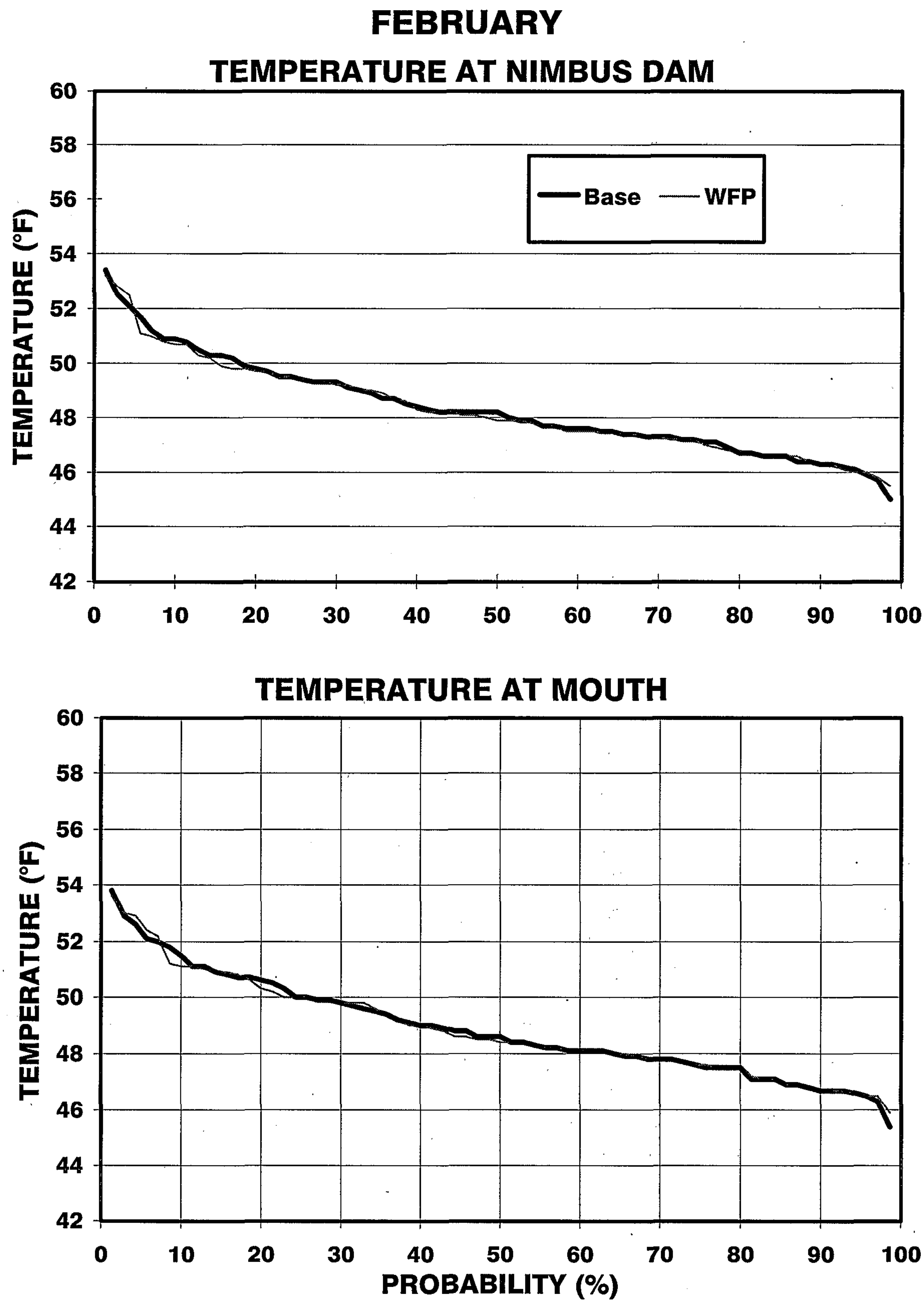
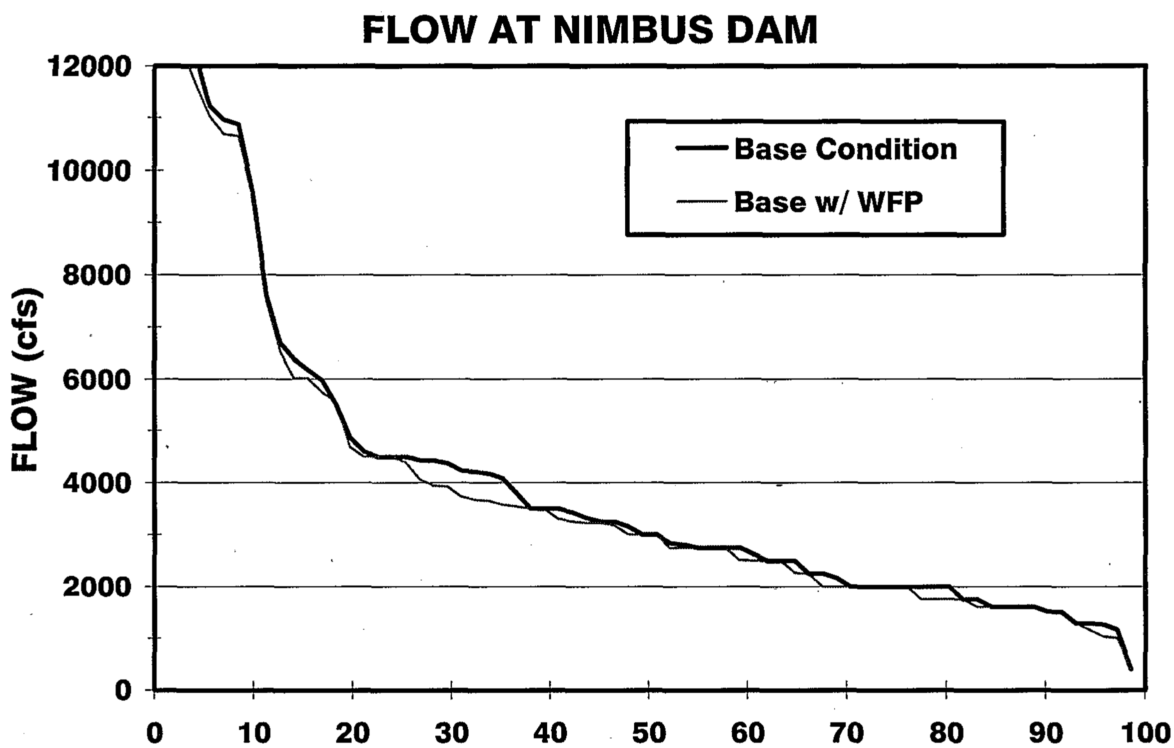


Figure 4.5-10. Probability that mean February temperature in the Lower American River would exceed specified levels at Nimbus Dam and at the Mouth.

MARCH



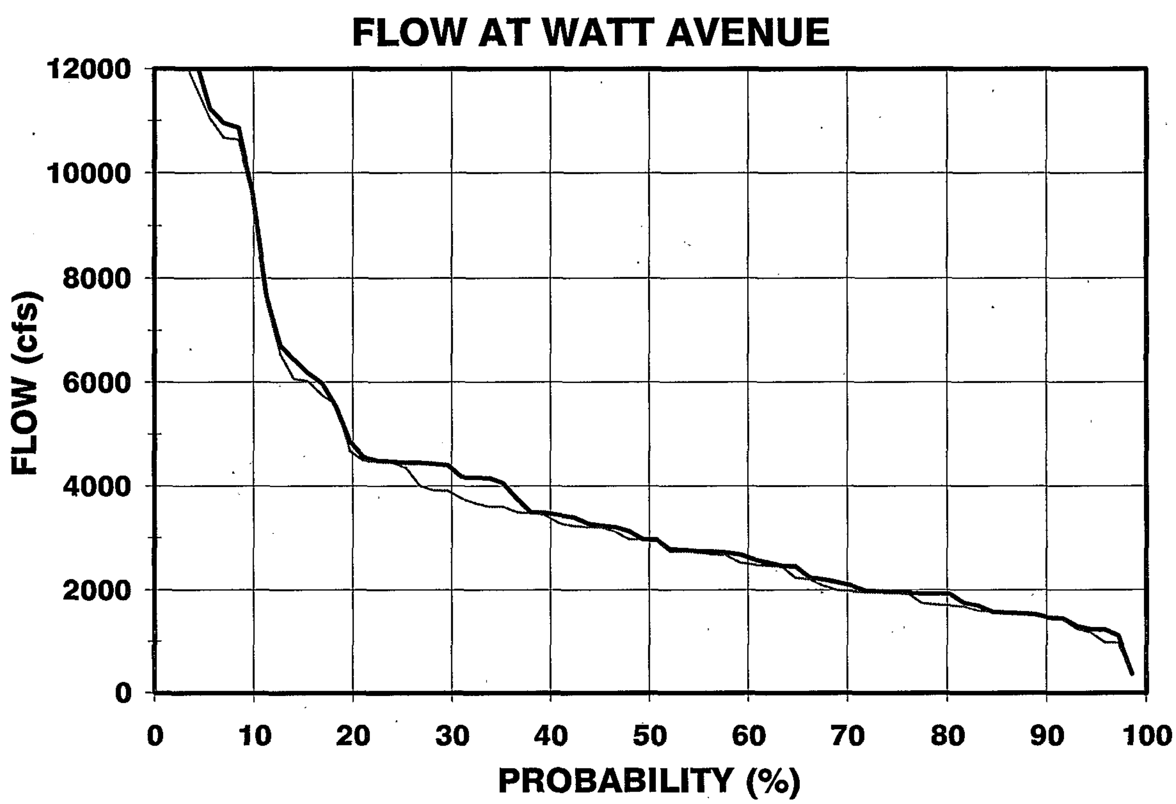


Figure 4.5-11. Probability that mean March flow in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

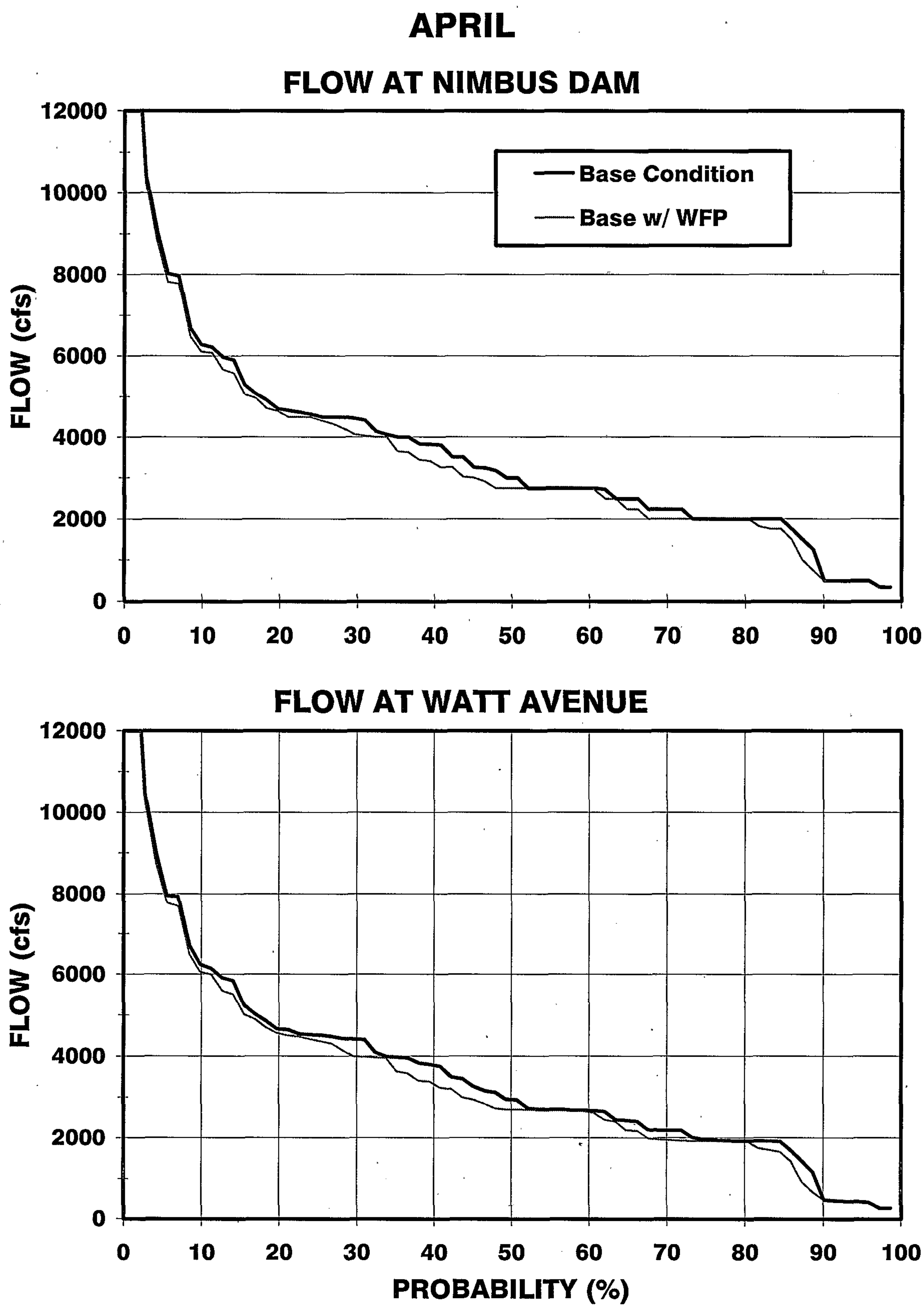


Figure 4.5-12. Probability that mean April flow in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

MAY

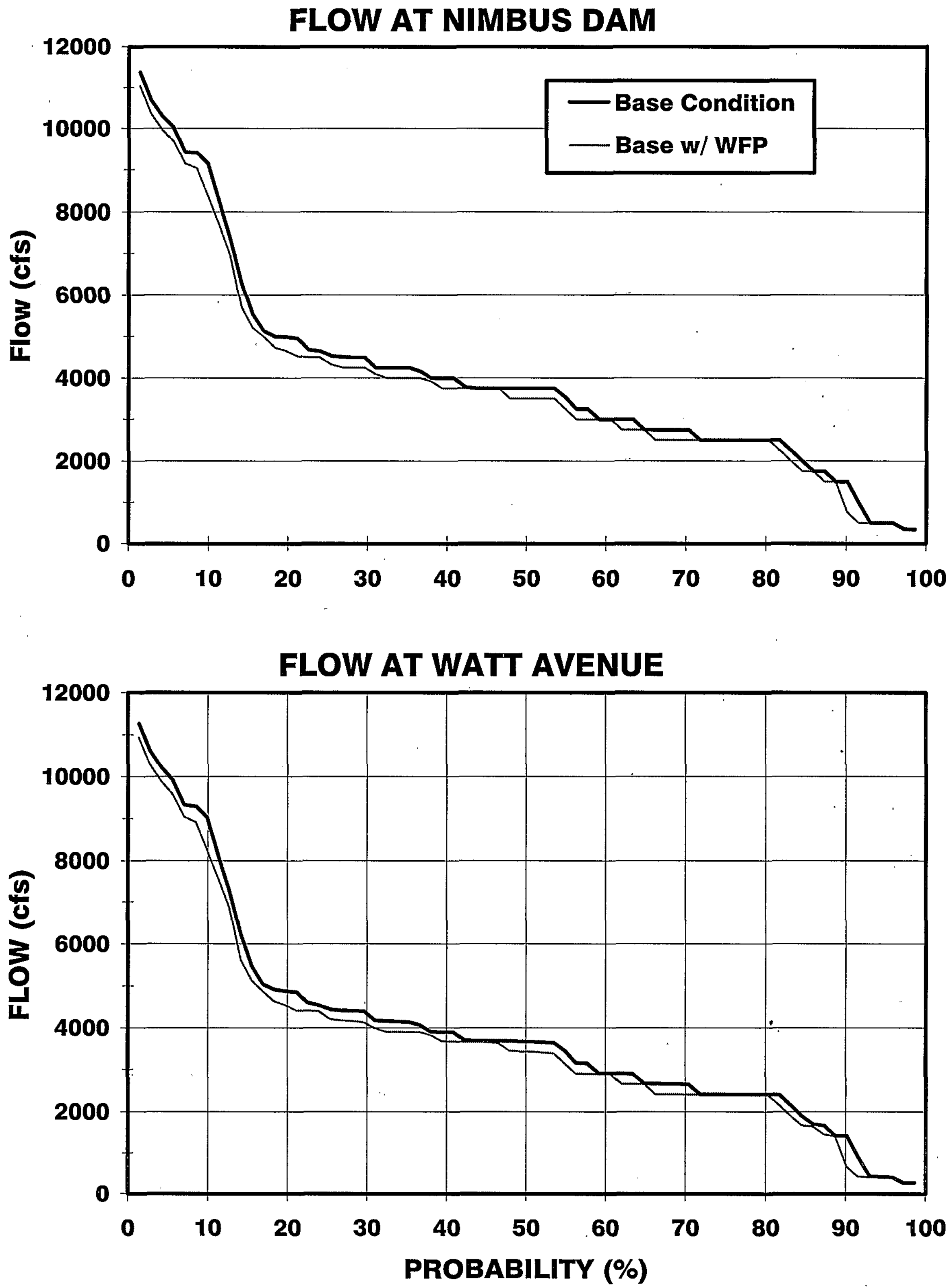


Figure 4.5-13. Probability that mean May flow in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

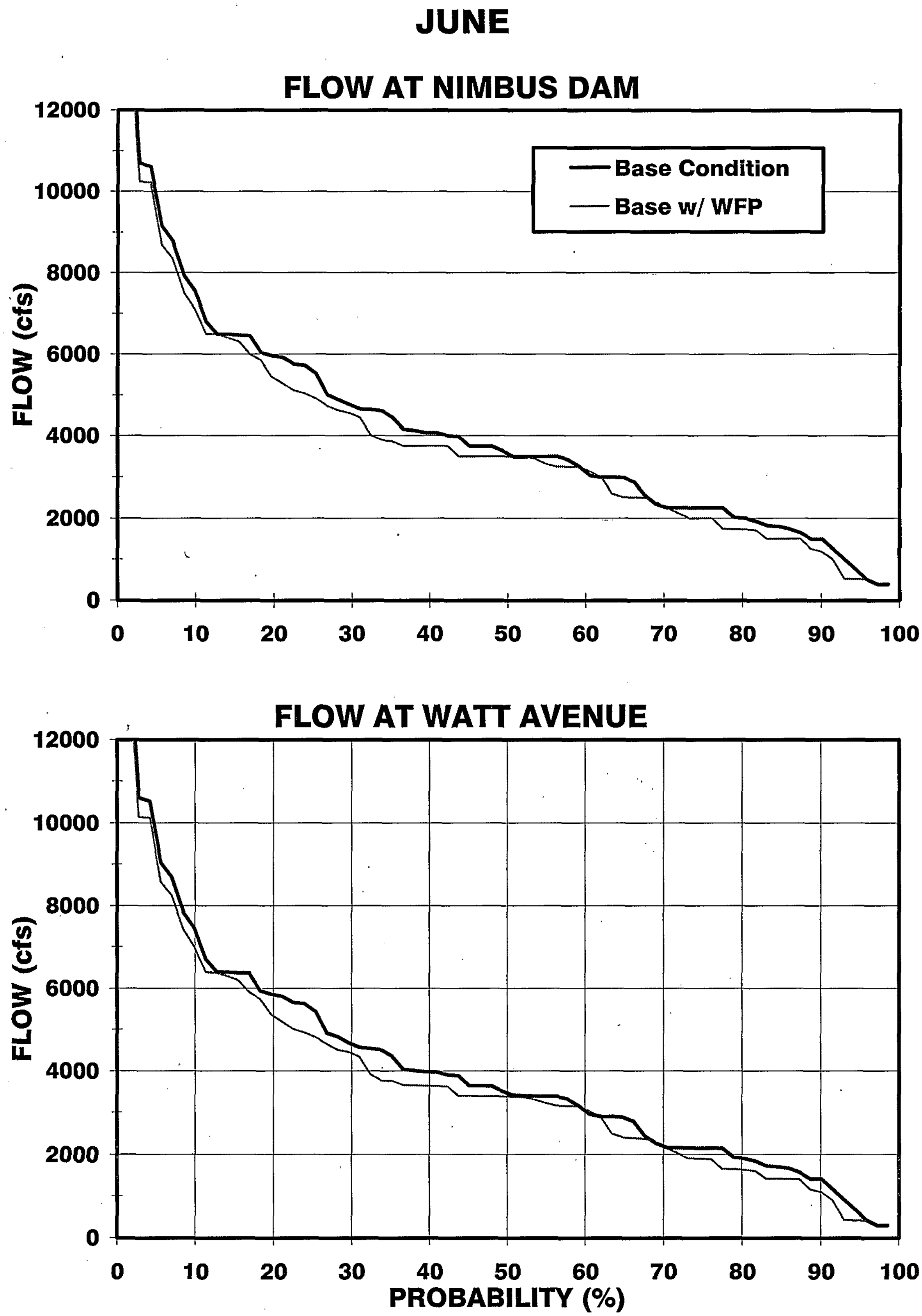
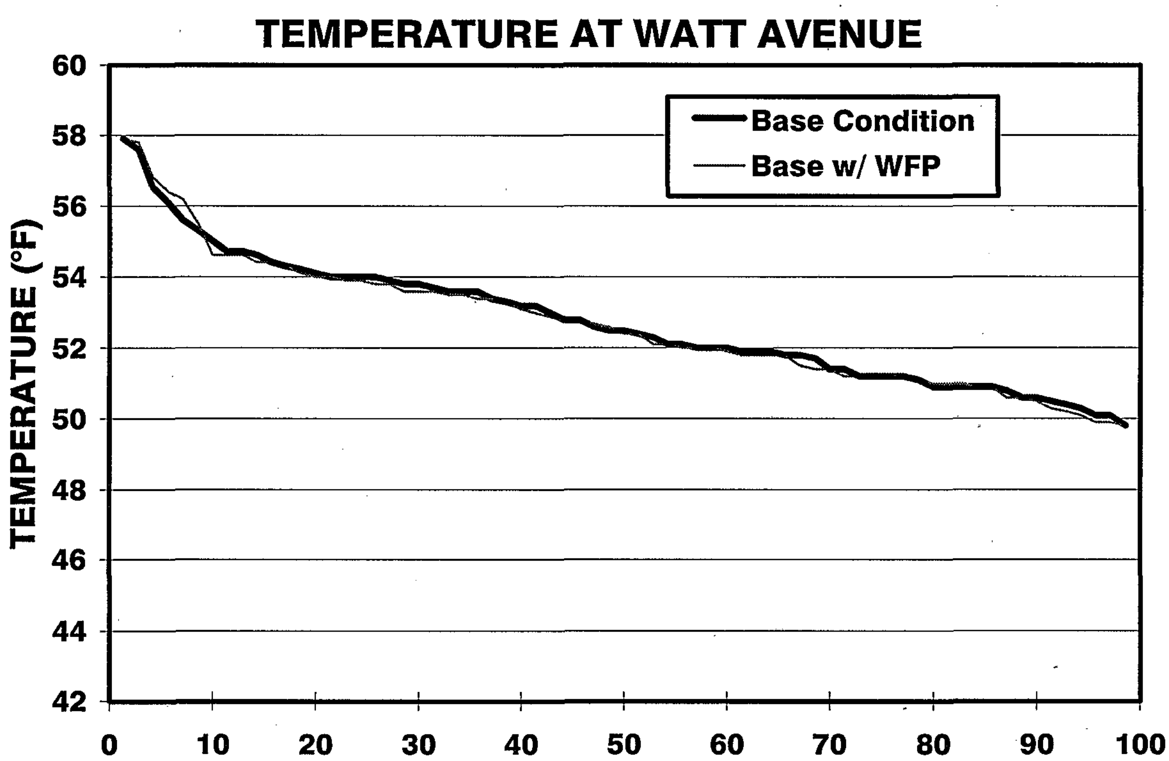


Figure 4.5-14. Probability that mean June flow in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

MARCH



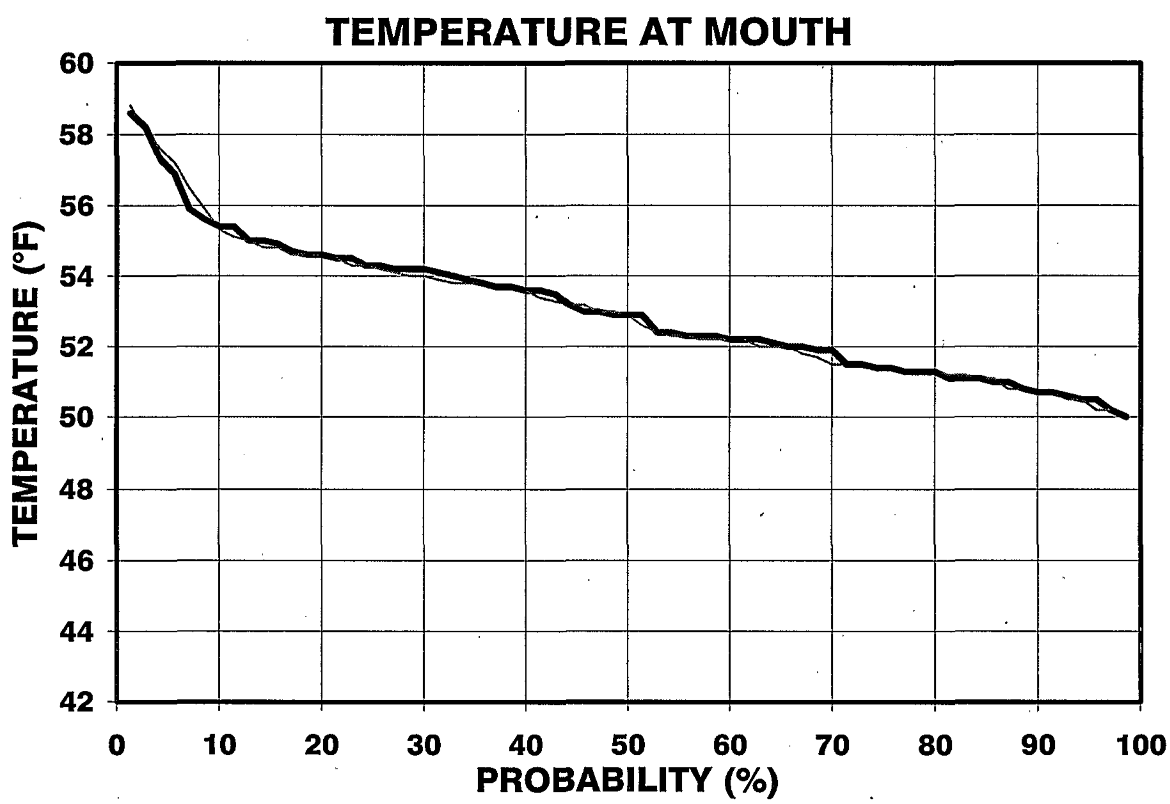


Figure 4.5-15. Probability that mean March temperature in the Lower American River would exceed specified levels at Watt Avenue and at the Mouth.

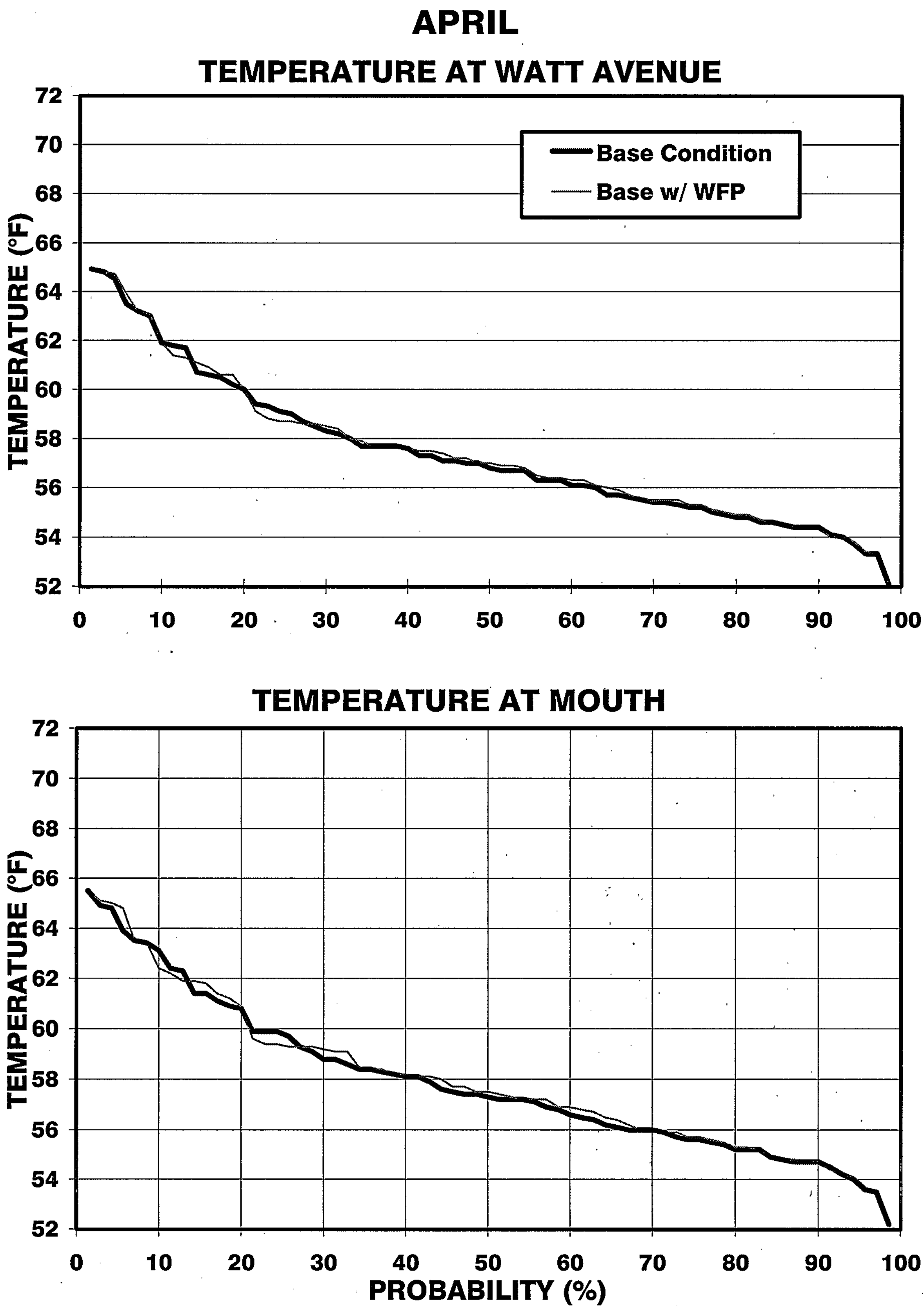


Figure 4.5-16. Probability that mean April temperature in the Lower American River would exceed specified levels at Watt Avenue and at the Mouth.

MAY

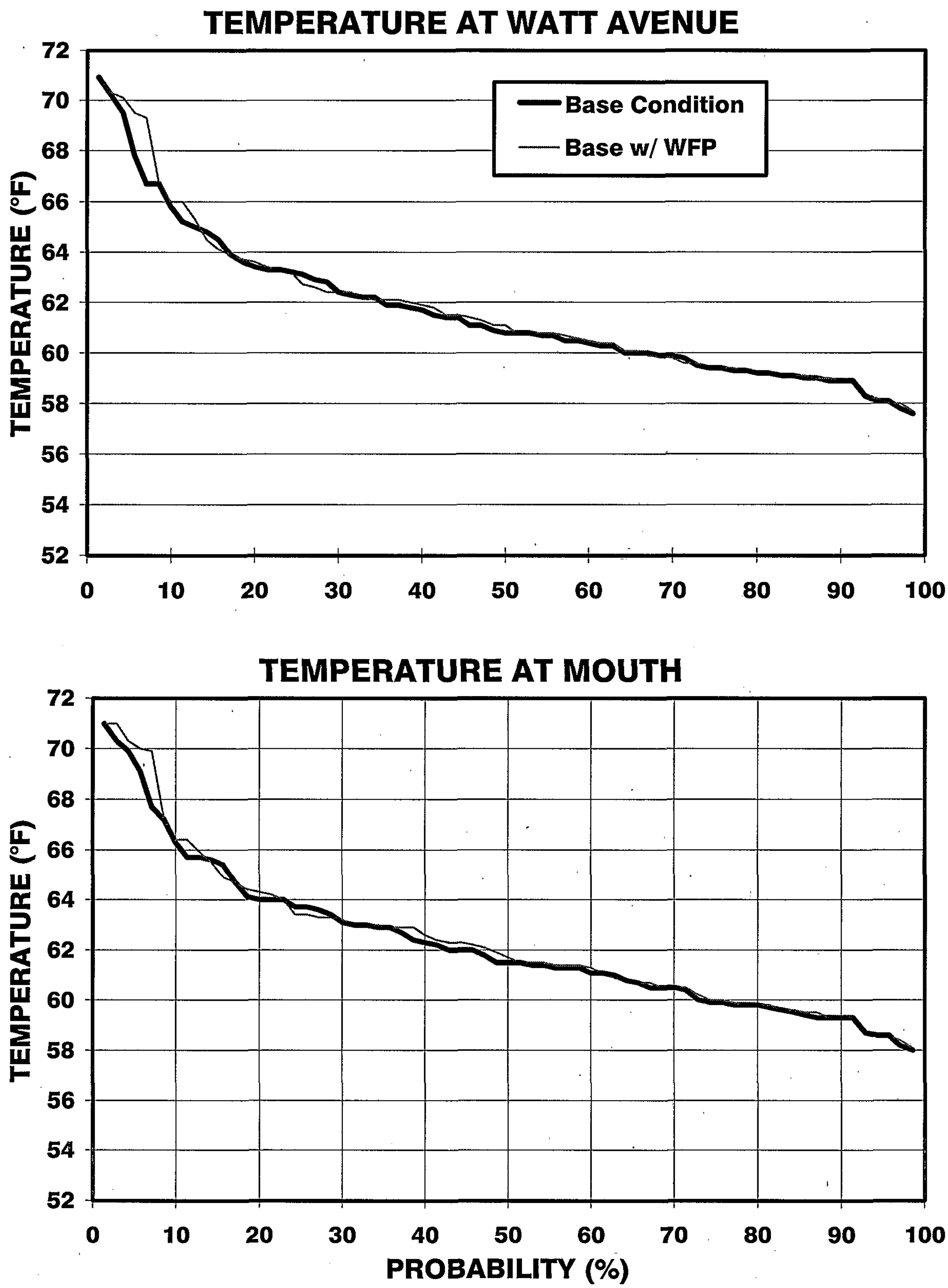


Figure 4.5-17. Probability that mean May temperature in the Lower American River would exceed specified levels at Watt Avenue and at the Mouth.

JUNE

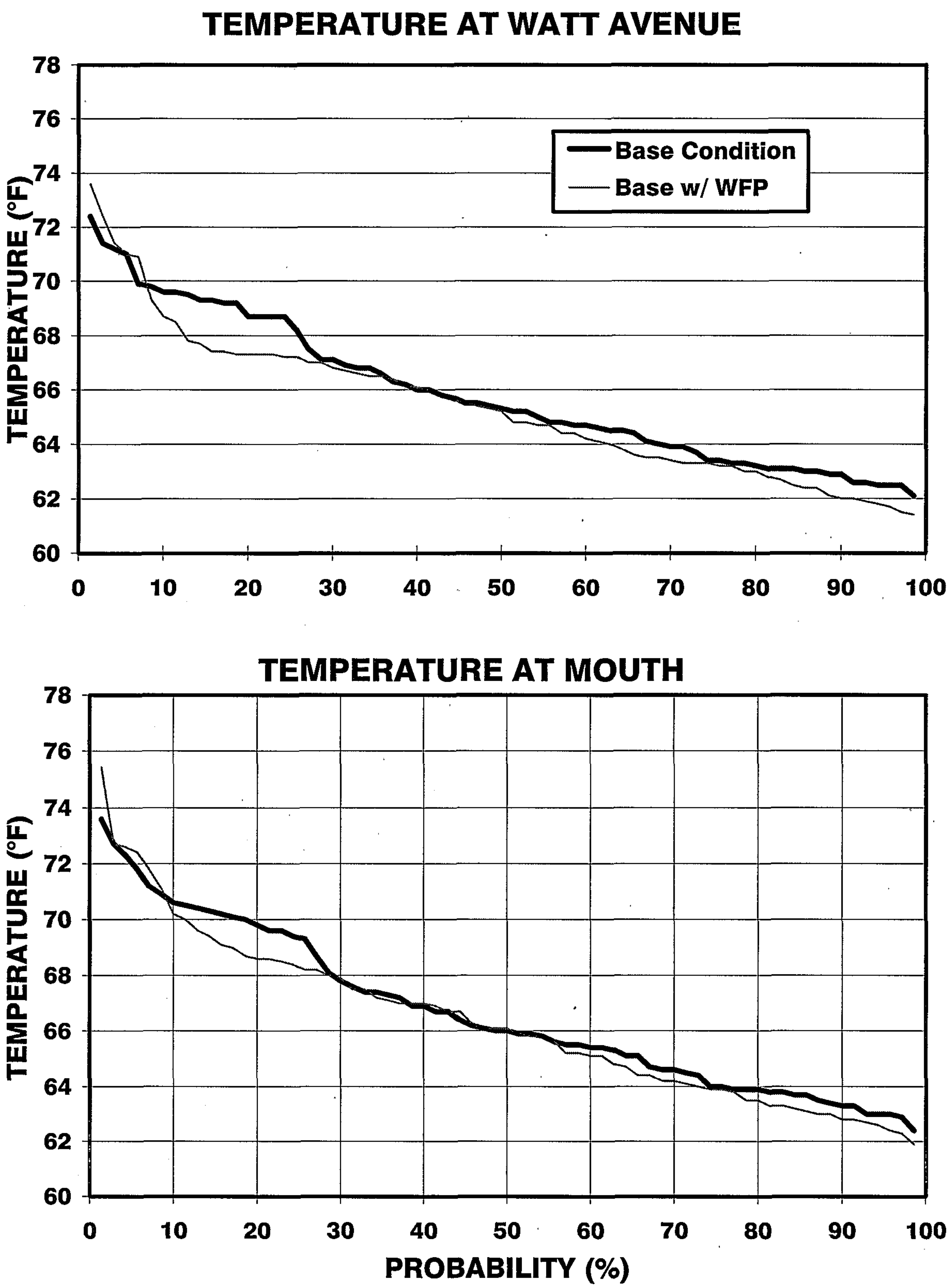
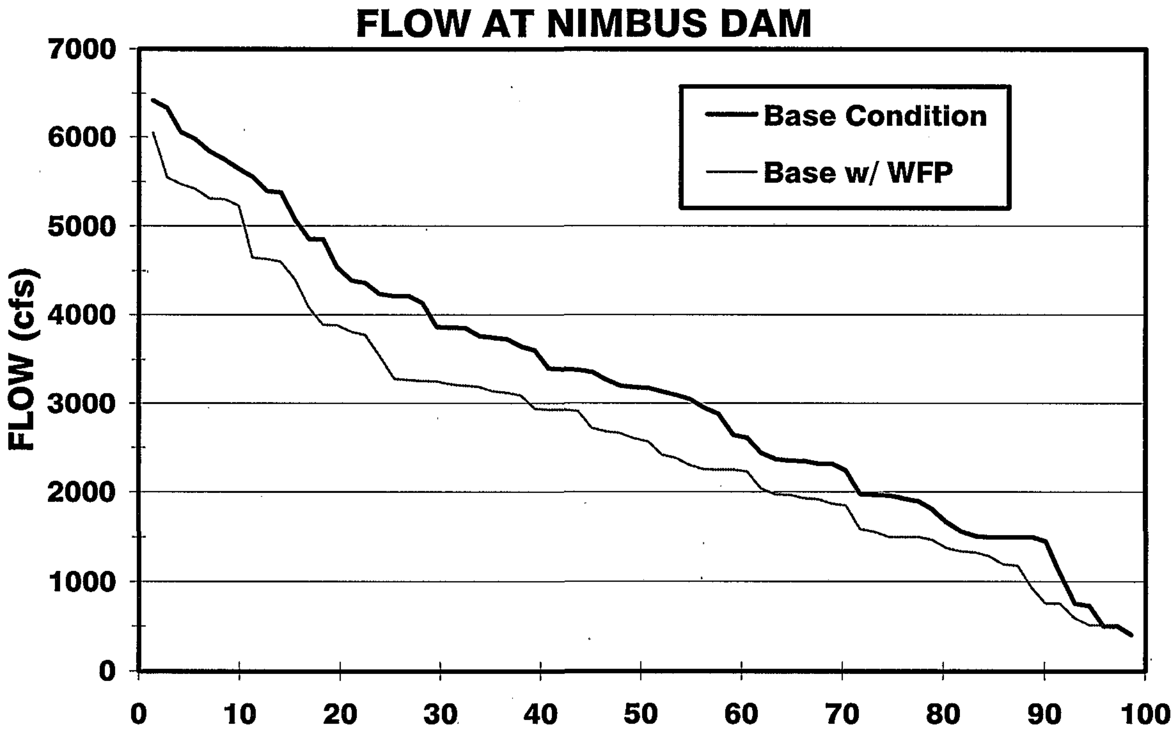


Figure 4.5-18. Probability that mean June temperature in the Lower American River would exceed specified levels at Watt Avenue and at the Mouth.

JULY



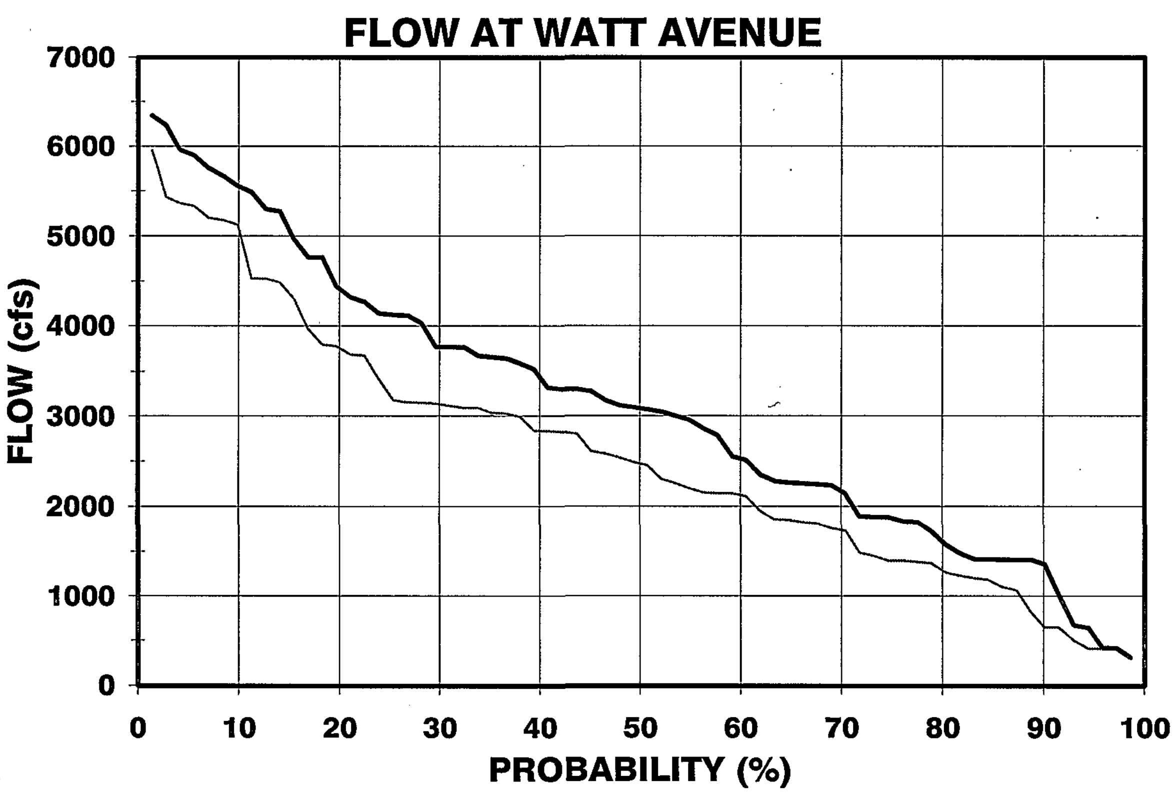


Figure 4.5-19. Probability that mean July flow in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

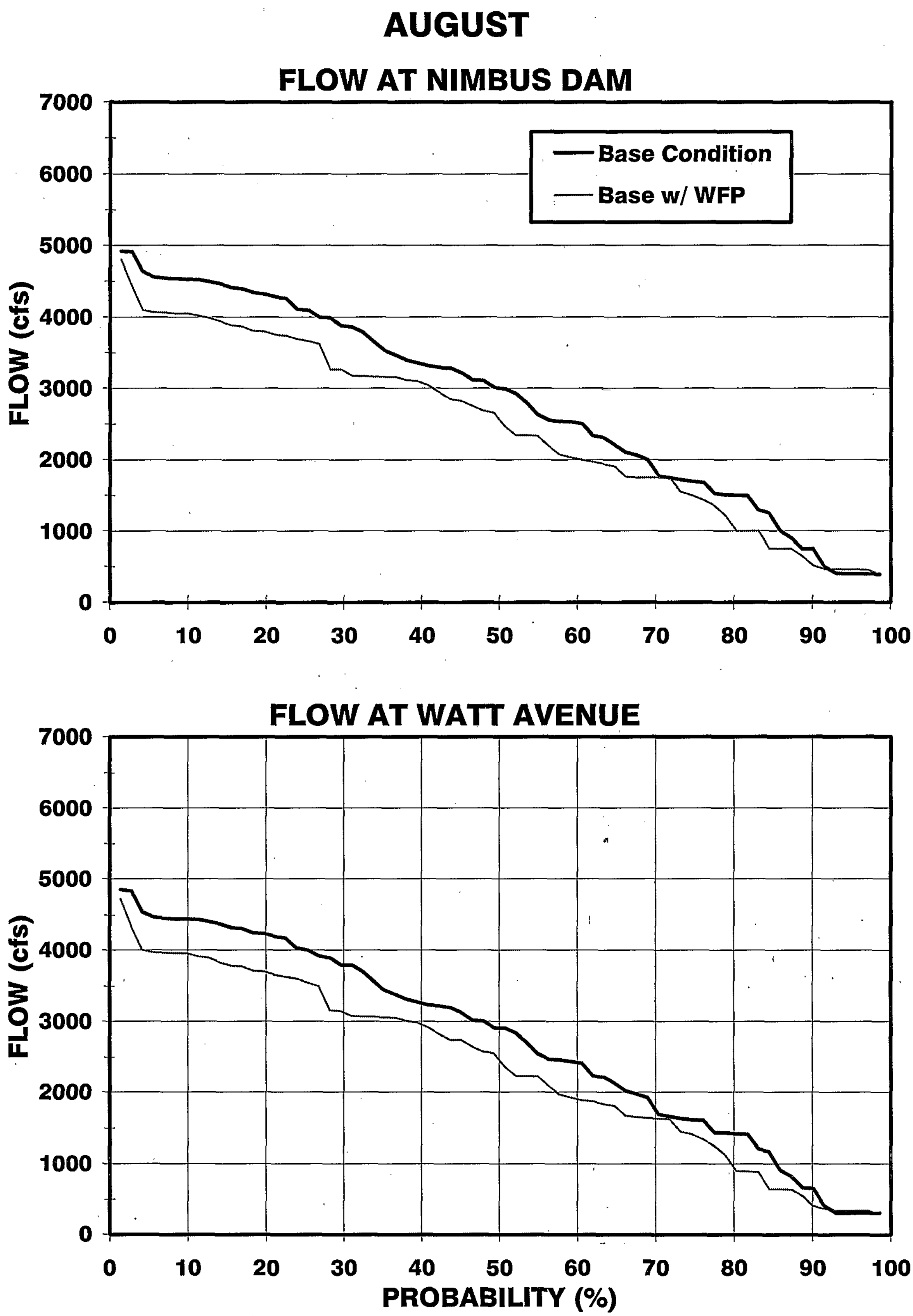


Figure 4.5-20. Probability that mean August flow in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

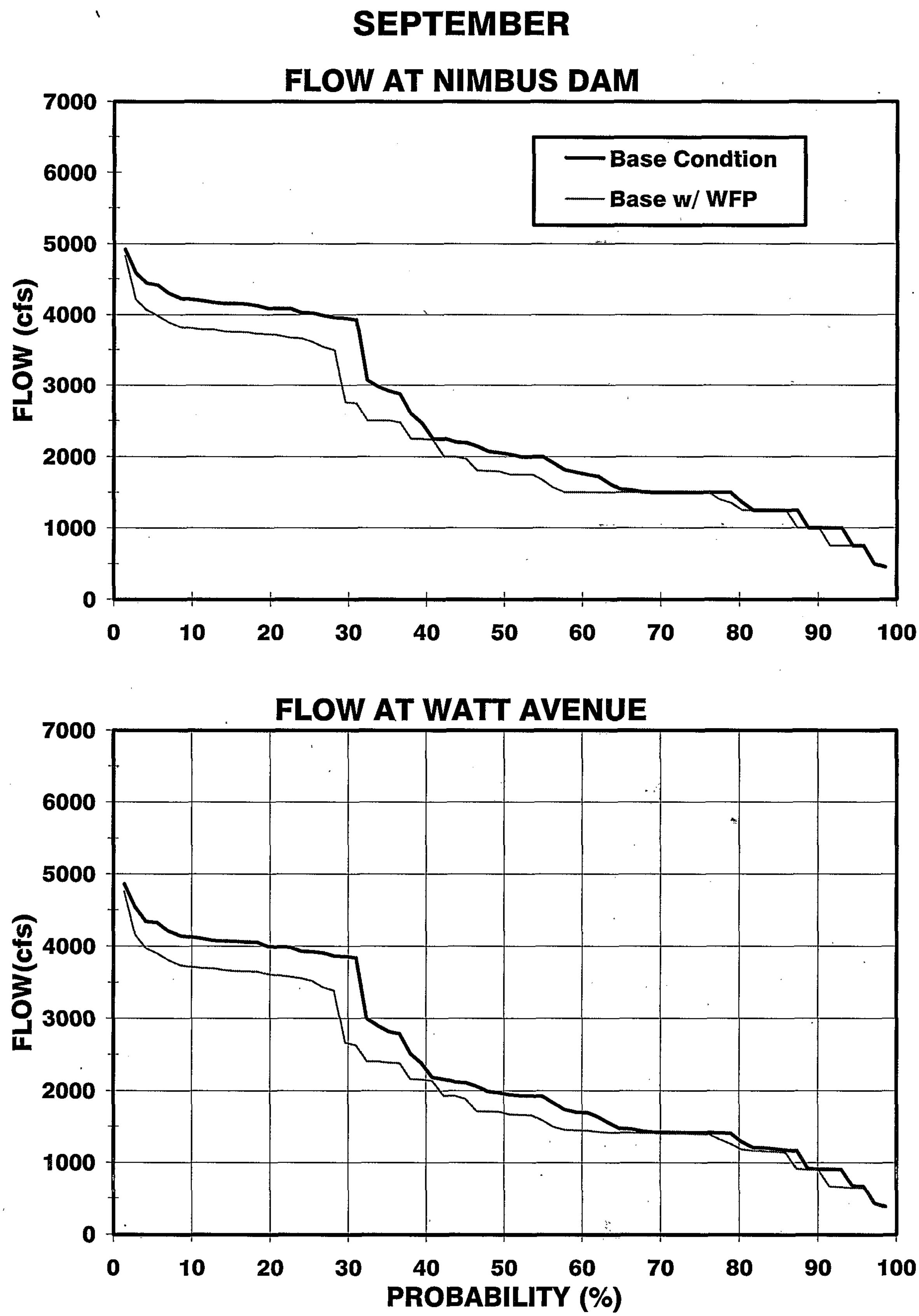


Figure 4.5-21. Probability that mean September flow in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

JULY

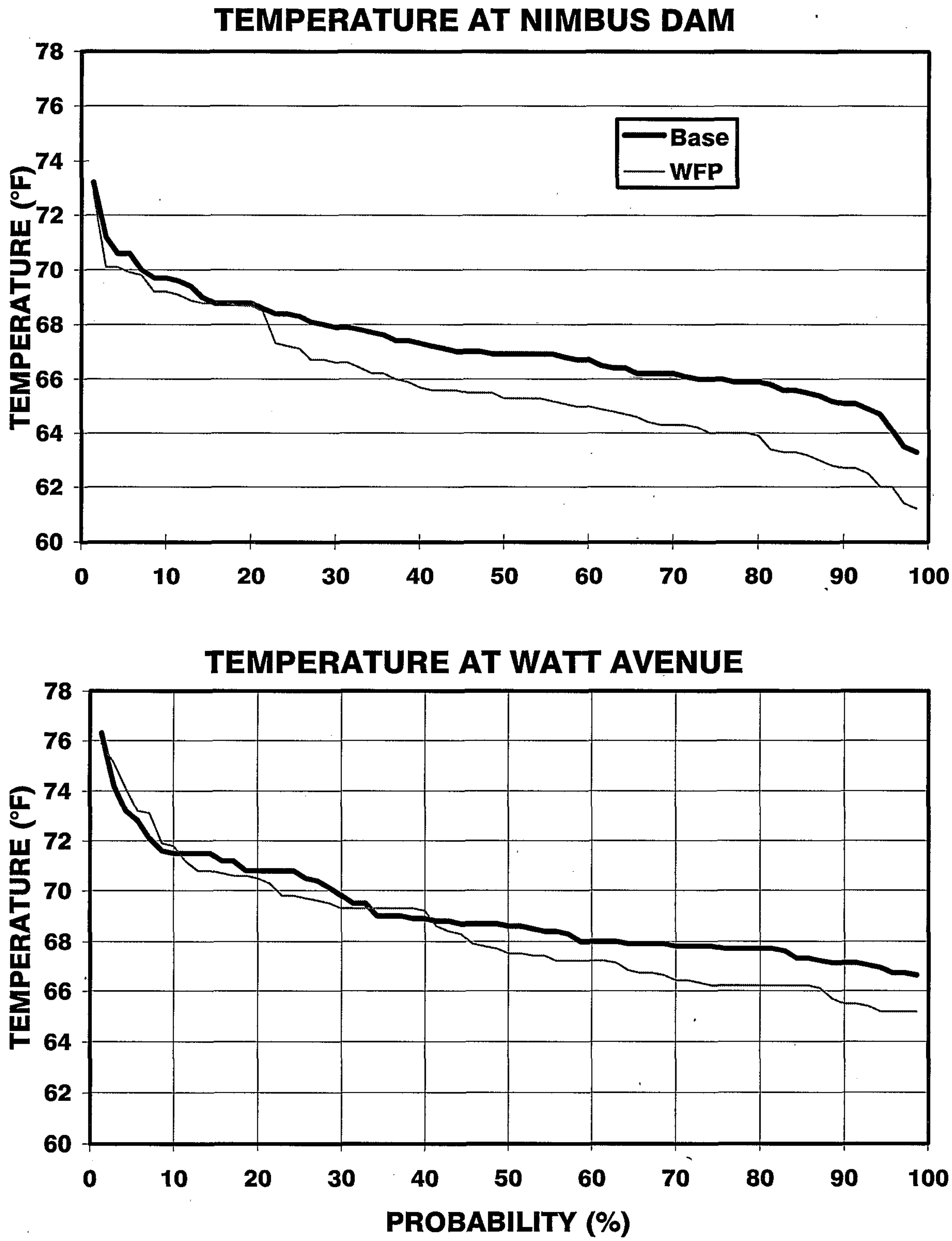


Figure 4.5-22. Probability that mean July temperature in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

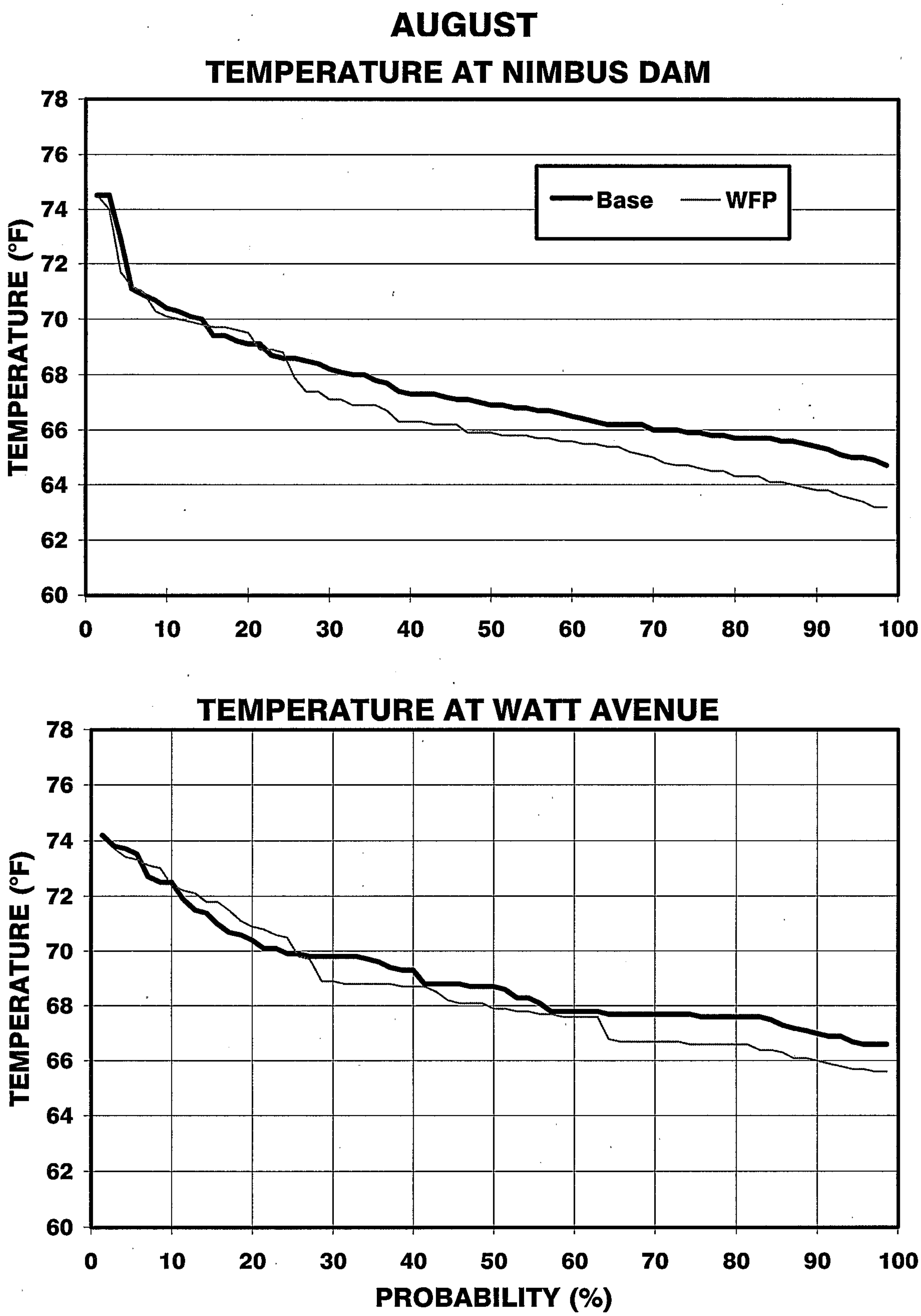
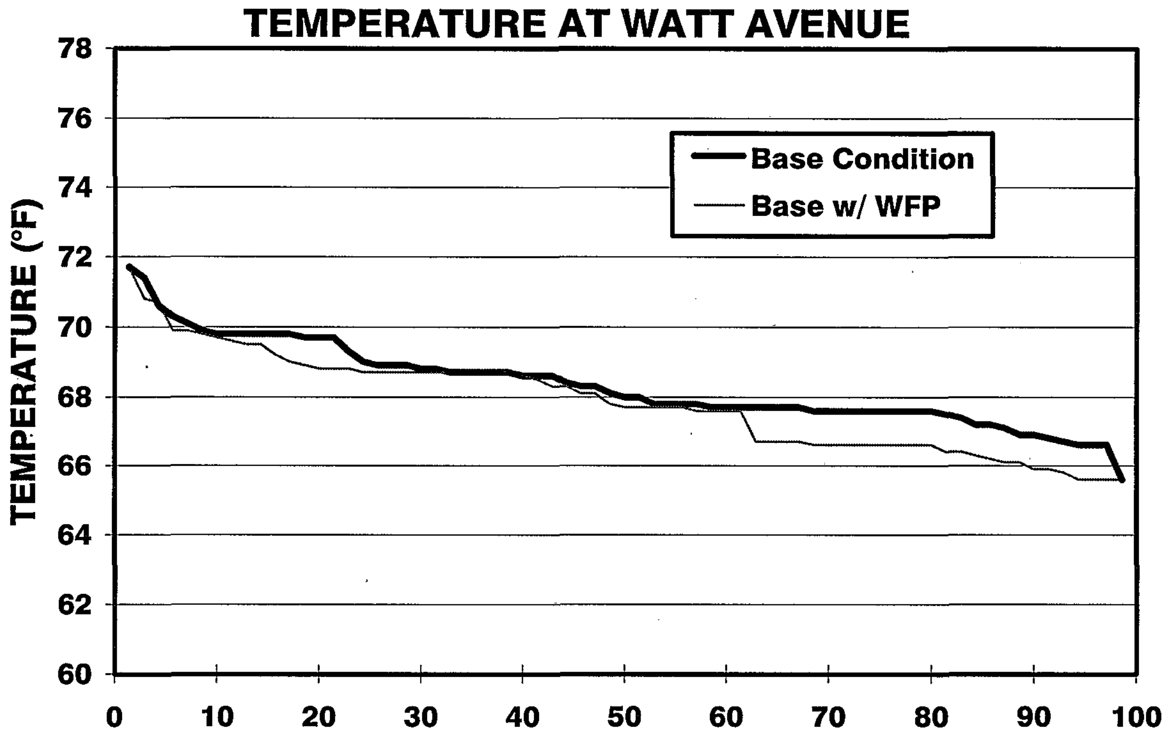


Figure 4.5-23. Probability that mean August temperature in the Lower American River would exceed specified levels at Nimbus Dam and Watt Avenue.

SEPTEMBER



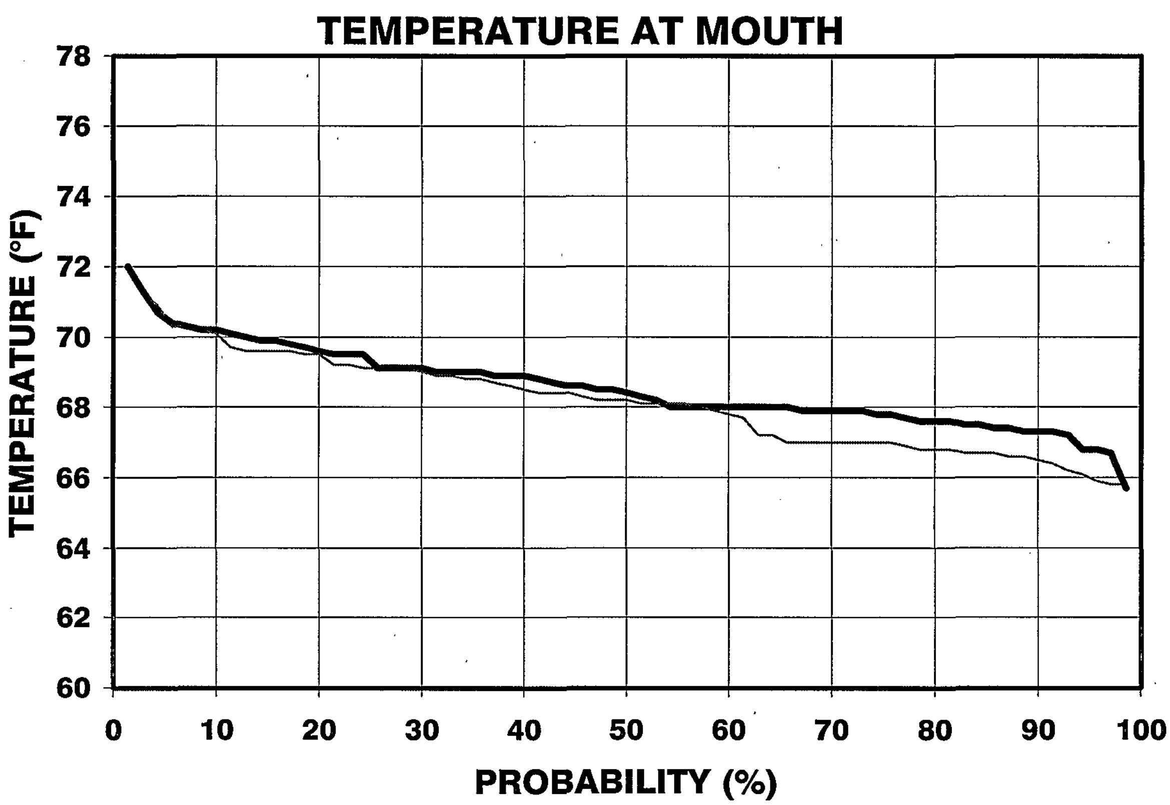


Figure 4.5-24. Probability that mean September temperature in the Lower American River would exceed specified levels at Watt Avenue and them Mouth.

TEMPERATURES AT FREEPORT

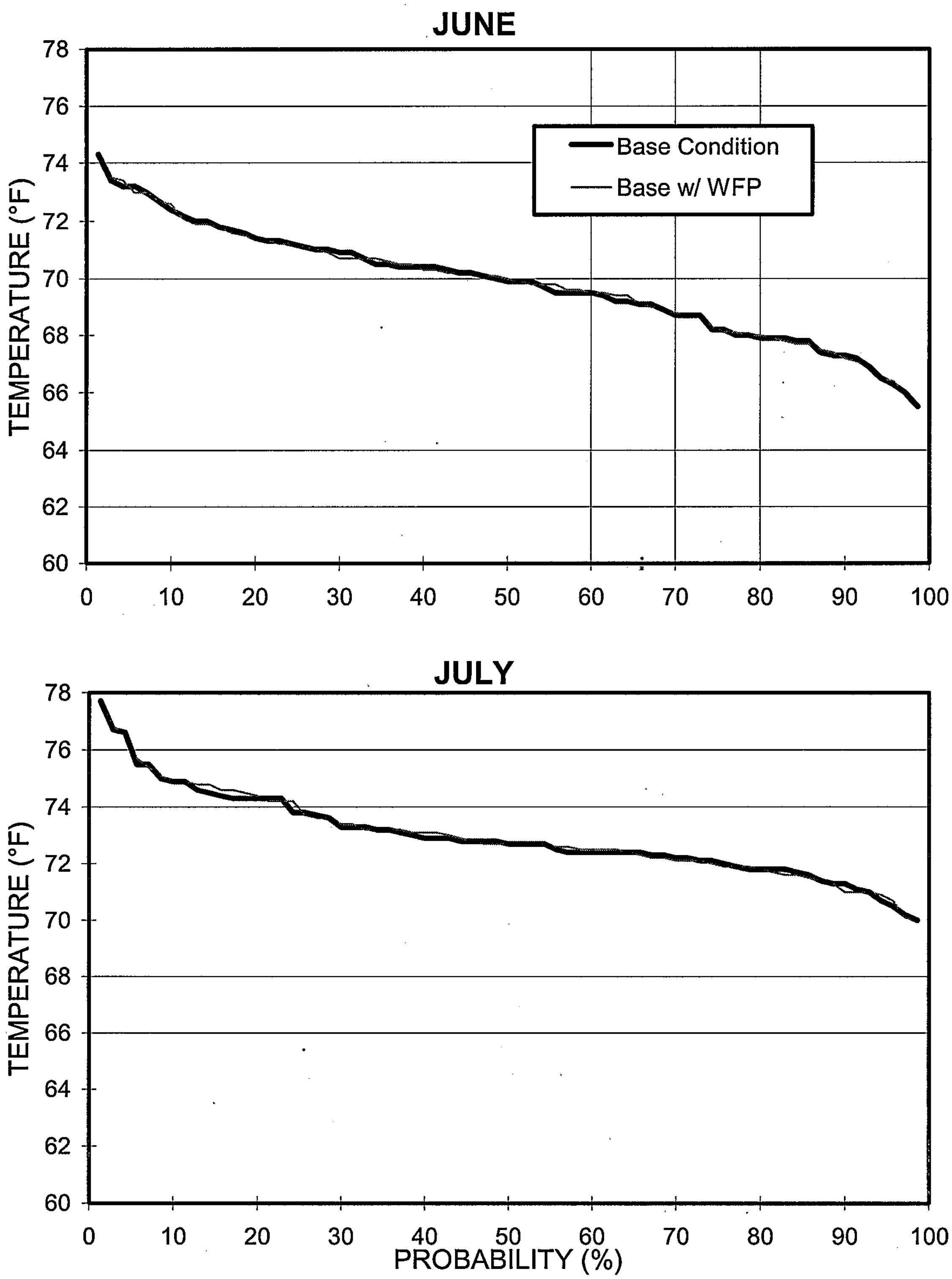


Figure 4.5-25. Probability that mean June and July temperatures in the Sacramento River would exceed specified levels at Freeport.

C-090320

TEMPERATURES AT FREEPORT

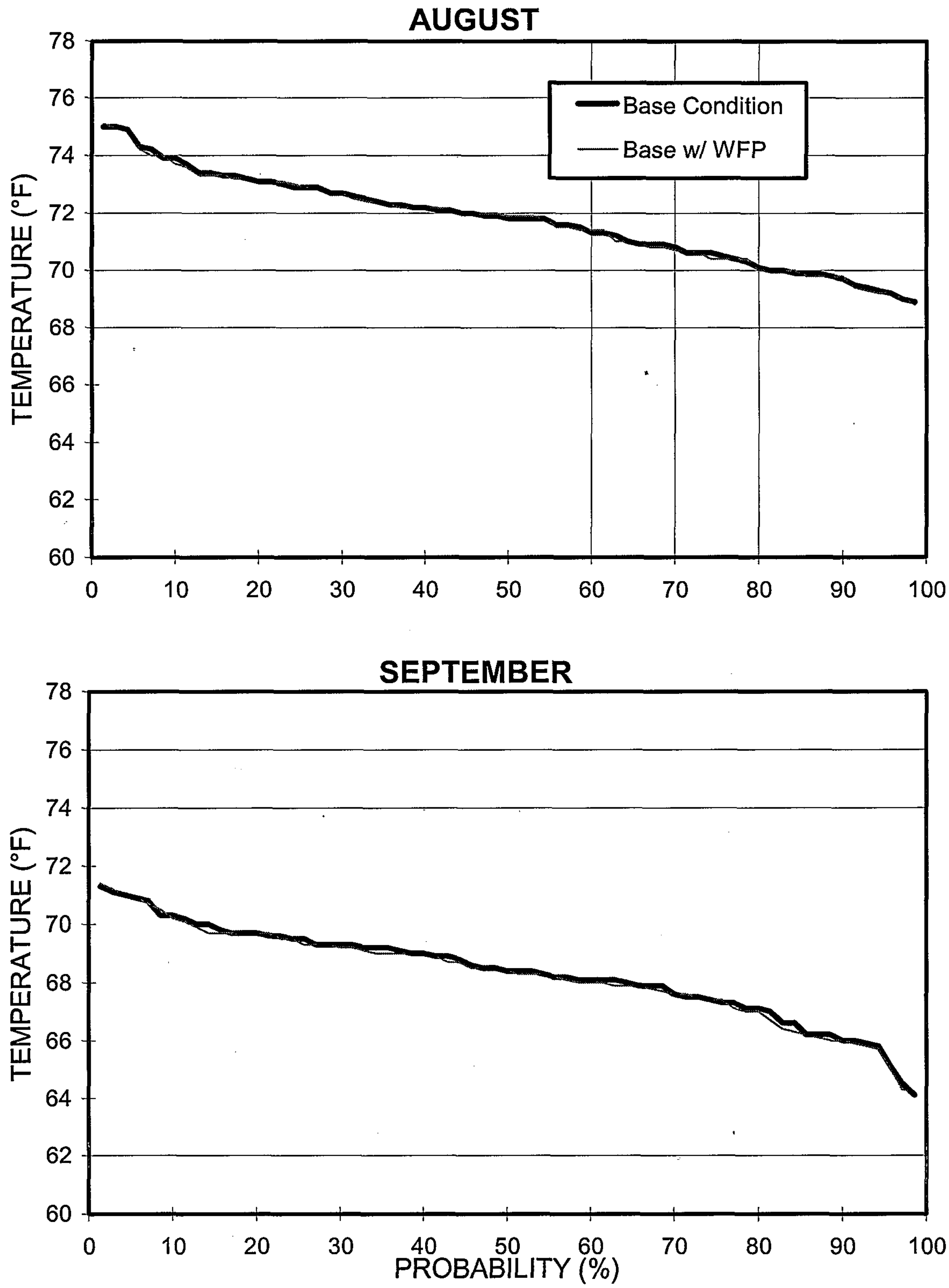


Figure 4.5-26. Probability that mean August and September temperatures in the Lower Sacramento River would exceed specified levels at Freeport.

C-090321

4.6 FLOOD CONTROL

4.6.1 EXISTING CONDITIONS

The creeks and streams within the Water Service Study Area ultimately drain runoff into the Sacramento and American rivers. During major storm events, flood control facilities along these rivers harness flood flows by regulating the amount of water passing through a particular reach of the river (Sacramento County, 1992). Flood control is afforded by a comprehensive system of dams, levees, overflow weirs, drainage pumping plants, and flood control bypass channels provided by the Sacramento River and American River Flood Control Projects as well as Folsom Dam and Reservoir (USBR and SCWA, 1995).

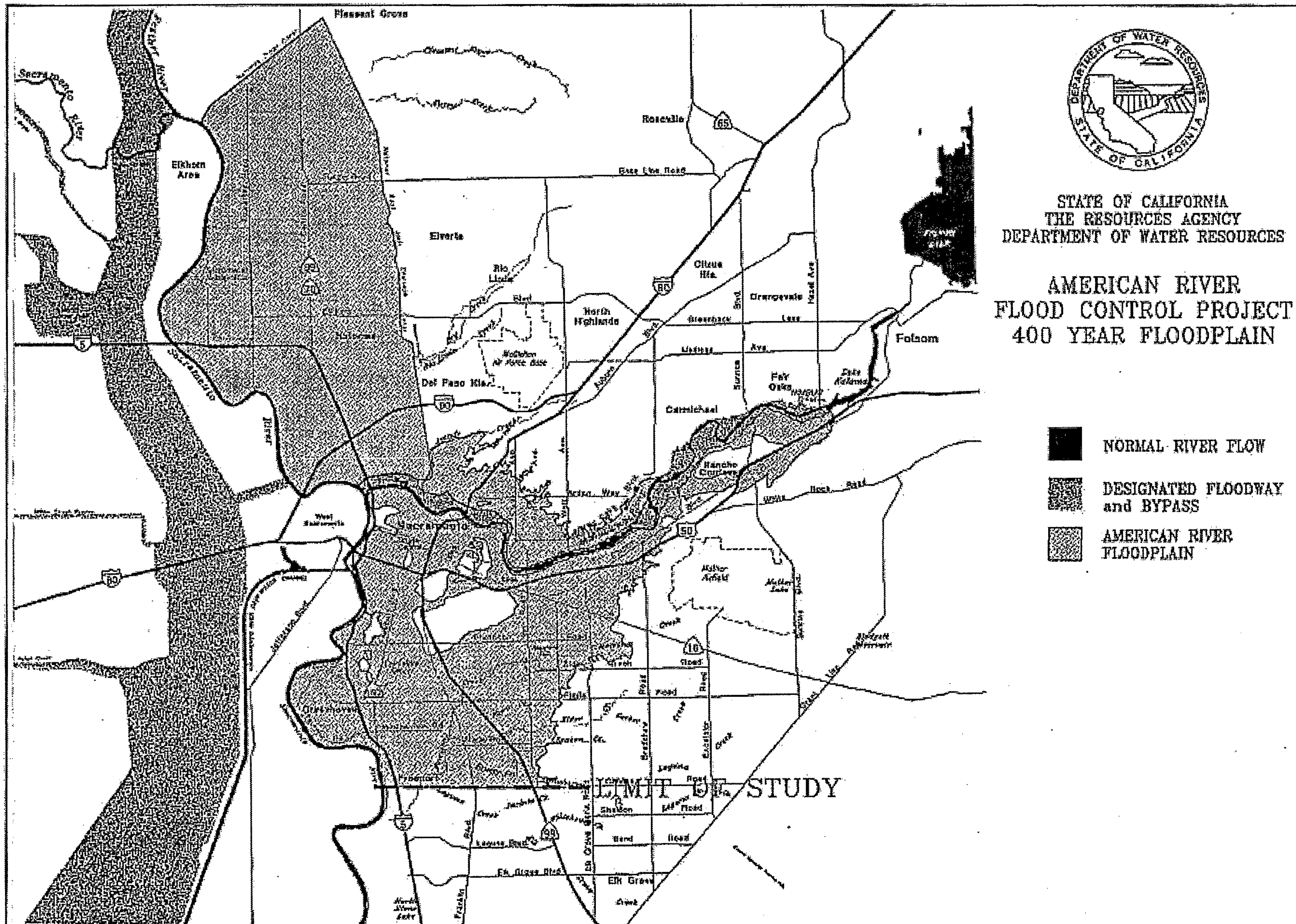
SACRAMENTO RIVER FLOOD CONTROL PROJECT

The Sacramento River Flood Control Project (SRFCP) was originally authorized by the Flood Control Act of 1917, and subsequently modified by various Flood Control and/or Rivers and Harbors Acts in 1928, 1937, and 1941. The SRFCP was constructed by the USACE between 1918 and 1968, with the non-federal sponsor being the State Reclamation Board. Located on the Sacramento River and the lower reaches of its main tributaries, its principal features extend from Ord Bend downstream to Collinsville, a distance of about 184 miles. As noted above, these features include a comprehensive system of levees, overflow weirs, drainage pumping plants, and flood bypass channels (USBR and SCWA, 1995).

The SRFCP operates by containing potential flood waters of streams, river channels, and sloughs between levees and diverting those flood waters into the Butte Basin, Sutter, and Yolo bypasses. Approximately 1,000 miles of levees provide flood protection to Yuba City, Marysville, Sacramento, West Sacramento, and numerous smaller communities along the Sacramento River. Protection is also afforded to highways, railroads, airports, and about 800,000 acres of agricultural lands. During its history, the SRFCP has prevented billions of dollars in flood damage (USBR and SCWA, 1995).

American River Flood Control Project

The American River Flood Control Project (ARFCP) was constructed by the USACE in 1958 and is operated and maintained by the State of California. The ARFCP consists of a levee extending along the north side of the American River. This levee originates upstream near Carmichael and extends approximately seven miles downstream to a previously existing levee near the Interstate Business 80 crossing. Two pumping plants, located in low areas landside of the levee, discharge storm drainage into the lower American River. Because of the presence of this levee, Folsom Reservoir is able to safely operate to its maximum design release of 115,000 cfs (USBR and SCWA, 1995). Exhibit 4.6-1 illustrates the ARFCP, the 400-year flood plain, normal river flow, and designated floodways and bypasses.



American River Flood Control Project

EXHIBIT 4.6-1

WATER FORUM PROPOSAL EIR

0 2.5 5 MILES

NORTH

SWRI SURFACE WATER RESOURCES, INC.

Folsom Dam and Reservoir

Folsom Reservoir is a multipurpose water project constructed by the USACE and operated by USBR as part of the CVP. Folsom Dam regulates runoff from about 1,875 square miles of the American River watershed. The reservoir provides flood protection for the Sacramento metropolitan area, water supplies for irrigation, domestic, municipal, and industrial use, and hydropower. The reservoir also provides extensive water related recreation opportunities , water quality control in the Delta, and maintenance of flows stipulated to balance the requirements of anadromous and resident fisheries and wildlife with recreational considerations in and along the Lower American River (USBR and SCWA).

Flood control objectives and regulating criteria for Folsom Dam and Lake, American River, California; Water Control Manual (USACE, 1987). The flood control objectives for Folsom Dam and Reservoir include:

- Protection of the City of Sacramento and adjacent areas within the lower American River floodplain from reasonable probable rain floods;
- Control of flows in the Lower American River to existing channel capacities, insofar as practicable, and to reduce flooding along the Lower Sacramento River and Delta in conjunction with other CVP projects;
- Provide the maximum amount of water conservation storage without impairing the flood control functions of the reservoir; and
- Provide the maximum amount of power practicable and be consistent with required flood control operations and the conservation functions of the reservoir.

USACE's current flood control diagram was adopted in 1986 and requires a minimum 400,00 AF of seasonal flood control space in Folsom Reservoir.

The Regional Director of the Mid-Pacific Region of Reclamation, based in Sacramento, California, has overall operation responsibility for Folsom and Nimbus dams. Nimbus Dam and Reservoir serve as an afterbay to Folsom Dam and regulates flow into the Lower American River. The Folsom facilities are operated to secure the greatest practicable coordinated benefits for its authorized purposes. The following play a role in the day-to-day operations of the Folsom facilities:

- USBR regulates the overall operation of Folsom Dam and Reservoir as part of the CVP;
- The flood control operation principles for Folsom Dam and Reservoir are mutually agreed upon by USBR and USACE. However, USACE is responsible for providing the flood control regulations (operating criteria/flood control diagrams) and has ultimate authority for approval of flood control operations;
- Irrigation and water supply releases are determined by USBR;

Delta water quality releases are made by USBR to meet SWRCB Delta water quality and flow requirements;

- Instream flows for environmental and recreational purposes are determined by USBR with input form environmental resource agencies;
- CDPR is responsible for regulating and administering recreation programs and facilities; and
- Agencies responsible for hydrologic forecasts include USBR, the National Weather Service, and DWR (USBR and SCWA, 1995).

Current flood control operations at Folsom Reservoir include flood storage space in excess of the minimum 400,000 AF required by USACE. These operations are based on an interim plan negotiated between the Sacramento Area Flood Control Agency (SAFCA) and USBR, for which a Final EIR and Finding of No Significant Impact were adopted in 1994. In 1996, the U.S. Congress authorized the Secretary of the Interior to indefinitely continue the current "interim" operation until such time as a long-term flood control plan for the Lower American River is implemented.

Under the current interim plan, depending on the time of year and the degree of basin wetness, the allowable flood control storage (i.e., flood control reservation) can be determined by the flood control diagram. No flood control storage is required for the period June 1 through September 30. Full flood control reservation is required from November 17 through February 7 and provides for a minimum winter season flood control allocation of 400,000 AF of empty space and a maximum of 670,000 AF of empty space, depending on the space available in Union Valley, Hell Hole, and French Meadows, all upstream reservoirs on the American River.

This diagram, referred to as the "variable 400-670 TAF" flood control diagram, requise operators at Folsom Dam to reduce the water pool to no more than 575,000 AF full (400,000 AF empty) at the beginning of each flood control season if the upstream reservoirs mentioned above have 200,000 AF or more of empty space available at that time. The 400,000 AF of empty space must be met by November 17 and maintained at that level unless the storage space available in the upstream reservoirs fall beneath 200,000 AF.

Upstream from Folsom Reservoir, approximately 820,000 AF of storage capacity exists in American River watershed reservoirs. These facilities have at times proved beneficial in attenuating inflow to Folsom Reservoir, although the extent of this beneficial effect is limited by the following three factors: (1) these reservoirs were constructed and are operated for water supply and hydropower generation (they do not include dedicated space or physical features for flood control); (2) they control only 14 % of the drainage area; (3) they are concentrated in the upstream area of the Middle Fork American River, and (4) their attenuating benefit occurs only during the early part of the runoff period because, once filled, they are not effective in reducing flood volume and peak flow. Nevertheless, under current operations, the three largest upstream reservoirs (French Meadows, Hell Hole, and Union Valley) provide as much as 200,000 AF of creditable flood storage for the American River (USBR and SAFCA, 1994).

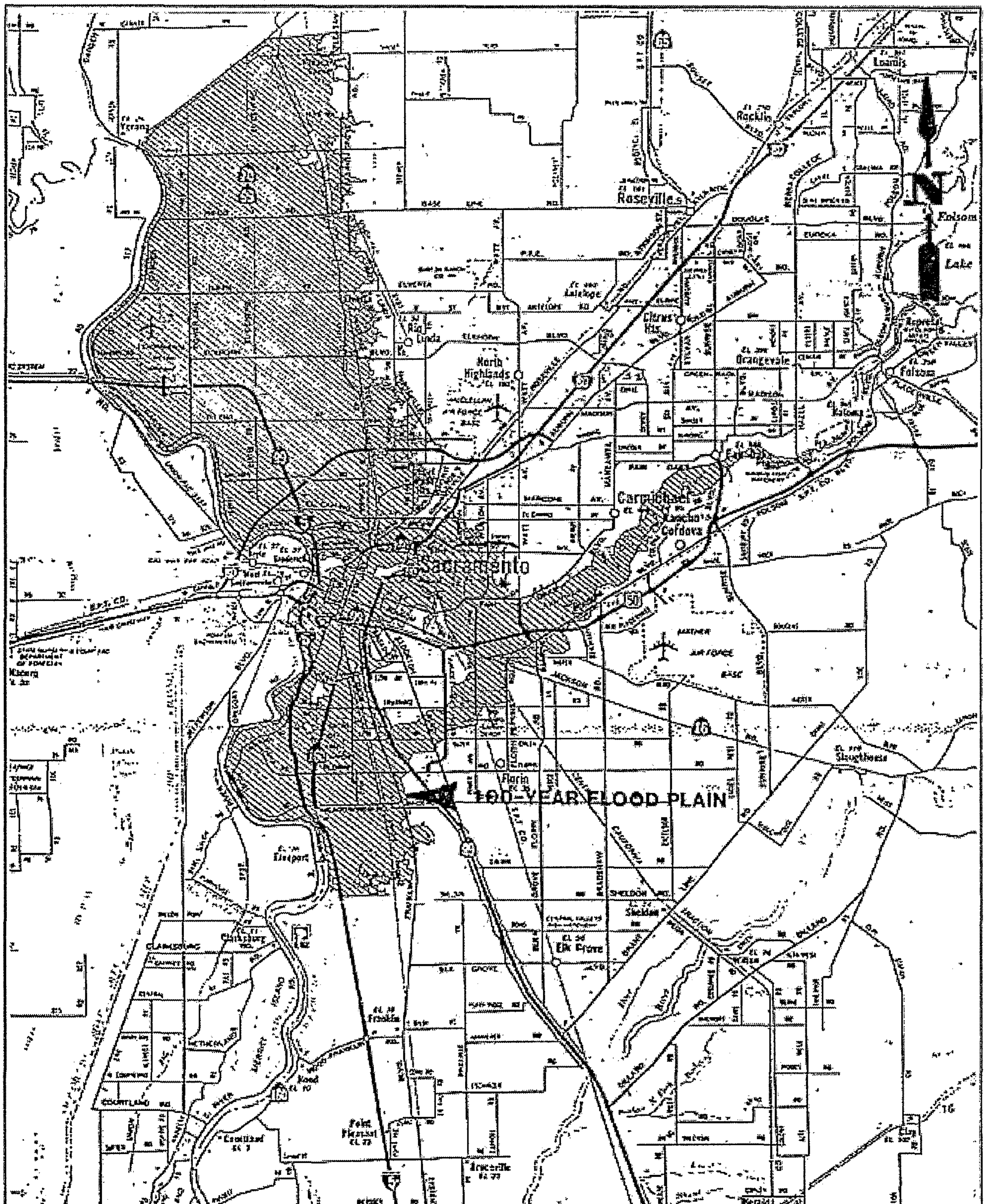
Sacramento Area Floodplain

After the 1986 flood, the USACE initiated a comprehensive evaluation of the entire Sacramento River and American River flood control systems. Conclusions from the USACE evaluation downgraded flood protection for the residents and businesses occupying low-lying areas of the Sacramento area to a 63-year level of flood protection. Flood control facilities for the Sacramento area were once thought to provide flood protection at approximately a 120-year level. As a result of the USACE's findings, the Federal Emergency Management Agency (FEMA) reassessed the 100-year floodplain in the Sacramento area and issued new Flood Insurance Rate Maps. This placed about 110,000 additional acres in the revised 100-year floodplain (Exhibit 4.6-2). These new insurance maps became effective in November, 1989 (USBR and SAFCA, 1994).

In order to address the deficiencies of the existing flood control systems, the USACE recommended bifurcation of the Sacramento and American River problems, clearing the way for the Sacramento Urban Levee Reconstruction Project to repair structurally deficient levees along the Sacramento River, and the American River Watershed Investigation to evaluate the alternatives available to increase the capacity of the American River flood control system and the levees around Natomas. The State of California, through DWR and the State Reclamation Board, joined these efforts as the non-federal sponsor (USBR and SAFCA, 1994).

Local agencies responsible for operating and maintaining the levee system around the Sacramento metropolitan area and for managing land use within the floodplain created SAFCA. SAFCA is a regional joint exercise of powers agency. The long-term goalof SAFCA is to provide the urbanized portions of Sacramento with as much flood protection as possible in order to reduce the risk of catastrophic damages and loss of life in the event of an uncontrolled flood. In pursuit of this goal, SAFCA has cooperated with the State of California and the USACE in completing the needed repairs to the Sacramento River levees, has undertaken levee improvements around North Natomas, and has negotiated an arrangement with USBR in 1994 to re-operate Folsom Dam and Reservoir to provide for at least a 100-year level of flood protection. Thus, the improved levee system in conjunction with interim re-operation of Folsom Dam and Reservoir was though to provide the Sacramento metropolitan area with a 100-year level of flood protection. However, based on the experiences of the 1997 flood and the resulting revised hydrology, the Sacramento area is considered to have a 77-year level of flood protection (USACE, 1998). Currently, SAFCA is working cooperatively with the City of Sacramento and FEMA to assure fair and reasonable floodplain mapping of the Sacramento area (USBR and SAFCA, 1994).

Under the Sacramento County Public Works Agency, the Sacramento County Water Resources Division (WRD) is responsible for almost every component of drainage infrastructure within the unincorporated areas of Sacramento County. WRD is involved in flood control and drainage investigations, planning, and regulation of the drainage infrastructure financing. The Sacramento County Transportation Division assumes responsibility for the maintenance of all county roadways including street drainage, roadside ditches, cross culverts, and bridges.



Source: Corps of Engineers, 1988.

100-Year Floodplain

EXHIBIT 4.6-2

WATER FORUM PROPOSAL EIR

NORTH

SWRI SURFACE WATER RESOURCES, INC.

USBR District 1000 (RD 1000) and the American River Flood Control District (AFRCD) are responsible for maintenance of levees in the American River Basin within Sacramento County. The AFRCD maintains levees along the American River and those along the east bank of the Natomas East Main Drain Canal. Both RD 1000 and AFRCD are members of SAFCA.

Sacramento County Drainage Master Plan Program

The Sacramento County Drainage Master Plan Program was endorsed by the (County) Board of Supervisors in August, 1991. The program was developed to address the long-term future drainage and flood control needs of the county through the implementation of cost-effective drainage and flood control systems which:

- accommodate development;
- provide the objective levels of drainage service and flood control protection;
- minimize continuing maintenance and operation costs; and
- minimize and mitigate flooding, habitat loss, and water quality impacts (Sacramento County, 1996)

Sacramento County has prepared watershed drainage master plans or other related flood control/detention plans including the Strawberry/Jacinto Creek Drainage Master Plan, Beach/Stone Lakes Flood Control Plan, and Elk Grove Creek Scoping Study. On March 9, 1993, the Board of Supervisors adopted the Floodplain Management and Interim Floodplain Development Policies which were designed to establish requirements and guidelines for minimizing and mitigating the impacts of new developments in the floodplains of the county. Policies include provisions that address or consider floodplain encroachment, easement dedication, minimization of watercrossings, prohibition on flow restrictive fencing, and prohibition on new levees for the purposes of reclaiming floodplain areas for new development.

4.6.2 THRESHOLDS OF SIGNIFICANCE

Appendix G of the State CEQA Guidelines provides only general guidance about criteria for flood control impacts that may be significant. Item (q) indicates that a project may be deemed to have a significant effect if it would "cause substantive flooding." Impacts to flood contro were considered significant if the proposed Water Forum Proposal or alternatives would result in:

- A substantial change in the ability to maintain the flood control diagrams for Folsom, Shasta, or Oroville reservoirs under either current interim or future permanent re-operation of the facilities;
- An increased exposure of persons or property to flood hazards;
- A substantial change in floodplain characteristics; or

- A substantial change in river channel geometry or gradients which could substantially change bank erosion, aggradation, degradation or meander processes.

4.6.3 WATER FORUM PROPOSAL IMPACTS

Impact 4.6-1

Ability to Meet Flood Control Diagrams of CVP/SWP Reservoirs *. The USBR is obligated to meet the flood control diagram for Folsom and Shasta reservoirs and the Department of Water Resources (DWR) has the similar responsibility for Oroville Reservoir. Any reduction in the ability of either the USBR or DWR to meet their flood control obligations for these reservoirs would constitute a significant impact. Since implementation of the Water Forum Proposal would increase water diversions from Folsom Reservoir, thereby allowing Folsom Reservoir to start the flood control season with less water in storage than under existing conditions, and since the integrated nature of CVP/SWP operations would also result in lowered reservoir storage in Shasta and Oroville reservoirs, none of the flood control diagrams for these reservoirs would be compromised. This is considered to represent a* ***less-than-significant*** *impact.*

In the future with the Water Forum Proposal in place, USBR's ability to meet the flood control diagrams established for its major flood control reservoirs would not be affected. USBR is bound by its obligations to meet the reservoir storage schedule (flood control diagram) for each of its reservoirs defined previously. With the increased level of water diversions from Folsom Reservoir contemplated in the future and defined by the Water Forum Proposal, relative to the Base Condition, Folsom, Shasta, and Oroville reservoirs would each commence their flood control season (November 17) with less water in storage and hence have greater opportunities of meeting the objective empty space requirements throughout the remainder of the flood control season. Future diversions associated with the Water Forum Proposal, by their nature, therefore, would take reservoir storage lower upon entering the flood control season, relative to the Base Condition. This would have an overall beneficial effect on the ability of these reservoirs to meet flood storage space at the outset, and throughout the duration of the flood control season.

Impact 4.6-2

Increased Stress on Lower American River Flood Control Structures *. Increased releases from Nimbus Dam and hence, flows in the Lower American River, during the flood control season could affect the stability of flood control structures on the Lower American River. Higher flows could increase stress on levees and other flood control structures. However, under the Water Forum Proposal, 70-year average mean monthly flows would always be lower than the Base Condition. Therefore, downstream structures on the Lower American River would remain unaffected. This is a* ***less-than-significant*** *impact.*

A comparison of Nimbus Dam releases between the Base Condition and the WFP for each month of the flood control season (November through April) and also including October was made. An analysis of river flows in the Lower American River revealed that during the flood control season, on average, over the 70-year hydrologic period of record, mean monthly Nimbus Dam releases under the WFP would be less than those under the Base Condition for every month (Table 4.6-1). While in individual months, in specific years, an increase in mean monthly flows under the WFP, relative to the Base Condition, would result, these would occur infrequently (13 out of 490 months) and would generally be of insignificant magnitude.

Table 4.6-1
Comparison of 70-Year Average Lower American River Mean Monthly Flows (cfs) at Nimbus Dam

Month	Base Condition	WFP	Difference[1]	
October	2,139	2,040	-99	(-5.0%)
November	2,713	2,566	-147	(-5.9%)
December	3,665	3,521	-144	(-5.6%)
January	4,337	4,211	-126	(-4.2%)
February	4,883	4,719	-164	(-4.5%)
March	3,991	3,849	-142	(-3.6%)
April	3,595	3,413	-182	(-5.8%)

[1] Change under the Water Forum Proposal, relative to the Base Condition. Values reported represent the average change for the 70 years modeled, rather than the difference between the 70-year average flow values for each month under the two scenarios.

Source: SWRI, 1998.

Increases of these magnitudes would not result in significant flow-related impacts since the resulting flows in the Lower American River would be well within their normal operating ranges. Additionally, at such flows, the resulting stress imposed on downstream flood control structures would not exceed those historically experienced.

In summary, under the WFP, mean monthly flows in the lower American River would generally be lower than the Base Condition. However, in 13 months out of 490 total months would individual mean monthly flows be greater than the Base Condition. The magnitude of increase, however, coupled with their relative infrequency, is considered to be less-than-significant, therefore, potential impacts to downstream structures would also be less-than-significant.

Impact
4.6-3

Increased Exposure to Flood Hazards. *Implementation of the Water Forum Proposal would not compromise the flood protection provided by Folsom Dam or structures along the Lower American River. Future projects, undertaken by Water Forum stakeholders, and their associated construction activities, may, however, affect local flood control efforts and/or structures. New projects having the potential to affect flood control structures will have to conduct flood control analysis and comply with flood control regulations before approval. Since these future projects are not part of the Water Forum Proposal, specific project-level analysis for flood control protection would be undertaken prior to their approval, and the fact that the flood control protection provided by Folsom Dam would not be compromised, increased exposure to flood hazards is considered to be a* ***less-than-significant*** *impact.*

As identified above, the flood control diagram for Folsom Dam and Reservoir would not be compromised under the WFP. Persons or property within the area provided protection by Folsom Dam, therefore, would not experience any significant increase in exposure to flooding hazards, relative to the Base Condition.

Future construction activities associated with individual or independent projects have the potential to impact local flood control. Existing institutional planning processes, however, contain provisions that consider both the large- and small-scale effects of projects on flood control protection. The Open Space Preservation Strategy Diagram contained in the 1993 Sacramento County General Plan, for example, would be conferred with to determine the presence of areas subject to flooding in any identified future site-plans.

Certain facilities are relatively small in scale and would include groundwater wells and pump stations. While the precise locations of any such future facilities are yet to be determined, these facilities would be located outside federally designated special flood hazard areas so that the risks to facility and property damage would be minimal. However, if the facilities were located within federally designated special flood hazard areas, a determination of significance and the risks to facility and property damage would be determined by appropriate personnel; in Sacramento County, this would be WRD. In this case, a County permit would be required since all activities within federally designated special flood hazard areas require that a permit be obtained. The Sacramento County Floodplain Management Permit Ordinance provides a review and approval process where WRD personnel make judgments as to what development activities are considered to pose a significant impact to anticipated flood elevations. The WRD would also make a judgment as to which activities at a site would be acceptable in order to maintain flood control integrity.

Future project-level analyses would be completed prior to proceeding with any future project. An analysis at the project-level would involve a more detailed examination of the specific components of the proposed construction-related activities and may identify significant impacts and relevant mitigation measures, as necessary, and at the time that such future projects are proposed. For the most part, construction activities involving surface disturbances such as trenching and backfilling would be temporary, localized, and not impinge upon existing flood control structures (i.e., levees).

Under the WFP, potential increases in exposure of persons or property to flood hazards would be a less-than-significant impact.

Impact 4.6-4

<u>Substantial Change in Floodplain Characteristics</u>*. No specific construction activities are associated with the Water Forum Proposal, which would affect Sacramento or American River floodplain characteristics. Any new future projects requiring construction of facilities would be required to evaluate their specific and individual impacts on flood control in a project-level study. Since the Water Forum Proposal does not include implementation of specific projects, impacts to floodplain characteristics as a result of the Water Forum Proposal are considered to be **less than significant**.*

Under the WFP, no specific projects, and therefore, construction related activities are proposed that would affect existing floodplain characteristics along either the Sacramento or American River floodways. Where any such new facilities would be proposed, the extent of their influence on the floodplain and its function in flood control would likely remain unaffected. This is because it is assumed that the installation of any new future infrastructure (e.g., intakes, water treatment plants, underground pipelines, etc.) involving surface disturbance, trenching and backfilling would be temporary, there would be no net fill within federally designated special flood areas, and projects of this nature do not typically have the ability to negatively affect floodplain geomorphology.

While increased withdrawals from the American River, however, could affect the morphometry of the channel over time, floodplain morphology is likely to remain unaffected by implementing the Water Forum Proposal since increased diversions alone, would not affect floodplain form. Any proposed changes to drainage courses, drainage master plans, or flood control programs that might lead to long-term changes in floodplain characteristics, however, would require independent CEQA review.

Impact 4.6-5

Changes in River Channel Geometry or Gradients Leading to Changes in Bank Erosion, Aggradation, Segradation, or Meander* Processes**. *While the Water Forum Proposal does not contain construction or improvement of instream structures, future projects might include such actions. These types of actions could ultimately affect the structural integrity of levees. Any such impacts would be addressed in future design plans and, therefore, are considered to represent a* ***less-than-significant *impact under the Water Forum Proposal.*

Future improvements to, or construction of, new instream structures within the Sacramento or American river floodways may result in impacts to the physical environment ofthe river channel in the immediate vicinity or downstream of any instream structure. There is the potential for scour-related impacts to occur at structures attached to the river bottom or river banks. The potential for scour around any structure fixed to the river bottom represents a potentially significant impact insofar as it can generate turbulent eddies which, by changing flow vectors, may affect levee stability. As an example, undermining scour present at the City of Sacramento ' s Fairbairn WTP intake structure on the Lower American River has progressed on all sides of the facility with scour at the upstream end of the structure the most severe. Future instream structures (e.g., water intakes) have the potential to promote scour patterning similar to that occurring at bridge piers, with the deep scour hole located at the leading edge of the structure. However, any such impacts would be addressed in detail during the development of final design phase site-plans, at the time that those projects are proposed. Since the Water Forum Proposal itself does not propose specific facility projects (including any instream structures), this impact is considered to be less-than-significant.

4.6.4 MITIGATION MEASURES

No mitigation measures are necessary for the following less-than-significant impacts:

4.6-1:	Ability to Meet Flood Control Diagrams of CVP/SWP Reservoirs
4.6-2:	Increased Stress on Lower American River Flood Control Structures
4.6-3:	Increased Exposure to Flood Hazards
4.6-4:	Substantial Change in Floodplain Characteristics
4.6-5:	Changes in River Channel Geometry or Gradients Leading to Changes in Bank Erosion, Aggradation, Segradation, or Meander Processes

4.6.5 LEVELS OF SIGNIFICANCE AFTER MITIGATION

All flood control impacts identified in this EIR are less than significant.

4.7 POWER SUPPLY

4.7.1 EXISTING CONDITIONS

This section considers power generation and consumption in the CVP. The Water Forum Proposal has the potential to affect CVP electrical energy production because changed reservoir operations could affect the generation characteristics of the powerplant, diminish water releases resulting in reduced energy, or increase pumping energy use by specific projects. In addition, the Water Forum Proposal has the potential to affect requirements for additional power related to the pumping of water (e.g., groundwater and pump-back of surface supplies from diversion points lower in the watershed). The following discussion regarding power generation and consumption is consistent with the analysis in the Reclamation and Sacramento County Water Agency Draft EIS/EIR for P.L. 101-514 Contract Water (1997) and the City of Sacramento Administrative Draft EIR for Water Supply Expansion (1995).

CVP HYDROPOWER SYSTEM

The CVP hydropower system consists of eight powerplants and two pump-generating plants (Table 4.7-1). This system is fully integrated into the Northern California Power System and provides a significant portion of the hydropower available for use in northern and central California. The installed power capacity of the system is 2,044,350 kilowatts (kW). By comparison, the combined capacity of the 368 operational hydropower plants in California is 12,866,000 kW and the Pacific Gas and Electric Company (PG&E) is the area's major power supplier with a generating capacity from all sources of over 20,000,000 kW.

Once a strong influence on CVP operations, power operations are now secondary to other considerations. In part, this subordination is caused by the elevation of environmental needs to a higher standing, but changes in contractual relationships have also reduced the priority of power.

Power produced by the CVP hydropower system is used first for meeting project water pumping loads, which is deemed "project use power," at CVP pumping facilities (Table 4.7-2). Power surplus to project use is "commercial power" and is marketed by the Western Area Power Administration (WAPA) under long-term firm contracts to municipal and government entities (preference customers) at cost-based rates pursuant to Reclamation Law. In an average year, 4,600 gigawatt hours (GWh) of energy and 1,700,000 kW of capacity are marketed to preference customers at rates that recover full cost of production and repayment obligations of project investment with interest. Energy surplus to CVP project use and preference customer power needs is "banked" under WAPA/PG&E Contract 2948A, to be repaid when needed by WAPA and its customers. The contractual agreements between WAPA and its customers terminate in 2004, and it is unlikely that the contract will be renewed. WAPA is currently in the process of determining how it will market the CVP hydropower resources surplus to project use power needs once the contract has expired.

Table 4.7-1
Power Resources of the Central Valley Project

Unit	Maximum Generating Capacity (kW)	Average Plant Factor (%)
Sacramento River Service Area		
Carr	184,000	34
Lewiston	350	100
Keswick	105,000	62
Shasta	584,000	50
Spring Creek	200,000	42
Trinity	140,000	51
Subtotal	1,213,350	
American River Service Area		
Folsom	215,000	45
Nimbus	17,000	61
Subtotal	232,000	
Delta Export and San Joaquin Valley		
New Melones	383,000	26
O ' Neill	14,000	1
San Luis [1,2]	202,000	10
Subtotal	599,000	
TOTAL	2,044,350	----

1 Pump-Generating Plant.
2 Jointly-owned, pumping and generating facility, federal share only.

Source: Western Area Power Administration, 1994.

Table 4.7-2
Major Pumping Plants in the CVP

Unit	Capacity (cfs)	Average Annual Energy Use (kWh)
American River Service Area		
Folsom Pumping Plant	350	1,041,000
Delta Export and San Joaquin Valley		
Contra Costa Canal	410	18,908,000
Dos Amigos [1]	13,200	180,146,000 [2]
O ' Neill	4,200	87,185,000
San Luis [1]	11,000	306,225,000 [2]
Tracy	4,600	620,712,000

1 Joint State-Federal facility.
2 Federal energy use.

Source: U.S. Army Corps of Engineers, 1992.

Folsom Dam and Reservoir

The Folsom Powerplant has three generating units, with a total release capacity of approximately 8,600 cfs. By design, the facility is operated as a peaking facility. Peaking plants schedule the daily water release volume during the peak electrical demand hours to maximize generation at the time of greatest need. At other hours during the day there may be no release (and no generation) from the plant.

To avoid water surface elevation fluctuations in the Lower American River, the downstream Nimbus Dam and Reservoir (Lake Natoma) is operated as a regulating facility. Although the water surface elevation in the reservoir behind Nimbus Dam fluctuates during the day, releases to the Lower American River are kept constant. The Nimbus Powerplant consists of two generating units with a release capacity of approximately 5,100 cfs. Electric generation from this facility is continuous throughout the day.

4.7.2 THRESHOLDS OF SIGNIFICANCE

The State CEQA Guidelines do not provide guidance related to changes in hydropower capacity or pumping power costs. Significance criteria have been tailored specifically to address these issues.

HYDROPOWER

The first of several hydropower-associated significance criterion is related to the availability of capacity for use by WAPA's preference customers. Preference customers are those users to whom WAPA provides capacity and energy under terms of power sales contracts. To the extent that the commitment to provide capacity to these entities cannot be met from net CVP capacity, WAPA must purchase power from other sources to satisfy these demands. If these purchases were increased as a result of the WFP, then a cost impact would be incurred. This analysis assumed that significant impacts to hydropower available capacity would occur if capacity purchases by WAPA were substantially increased by the implementation of the WFP.

A second capacity criterion is related to the availability of surplus capacity. During the months of May through August, any CVP capacity surplus to project use and preference customer needs may be marketed by WAPA. Impacts to surplus capacity would be considered significant if the average annual surplus available for WAPA's sale was substantially decreased by the implementation of the WFP.

Energy that has value throughout the year is a third significance criterion. Substantial reduction in available CVP energy is a cost impact either in the sense that the CVP is precluded from selling any excess energy, or, is required to purchase additional energy for its contractors.

PUMPING POWER

Impacts to pumping power could result from changes in pumping requirements due to changes in the elevation and timing of available water supplies in Folsom Reservoir under the Water Forum Proposal. Such impacts would be considered significant if average annual pumping energy requirements for purveyors at Folsom Reservoir were to increase over the Base Condition.

4.7.3 IMPACTS ASSESSMENT METHODOLOGY

Using PROSIM, the net CVP capacity and energy for each month under the 1998 with WFP was calculated and compared to the Base Condition (i.e., current level of demand). Differences between the Base Condition and the WFP were then evaluated for impacts. These impacts represent the WFP impacts at the current level of development.

HYDROPOWER IMPACTS FRAMEWORK

Potential hydropower impacts are associated with two quantities, electrical capacity and electrical energy. Reductions in one or both could result from the implementation of the Water Forum Agreement. These impacts would not be expected to cause direct environmental effects, but would have economic consequences for CVP power users in the form of increased capacity/energy purchases to support preference customer loads, or reduced surplus capacity/energy sales. It is quite possible that thermal generation resources, which do emit air pollutants, would supply some portion of the replacement energy. Estimating when, where, and how "dirty" the replacement energy might be, would be speculative and ibeyond the ability to predict, given the interconnection of electric utility generation in the western United States.

CVP powerplants such as Folsom are part of an integrated generation/pumping system for distribution of water supplies to CVP customers. Hydropower production is a function of reservoir storage and water releases through powerplants. Hydropower consumption is dependent on CVP project use (primarily pumping). The remaining quantity of CVP hydropower production minus CVP project use provides a measure of capacity and energy by which the alternatives can be compared to a base condition.

Hydropower impacts for this analysis were assessed by comparing changes in monthly values of net (CVP production minus losses minus project use) CVP capacity and energy under the WFP, relative to the Base Condition. These changes in values were obtained from the power subroutine of PROSIM for each month of the modeled 69-year hydrologic period of record.[1]

PUMPING POWER IMPACTS FRAMEWORK

Pumping power impacts are also associated with electrical capacity and electrical energy. Reductions in Folsom Reservoir levels caused by the Water Forum Proposal may increase

[1] PROSIM simulates the water years 1922-1991, however, power is normally evaluated on a calendar year basis. Thus, only 69 years of data (1922-1991) are available for assessment.

capacity and energy requirements to pump water at the Folsom Pumping Plant and the EID pumping plant at Folsom Reservoir. These impacts, like those for hydropower, would not be expected to cause direct environmental effects, but would have economic consequences and increase the demand for other sources of power.

Using PROSIM, the Folsom Reservoir elevation for each month under the WFP was calculated and compared to the Base Condition. Pumping power impacts include several considerations. First, do the Folsom Reservoir elevation differences affect the ability to "gravity flow" water to the North Fork and Natomas pipelines? Second, do the Folsom Reservoir elevation differences affect the ability to serve water at the flow rates required? Third, what additional capacity and energy needs are there for increased pumping caused by increased lift?

Table 4.7-3 presents Folsom Reservoir elevations related to water supply (pumping plant) capabilities. Because Folsom Reservoir elevations affect gravity flow to the North Fork and Natomas pipelines, the first step of the analysis was to eliminate those occasions when elevation differences would not inhibit gravity flow. If gravity flow is uninhibited, then there would be no impact.

The second step involved identifying those elevation conditions when additional pumps would have to be installed to make up for the elevation difference (non-gravity flow conditions). Based on the analysis, if the WFP was shown to contribute to differences sufficient to require installation of additional pumping facilities, there would be a significant impact.

The third step involved identifying those elevation conditions when there would be a need for additional electrical energy to compensate for increased lifts. Energy requirements for EID were computed as a variable (elevation dependent) kilowatt hour (kWh) per AF pumping rate times the water pumped for the month. At the Folsom Pumping Plant, energy requirements were applied to the product of a single (70 kWh per AF) pumping rate times the water pumped for the month for those months when gravity flow would be inhibited.

4.7.4 WATER FORUM PROPOSAL IMPACTS

Potential power supply impacts include changes in CVP hydroelectric power generation, project use, and electrical requirements for water supply pumping for diverters at Folsom Reservoir. No other potential effects on power generation or demand are anticipated from the implementation of the Water Forum Proposal with the exception of potential increases in the use of energy resources for conveyance and treatment of the new water supplies.

Table 4.7-3 Folsom Reservoir Water Surface Elevation Pumping Relationship		
Surface Elevations (ft msl)	Storage[1] (AF)	Pumping Relationship
433	640,800	Pumping to City of Roseville and SJWD during irrigation season (Apr - Oct)
425	569,900	Pumping required to City of Roseville and SJWD during non-irrigation season
414	480,200	Pumping begins to City of Folsom and Folsom Prison.
356	158,900	EID pumps begin to develop vortex problems.
340	111,900	Potential vortex at dam intake, depending on volume of pumping.
335	100,000	Folsom Pumping Plant limited to 70 cfs.
325	79,200	Lower limit of EID pumps and Folsom Pumping Plant; pumps on barges required to pump water to existing intakes
315	62,100	Elevation of Folsom Dam water intake; tap penstocks.
307	50,400	Elevation of power penstocks; portable pumps placed on a barge to supply pipeline intake.

[1] USBR Folsom Reservoir 1993 Area Capacity Tables.

Source: U.S. Army Corps of Engineers. 1992. Folsom Dam and Reservoir Re-operation, California, Operation Plan and Environmental Impact Statement, Draft Report. Sacramento, California.

Hydropower Impacts

Impact 4.7-1

Reduced CVP Hydropower Capacity and Generation. *Implementation of the WFP would not result in reduced capacity for use by WAPA's preference customers or reduce average annual surplus capacity available for WAPA's sale. Although under the WFP, WAPA's capacity peak maximum of 1,152 megawatts would not be met in 41 of the 828 months studied, the Base Condition would also fall short of the maximum in 42 of the 828 months. Implementation of the WFP would reduce average annual CVP energy production, however. With the WFP, an average annual reduction of 30 Gwh would occur, as compared to the Base Condition. This reduction when compared to the annual average CVP energy production of 3,650 Gwh is considered a* ***less-than-significant*** *impact.*

Changes in Capacity for Preference Customer Use - Net CVP capacity values for each month of the 69-year hydrologic period of record were obtained from the PROSIM simulations of the Base Condition and the WFP. Net CVP capacity is defined as the capacity available at load center and is calculated as the total CVP generated capacity minus transmission losses minus project use. The minimum monthly net CVP capacity that was observed in the Base Condition was 926 megawatts (Mw), occurring during the month of September. Minimum monthly capacity values and selected statistics for the Base Condition simulation are shown in Table 4.7-4.

Table 4.7-4 Net CVP Capacity (Mw)													
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Base Condition	Minimum	1036	1131	1143	1257	1303	1269	1173	960	926	965	891	970
	Average	1385	1426	1476	1568	1579	1515	1471	1391	1297	1312	1324	1362
	Maximum	1580	1597	1620	1699	1676	1609	1580	1582	1542	1529	1562	1606
	Adverse Year	1228	1294	1375	1454	1446	1407	1363	1266	1136	1174	1154	1196
	Months < 1152 Mw	6	3	1	--	--	--	--	3	8	7	7	7
WFP	Minimum	1043	1134	1124	1239	1308	1278	1184	974	943	983	907	971
	Average	1383	1427	1475	1569	1578	1517	1475	1392	1296	1311	1323	1361
	Maximum	1581	1613	1620	1689	1676	1606	1583	1580	1539	1524	1562	1606
	Adverse Year	1234	1286	1376	1442	1450	1416	1368	1263	1144	1171	1150	1206
	Months < 1152 Mw	6	2	1	--	--	--	--	2	8	7	8	7
Source: SWRI, 1998.													

The same statistics for the WFP simulation are also shown in Table 4.7-4. The minimum monthly net capacity for the WFP simulation was 907 Mw, occurring in November.

Contract 2948A requires PG&E to provide capacity support up to 1,152 Mw for CVP preference customer loads. If CVP production and purchases are insufficient to meet preference customer demands, WAPA purchases capacity from PG&E to cover the difference. Monthly loads for projecting power purchases by CVP preference customers vary from year to year and a 69-year hydrologic period of record for the modeled period is not available. In recent years, CVP system simultaneous capacity peaks have approached the 1,152 Mw maximum.

The WFP would not increase preference customer electrical loads. However, the availability of less than 1,152 Mw from CVP hydropower production could necessitate an incremental increase in capacity purchases by WAPA from PG&E. To assess the potential for additional purchases, the monthly net CVP capacity at load center was compared to the 1,152 Mw support level.

For the Base Condition, 42 months in the study period exhibited a net CVP capacity less than 1,152 Mw. Under the WFP, 41 months of the 828 contained in the study period exhibited a net CVP capacity less than 1,152 Mw. Because there are fewer infringements on the 1,152 Mw criteria under the WFP than there are under the Base Condition, no significant impact to the net capacity available to CVP preference customers would occur.

<u>Changes in Surplus Capacity</u> - Surplus CVP capacity is that which remains after project use and preference customer needs are met. A market exists during the months of May through August in which WAPA may sell excess capacity. Several statistical representations (Table 4.7-4) based on simulations of the Base Condition and the WFP were initially used to identify impacts.

The average year statistic (average of 69 values for each month) indicates that approximately the same surplus capacity is available under the WFP than is currently available under the Base Condition. A summation of the monthly surplus capacity available in the May through August for the 69-year hydrologic period of record found that in the Base Condition there would be 94,595 Mw-months of surplus capacity. Under the WFP, 95,024 Mw-months of surplus capacity would occur. The simulations show that the Base Condition produces surplus capacity values less than under the WFP. Because surplus CVP capacity was not reduced by the WFP (95,024 Mw-months minus 94,595 Mw-months = 429 Mw-months), WAPA would not experience a significant impact.

Reduction in Annual Average CVP Energy Production - CVP powerplants produce energy for project use and commercial sales. Energy production could be reduced by the WFP, causing WAPA to either reduce surplus energy sales or increase energy purchases to meet its commitments. In either case, there is definable economic cost but an unidentifiable environmental impact. The environmental impact is associated with the replacement energy produced by dirty sources. These dirty sources are generally identified as thermal powerplants burning some form of hydrocarbon fuel. A comparison of annual net CVP energy available at load center was performed using data from the Base Condition and the WFP. The analysis included the development of graphs, Exhibits 4.7-1 and 4.7-2, at the end of the section, showing the annual net CVP energy for each simulation.

Shown on each exhibit is the average net CVP energy for the 69-year period of record. From these averages, it is apparent that the net CVP energy at load center for the WFP is less than that under the Base Condition. Exhibit 4.7-3, at the end of the section, illustrates the annual changes in net CVP energy resulting under the WFP. The average annual reduction is shown to be 30 GWh (3,620 GWh minus 3,650 GWh = -30 GWh). Although, with respect to average annual CVP energy, the percentage (30/3650 = 0.8%) is small, the overall effect of the 30 GWh reduction in annual average net CVP energy at load center is considered to be a less-than-significant impact to WAPA.

Pumping Power Impacts

Impact 4.7-2

Increased Energy Requirements for Diverters Pumping From Folsom Reservoir.
*Implementation of the WFP would result in changes in pumping requirements for those who pump water from Folsom Reservoir. Under the WFP, it is anticipated that an increase in average annual pumping energy would be required. While this impact would be environmentally less-than-significant, it represents an **economically significant** impact.*

Reductions in Folsom Reservoir water surface levels resulting from the implementation of the WFP could contribute to increased pumping requirements at the Folsom Pumping Plant and the EID Pumping Plant. Exhibits 4.7-4 and 4.7-5, at the end of the section, show the frequency of Folsom Reservoir water surface elevations during the non-irrigation (November-March) and irrigation (April-October) periods. Using Table 4.7-3 as a reference, a comparison of data from the Base Condition and the WFP, illustrates differences for a number of conditions.

Examination of the monthly data shows the Base Condition falling below the 356 feet msl elevation five months out of the 70-year hydrologic period of record. Under the WFP, there are 12 months when the water surface falls below this critical elevation for EID. Four of these 12 months under the WFP, fall below elevation 335 feet msl, the level where severe restrictions on pumping at the Folsom Pumping Plant would occur.

Below elevation 414 feet msl, pumping is required to serve the City of Folsom and Folsom Prison. During the November-March period, pumping would be required 50% of the time under the Base Condition and nearly 54% of the time under the WFP. For the April-October period pumping would be required 31% of the time under the Base Condition and 34% of the time under the WFP.

Below elevation 425 feet msl, pumping is required to serve the City of Roseville and the San Juan Water District during the November-March period. Under the Base Condition, pumping would be required about 79% of the time while under the WFP, pumping would be necessary nearly 80% of the time.

When the reservoir surface elevation falls below 433 feet msl during the April-October period, pumping is required to serve both the City of Roseville and the San Juan Water District. Under the Base Condition, elevations are below 433 feet msl about 54% of the time. During the same period, under the WFP, elevations would fall below 433 feet msl about 56% of the time.

The increased pumping requirements at the Folsom Pumping Plant and the EID Pumping Plant occur regularly during the November-March period and, though less frequently, also during the April-October period. Table 4.7-5 illustrates the combined average monthly energy requirements for pumping at the EID and Folsom pumping plants. On average, over the 70 years simulated, there was an increase in the annual pumping energy requirement of approximately 5,800,000 kWh under the WFP, relative to the Base Condition. While this is not an environmentally significant effect, it represents an economically significant impact.

Table 4.7-5 Average Energy Requirement for Pumping at EID and Folsom Pumping Plants (kWh)		
Month	**Base Condition**	**WFP**
October	599,754	1,251,725
November	409,432	815,850
December	337,858	703,249
January	355,480	700,772
February	342,779	691,433
March	226,337	496,563
April	214,510	481,402
May	239,684	556,666
June	432,086	973,151
July	586,224	1,305,573
August	690,576	1,484,472
September	633,011	1,408,810
TOTAL	5,067,730	10,869,665
Source: SWRI, 1998.		

4.7.5 MITIGATION MEASURES

No mitigation measures are necessary for the following less-than-significant impacts:

4.7-1: Impacts to CVP Hydropower: Reduced Annual Average CVP Energy Production

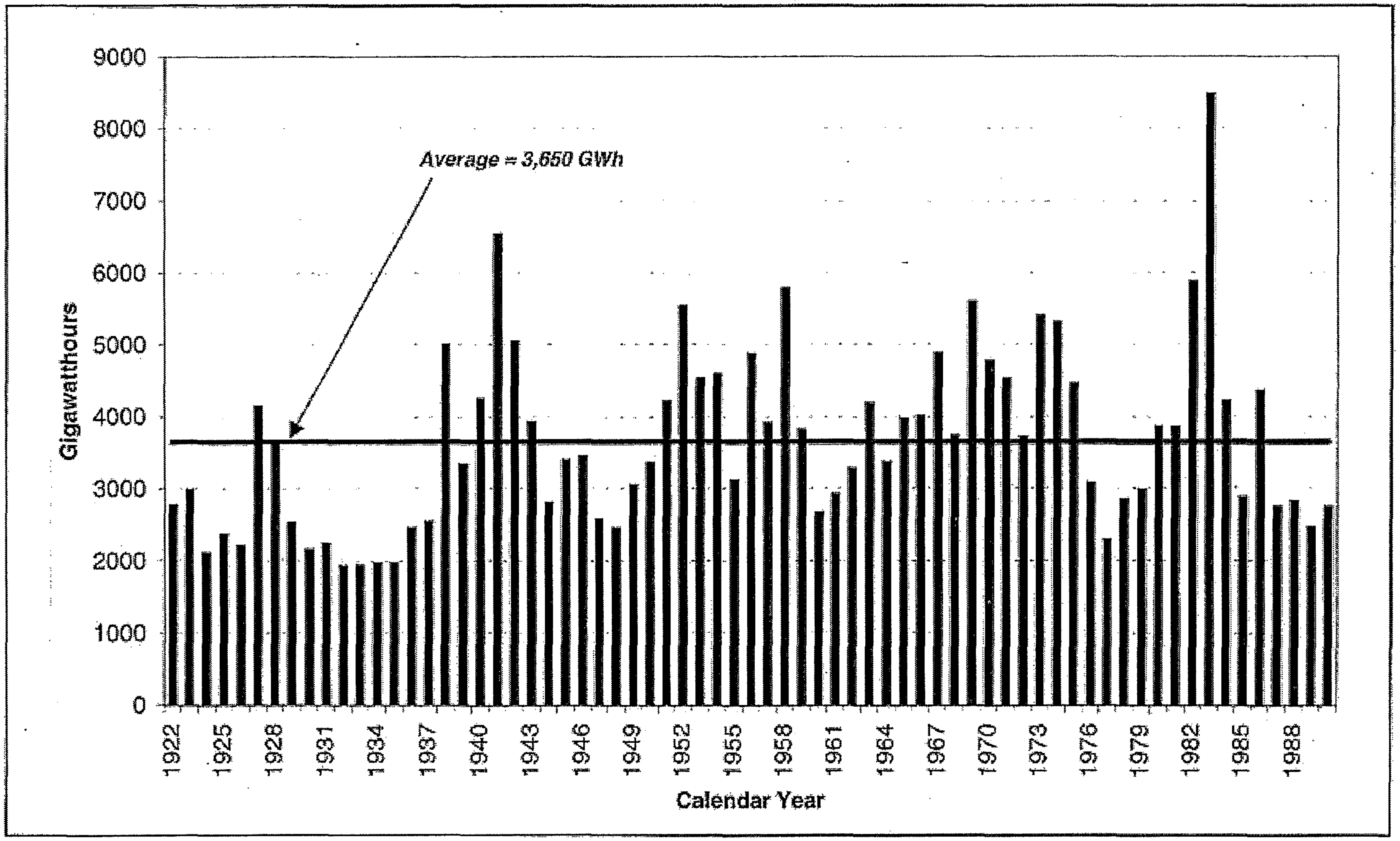
No feasible mitigation measures are available for the following significant economic impact:

4.7-2: Changes in Pumping Requirements for Diverters at Folsom Reservoir

The economic impact identified is unavoidable given that the process of delivering water necessitates pumping and consequently electrical energy. With respect to Folsom Reservoir pumping costs, the relatively small size of Folsom Reservoir, coupled with a large storage reservation for flood control, constrains operations from achieving large carryover storage volumes. Consequently, the reservoir can frequently be considered as an annual operation, that is, it is filled and essentially emptied every year. Within limits, in most years additional demands for water have a greater effect on the timing of storage in the reservoir than an effect on ultimate maximum or minimum annual storage. Any additional use of water from Folsom Reservoir that alters the timing of storage does, however, affect pumping requirements and the WFP is no exception. Pumping energy economic impacts are unavoidable and are borne by the Folsom Reservoir diverters themselves.

4.7.6 LEVEL OF SIGNIFICANCE AFTER MITIGATION

Although the WFP contains features that lessen environmental impacts (including water conservation, dry-year diversion restrictions, and conjunctive use of ground water and surface water), the WFP does not entirely avoid significant economic effects on power supply. There are no feasible mitigation measures that would reduce the economic impact to less-than-significant levels. Consequently, for disclosure reasons, this EIR indicates that power supply impacts are considered economically significant and unavoidable. For purposes of CEQA compliance, the effect is environmentally less than significant, so it does not represent a significant unavoidable environmental impact.

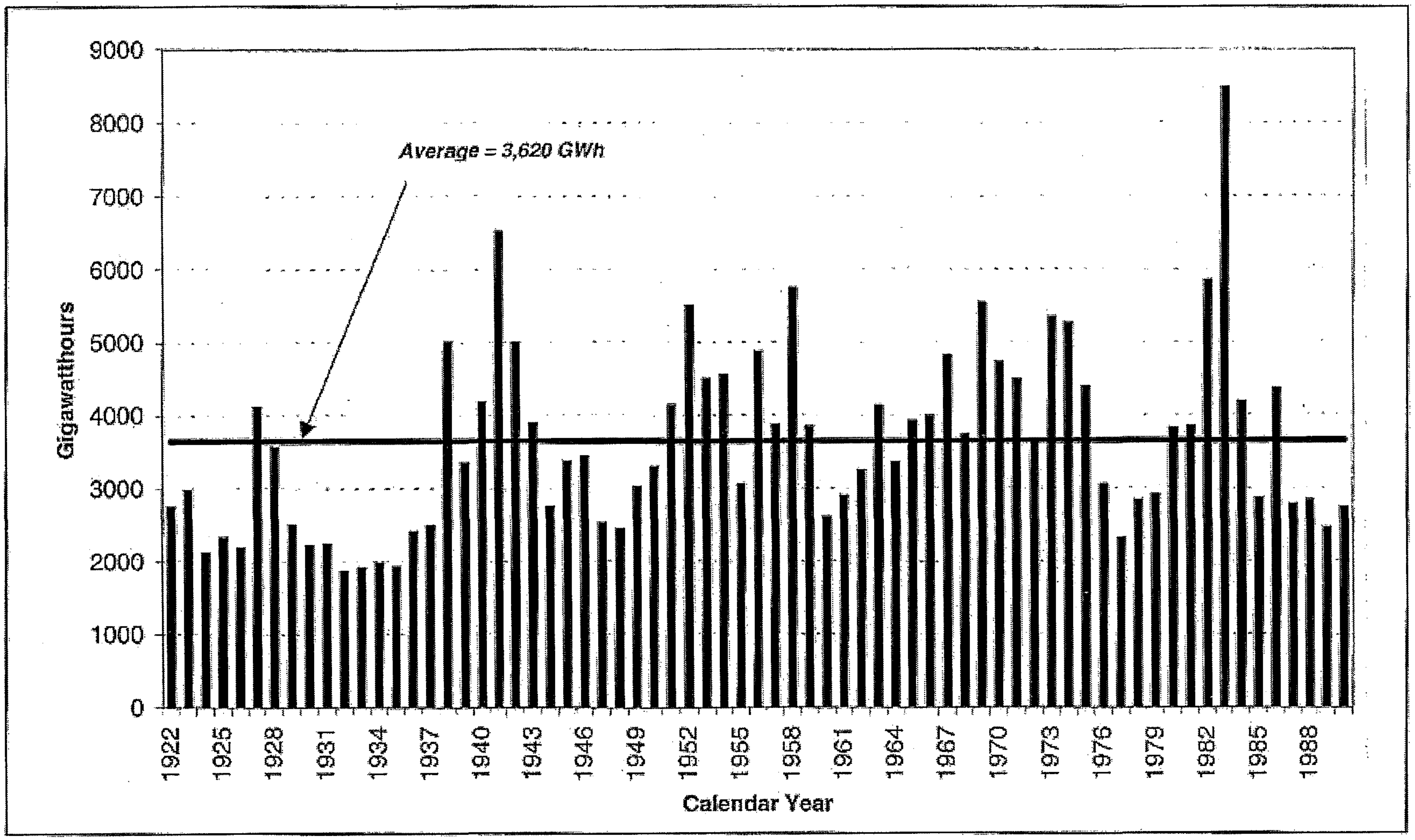


Base 1998 Annual Net CVP Energy at Load Center

EXHIBIT 4.7-1

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES, INC

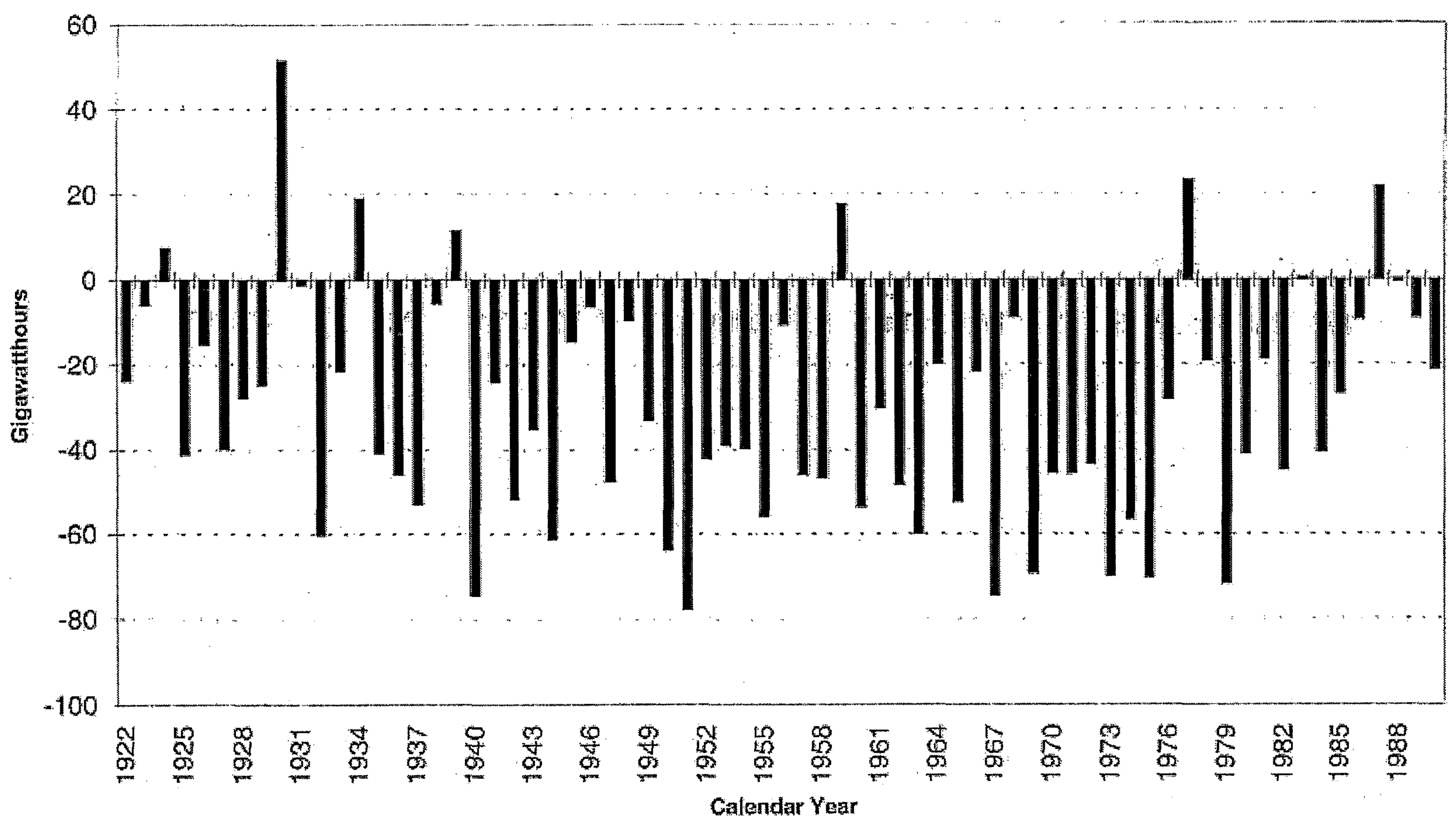


1998 With WFP Annual Net CVP Energy at Load Center

EXHIBIT 4.7-2

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES, INC

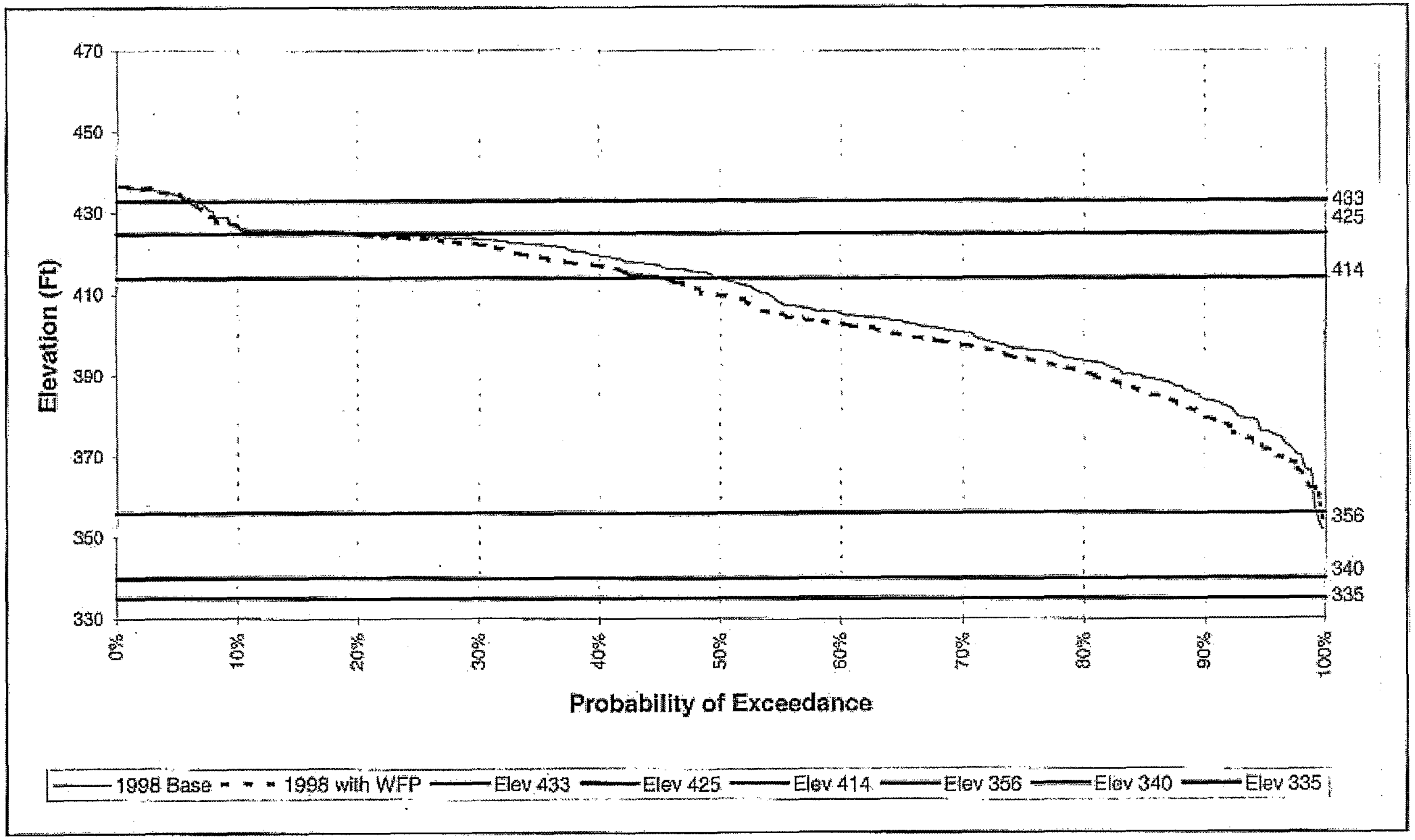


Change in Annual Net CVP Energy at Load Center
1998 With WFP Minus 1998 Base

EXHIBIT 4.7-3

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES INC.

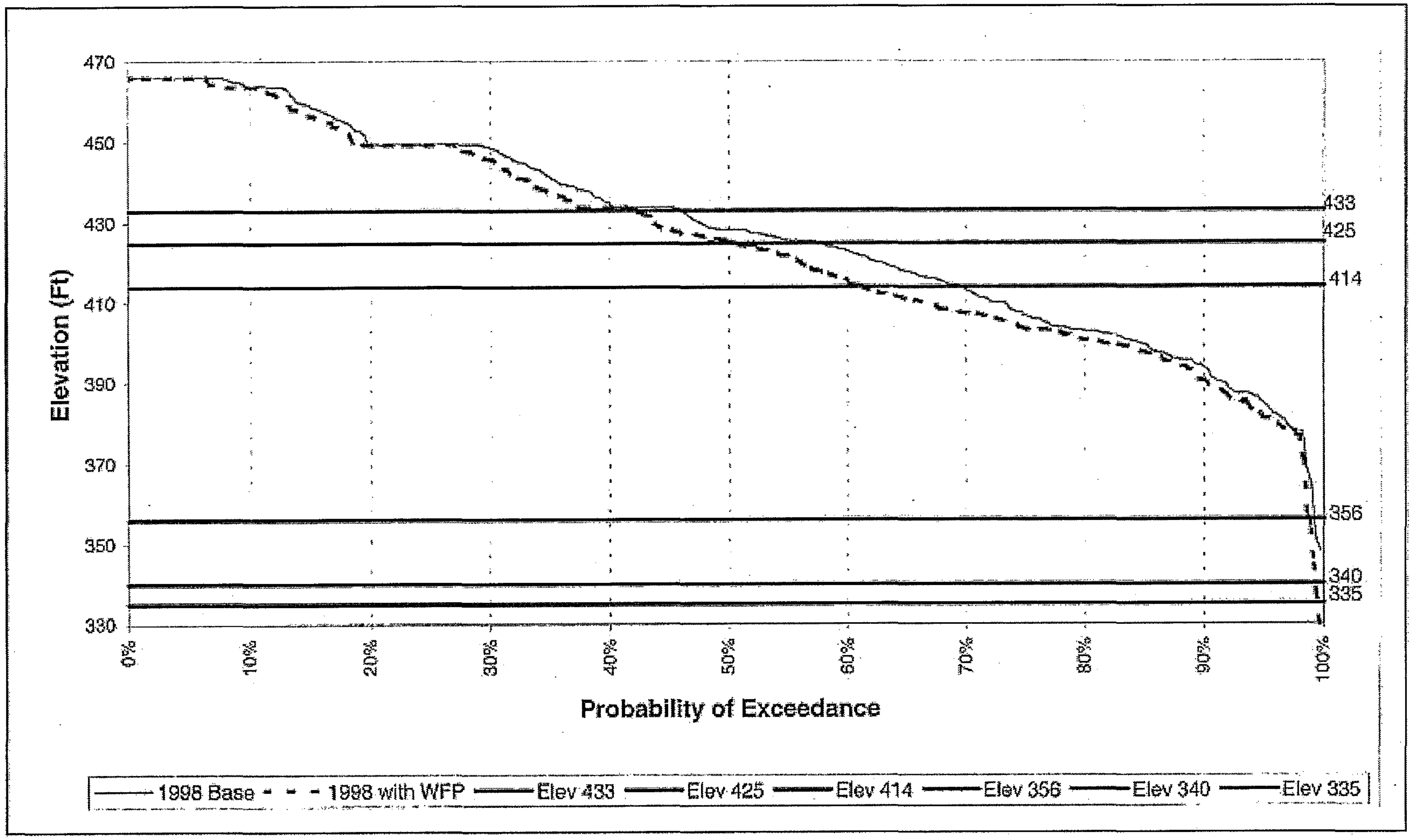


Folsom Reservoir Elevation November - March

EXHIBIT 4.7-4

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES, INC



Folsom Reservoir Elevation April - October

EXHIBIT 4.7-5

WATER FORUM PROPOSAL EIR

SWRI SURFACE WATER RESOURCES, INC

4.8 VEGETATION AND WILDLIFE

The changes in American River diversions and water release schedules in the WFP would involve altering river flows and reservoir water surface elevations in the direct and indirect effect study areas. This section contains a discussion on whether changes in the hydrologic regime would affect terrestrial vegetation and wildlife.

Emphasis is placed on riparian and near-shore habitats and wildlife that could be directly affected by changes in storage levels in Folsom Reservoir and in flows in the Lower American River. Terrestrial vegetation and wildlife resources are briefly described for the broader indirect effect study area, which includes the reservoirs of the upper Sacramento River, the upper and lower Sacramento River, and the Sacramento-San Joaquin Delta region.

4.8.1 EXISTING CONDITIONS

Descriptions of the vegetation communities and terrestrial wildlife within the direct effect study area have been well documented (Sands, et al., 1985; Watson, 1985; USFWS, 1991; USBR, 1997). The following represents a summary of the existing vegetation communities and terrestrial wildlife associated with the potentially affected water resources. Previous documentation of these resources has been incorporated by reference to the extent that they provide appropriate background information.

LOWER AMERICAN RIVER

Vegetation of the Lower American River

The Lower American River provides a diverse assemblage of vegetation communities, including freshwater marsh and emergent wetland, riparian scrub, riparian forest, and in the upper, drier areas further away from the river, oak woodland and non-native grassland. The current distribution and structure of riparian communities along the river has been determined by human-induced changes such as gravel extraction, dam construction and operations, and levee construction and maintenance, as well as by both historic and on-going streamflow and sediment regimes and channel dynamics (Sands, et al., 1985; Watson, 1985). Currently, the Sacramento Area Flood Control Agency (SAFCA) is conducting habitat studies along the Lower American River and has mapped habitats from Nimbus Dam downstream to the confluence of the Sacramento River. Habitats associated with the Lower American River are presented in Exhibit 4.8-1a through 4.8-1h, at the end of this section.

As a result of these factors, several riparian vegetation zones exist along the banks of the Lower American River. The composition and vegetative structure of these zones at any particular location along the river depends on the geomorphology and other physical characteristics of the river bank. In general, willow scrub and alders tend to occupy areas within the active channel of the river, which are repeatedly disturbed by river flows, thus prohibiting successional stages in advancement of plant communities leading to a climax plant community, which is a plant community that has reached its full development. Plant species in this zone typically include various species of willow. Cottonwood-willow thickets and cottonwood forests occupy the narrow belts along the active river channel where repeated disturbance by occasional large flows keep the communities at earlier stages. Fremont's cottonwood (*Populus fremontii*) dominates these riparian forest zones. Other species associated with this habitat include willow (*Salix* sp.), poison oak (*Toxicodendron diversilobum*), wild grape (*Vitis californica*), blackberry (*Rubus ursinus*), northern California black walnut (*Juglans californica* var. *hindsii*), white alder (*Alnus rhombifolia*), and acacia (*Acacia* sp.). Alder-cottonwood forest is typical of the steep, but moist banks along much of the river corridor. Valley oak woodland occurs on upper terraces composed of fine sediment where soil moisture provides a long growing season. Valley oak (*Quercus lobata*) is the dominant tree species in these areas, although some of the sites also have a cottonwood component as a result of infrequent flood inundation. Live oak woodland occurs in the more arid and gravely terraces that are isolated from the fluvial dynamics and moisture of the river. Non-native grassland commonly occurs in areas that have been disturbed by human activity and can be found on many of the sites within the river corridor.

Backwater areas and off-river ponds that are recharged during high flows support emergent wetland vegetation. These habitat areas are located throughout the length of the river, but occur more regularly downstream of the Watt Avenue bridge. Plant species that dominate this habitat type include various species of willow, sedge (*Carex* sp.), cattail (*Typha* sp.), bulrush (*Scirpus* sp.), rush (*Juncus* sp.), barnyard grass (*Echinochloa crusgalli*), slough grass (*Paspalum dilatatum*), and lycopus (*Lycopus americanus*).

<u>Wildlife of the Lower American River</u>

Previous studies have determined that the cottonwood-dominated riparian forest and areas associated with the backwater and off-river ponds are highest in wildlife diversity and species richness relative to other river corridor habitats (Sands, et. al., 1985; Watson, 1985; USFWS, 1991). More than 220 species of birds have been recorded along the Lower American River and over 60 species are known to nest in the riparian habitats (USFWS, 1991). Common species that can be found along the river include great blue heron (*Ardea herodias*), mallard (*Anas platrhynchos*), red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), American kestrel (*Falso sparverius*), California quail (*Callipepla californica*), killdeer (*Charadrius vociferous*), belted kingfisher (*Ceryle alcyon*), western scrub jay (*Aphelocoma californica*), ash-throated flycatcher (*Myiarchus cinerascens*), tree swallow (*Tachycineta bicolor*), and American robin (*Turdus migratorius*). Additionally, more than 30 species of mammals reside along the river, including striped skunk (*Mephitis mephitis*), Virginia opossum (*Didelphis virginiana*), brush rabbit (*Sylvilagus bachmani*), raccoon (*Procyon lotor*), western gray squirrel (*Sciurus griseus*), California ground squirrel (*Spermophilus beecheyi*), meadow vole (*Microtus pennsylvanicus*), muskrat (*Ondatra zibethicus*), black-tailed deer (*Odocoileus hemionus*), gray fox (*Urocyon cinereoargenteus*), and coyote (*Canis latrans*).

The most common reptiles and amphibians that depend on the riparian habitats along the river include western toad (*Bufo boreas*), Pacific tree frog (*Hyla regilla*), bull frog (*Rana catesbeiana*), western pond turtle (*Clemmys marmorata*), western fence lizard (*Sceloporus occidentalis*), common garter snake (*Thamnophis sirtalis*), and gopher snake (*Pituophis melanoleucus*).

Along with providing food, cover, and nesting habitat for several species, the Lower American River functions as a wildlife corridor for the movement of animals between the valley floor and the foothills of the Sierra Nevada.

River Channel Hydrology and Riparian Vegetation Relationships Along the Lower American River

The type and distribution of riparian vegetation along a river is generally a function of the complex hydrologic and geomorphic conditions of the river (Watson, 1985). In particular, water availability and magnitude (i.e., flow regimes), floodplain geology, and channel morphology are the driving forces behind the ability of various riparian plants to germinate, establish, and grow. Flood flows mobilize bank and riverbed sediments that result in the deposition of nutrient-rich sediments on the floodplain that, when timed with the release of seeds in the spring, provides suitable areas for seed germination. High water (flushing) flows, usually occurring in late winter and early spring, are necessary to clear the river channel of debris, control the encroachment of vegetation, and unclog sediments. Water availability during the summer and early fall months can determine growth rates and plant types. The structure and composition of the channel bed and banks affects the rate of channel migration, the elevation of the water surface during low flow periods, the lateral movement of groundwater into the banks, the transport and deposition of sediments, and how often certain areas are inundated by flood flows. These in turn affect overall plant diversity, growth, and generation.

History of Events Affecting the Riparian Corridor

From Folsom Reservoir to the confluence with the Sacramento River, the Lower American River has undergone tremendous change over the past 100 years. The combination of gold mining, gravel dredging, levee building, land clearing, water diversion projects, and reservoir construction have dramatically altered the riverbed and channel, as well as overall flow regimes. Specifically, the construction of flood control levees reduced the width of the riparian corridor by isolating the floodplain from the river; these levees also reduced channel erosion and migration (Watson, 1985). In addition, the construction of the Folsom and Nimbus Dams has significantly altered both the streamflow and sediment regime of the Lower American River. In particular, the magnitude and frequency of flood flows has been effectively reduced, causing a reduction in the frequency of overbank flows that deposit sediments on the higher terraces that are conducive to seed germination. The dam complex also significantly reduced the amount of sediment supply to the lower reaches of the river from its watershed.

The existing channel morphology of the Lower American River spans a continuum from a meandering belt confined within relatively resistant terraces and bluffs in the upper reaches to a low gradient and semi-confined floodplain channel in the lower reaches (Watson, 1985). Channel pattern and morphology in the upper 11 miles of the river, to the Folsom and Nimbus dam complex, is largely controlled by resistant bedrock exposures that characterize this portion of the river. Bank erosion and deposition of sediments is relatively minor, with most sediment being transported through or temporarily stored in the river channel. Point bars within this reach are forming in some areas, but are typically small. Prior to urbanization and levee construction, the American River deposited sediment in a floodplain belt that widens toward the confluence with the Sacramento River. Lateral migration of the river channel was slowly occurring over time. However, channel realignment and levee construction have confined the river to a substantially narrower belt. The low gradient and blockage of channel migration has allowed for the formation of gravel bars and sediment deposits throughout this portion of the river. Terraces, once commonplace and complex as a result of extensive overbank flooding, now only occur in specific areas between the levees.

The current composition of the riparian plant communities along the Lower American River is a function of the resulting set of hydrologic, geomorphic, and substrate conditions that have occurred there over time; it is also a result of the adaptations of the riparian system to these conditions. In the upper reaches of the river near Nimbus Dam, steep banks of resistant soils and bedrock allow only a very slow rates of erosion and sediment deposition. In these areas, alder-dominated vegetation occur as stringers along portions of the channel, particularly along the base of bluffs and steep banks. Further down the river where gravel bars and point bars occur as a result of sediment transport and storage along the channel bed, regeneration of willows occurs on scoured gravel bar sites. Cottonwoods also form small stringers on freshly deposited sediment on point bars as well as on less steep terraces with suitable seed beds, where even-aged stands of older cottonwoods occur.

Because most of the disruptions and alterations of the channel and flow regime of the American River have occurred in relatively recent times, it is likely that the entire ecological system has not completely adjusted to the present hydrologic regime. The present riparian structure and diversity may likely represent one stage of an ongoing and dynamic adjustment to the new set of hydrologic and geomorphic conditions as a result of human influence. In addition, the flow record since the completion of the modern Folsom Dam may not be long enough to reflect the present long term flow regime.

Most of the riparian forest habitat immediately adjacent to the Lower American River is dominated by cottonwood intermixed with willows. In addition, several backwater and off-river ponds occur at some of the bars along the river. Riparian zones support a greater abundance and diversity of wildlife than any other terrestrial habitat in California (Sands, et al. 1985); this is especially true of the American River Parkway because it is virtually surrounded by urban development. In addition, previous studies have determined that the riparian vegetation surrounding the backwater channels and off-river ponds ranked very high in overall wildlife diversity and species richness (Sands, et al., 1985). Because of the biological importance value of these areas, the following discussion focuses on the relationship of changes in river flows to both cottonwood trees and river-associated ponds.

Cottonwood Growth Along the Lower American River

The germination, establishment, growth, and long-term survival of Fremont's cottonwood along the Lower American River is dependent upon the dynamic flow regimes and fluvial geomorphic processes of the river. In particular, the capacity of the river to erode, transport, and deposit alluvial materials is central to the structure and maintenance of cottonwood ecosystems. Because cottonwood seed release and establishment has adapted over time to the flow regime and fluvial process of the Lower American River, maintenance of this regime is vital to maintain a viable cottonwood riparian system.

Successful regeneration of cottonwood relies on the synchronous timing of seed dispersal to appropriate soil moisture levels to germinate and establish successfully (Stromberg, 1995). Cottonwoods disperse seeds over a two- to six-week period, typically in the early to mid-spring months. Dispersed seeds rapidly lose the ability to germinate, so seeds must encounter suitable germination sites soon after release. Germination takes place on freshly deposited alluvial soils in areas along the river bank low enough in elevation to provide adequate moisture but high enough to avoid subsequent flooding after establishment. Peak water flows of sufficient magnitude are necessary, just prior to seed dispersal, to provide these suitable germination sites.

To survive, cottonwood seedlings require a continuous source of adequate moisture (Scott, et al., 1996). Consequently, river flows must decline at a rate that allows seedling roots to maintain continuous contact with saturated or sufficiently moist substrate. If river flows and the alluvial groundwater table drop too rapidly, seedling survival decreases appreciably (Scott et al., 1993). Studies have shown that first-year seedlings of Fremont's cottonwood survive only where the groundwater depth is less than one meter, and tolerate daily declines of no more than a few centimeters per day (Stromberg, et al., 1991; Segelquist et al., 1993). Summer flows are critical to the continued survival of newly established seedlings and provide necessary moisture when evapotranspiration is highest (Scott, et al., 1993). Long-term survival of established cottonwoods is generally related to the depth to groundwater and to river flows. While cottonwoods can adapt to drought periods, overall growth and long-term maintenance of these trees is dependent upon the ability of root systems to reach the alluvial groundwater table, the recharging of which is dependent upon adequate river flows.

While very few studies on the long-term flow regimes necessary for continued cottonwood regeneration and growth maintenance have been conducted along the Lower American River, several relatively short-term studies have provided insights into the relationship between river flows and cottonwood growth (Table 4.8-1). In one study, the annual radial growth rate of young cottonwoods along a particular segment of the Lower American River was found to be significantly related to the groundwater depth and to river flows during the March-October growing season (Stromberg, 1995). The study found that cottonwoods had little or no radial growth when average river flows during the growing season dropped below 1,765 cfs.

A USFWS study concluded that an average flow of 3,000 cfs is required along the Lower American River to ensure reasonable tree growth and maintenance of the trees (USFWS, 1996). This study also found that flows of 5,000 - 13,000 cfs are required for the inundation of terraces, that is essential for the germination of cottonwoods, with the highest terraces inundated at 50,000 cfs. In order for seed germination to occur, these terraces must be inundated during, or just prior to, cottonwood seed release, which typically occurs between late April and mid-July on the Lower American River.

Table 4.8-1
Lower American River Flow Criteria for Riparian Vegetation and Backwater Pond Recharge

SOURCE	Flow Criteria (cfs)				
	Riparian Vegetation			Backwater Pond Recharge	
	Minimum	Optimal	Maximum	Minimum	Optimal
Hodge Decision [1]	3,000	n/a	n/a	3,000	n/a
USFWS [2]	2,000	3,000 - 4,500	4,500	2,700	4,000
Stromberg [3]	1,765	n/a	8,000	n/a	n/a
Sands [4]	n/a	n/a	n/a	2,750	4,000

1 From Environmental Defense Fund et al. v. East Bay Municipal Utility District, for the period of July 1 through October 14.
2 From USFWS (1996). At least 3,000 cfs is needed for "healthy" growth.
3 From Stromberg (1995).
4 From Sands, et al. (1985).

Source: EDAW, 1998.

Backwater Ponds of the Lower American River

Backwater pond areas along the American River Parkway are generally the result of naturally formed gravel deposits and man-induced dredging, although some are likely to be remnant oxbow lakes, such as Bushy Lake (Sands, et al., 1985). These backwater ponds and lagoons are known to occur throughout the Lower American River system, but occur predominantly at Sacramento Bar, Arden Bar, Rossmoor Bar, and between Watt Avenue and Howe Avenue (Sands, et al., 1985).

Vegetation around these ponds is typical of the riparian associations in the area and is composed of mixed-age willow, alder, and cottonwood. Because the water is slower moving and the ponds are isolated from human disturbances, these areas tend to be of higher value to wildlife (Sands, et al., 1985). Wildlife species that have been recorded in these areas include: pied-billed grebe (*Podilymbus podiceps*), American bittern (*Botaurus lentiginosus*), green heron (*Butorides striatus*), common merganser (*Mergus merganser*), white-tailed kite (*Elanus leucurus*), wood duck (*Aix sponsa*), yellow warbler (*Dendroica petechia*), warbling vireo (*Vireo gilvus*), dusky-footed woodrat (*Neotoma fuscipes*), western gray squirrel, Pacific tree frog, and western toad.

Studies have been conducted to determine how these backwater ponds are influenced by flows in the Lower American River (Sands et al., 1985). These ponds are located at varied distances from the river channel, have varied depths, and are at different elevations along the river. Ponds were studied in the spring of 1985 at flow regimes of 1,300 cfs and 2,750 cfs. In general, these studies concluded the following: (1) while the interrelationships of the ponds with the river is complex, the ponds do respond to changes in water levels in the American River; (2) the response of ponds to changes in water flows and river levels is dependent upon the distance of the ponds from the river channel, the permeability of the soils surrounding the ponds, and the nature of intervening soils and gravels; (3) the impact of changes in pond water levels on vegetation and wildlife may differ in intensity between sites depending on local soil compaction and root distribution of individual plants; (4) flows of at least 2,700 cfs are required to adequately recharge the ponds near the river; (5) at sustained flows of 1,300 cfs or below, many of the ponds would become more shallow and smaller, hold very little water, and become choked with willows; and (6) further reductions in river flows, to levels in the 500 cfs range, would result in these ponded areas becoming completely dry, resulting in deterioration of the riparian vegetation and quality wildlife habitats associated with the ponds.

An important consideration for the maintenance of backwater pond habitats is the frequency and duration of the necessary recharge flows. Past studies have not come to definitive conclusions about specific frequency and duration needs. Historically, however, the flows high enough to allow recharge have occurred most often either in the winter or spring. This pattern allows the backwater ponds to be recharged prior to the important spring and summer growing seasons. Therefore, it appears that regular recharge flows during most of the winter or spring months are sufficient to maintain backwater pond habitats.

FOLSOM RESERVOIR

Vegetation of Folsom Reservoir

Habitats associated with Folsom Reservoir include non-native grassland, blue oak-pine woodland, and mixed oak woodland. Non-native grasslands occur around the reservoir, primarily at the southern end. The reservoir rim is surrounded by a barren band (the draw down zone) as a result of historic fluctuations in water elevations. The majority of this zone is devoid of vegetation, although arroyo willows (*Salix lasiolepis*) and narrow-leaved willows (*Salix exigua*) have established in some areas because of prolonged exposure during the recent drought (USFWS, 1991a). The only contiguous riparian vegetation occurs along Sweetwater Creek at the southern end of the reservoir (USFWS, 1991a). Because the draw down zone is virtually devoid of vegetation and the sparse willows that have established in some areas do not form a contiguous riparian community, the draw down zone does not possess substantial habitat value.

Non-native grassland consists of wild oats (*Avena fatua*), soft chess brome (*Bromus hordeaceus*), ryegrass (*Lolium multiflorum*), mustard (*Brassica* sp.), and foxtail (*Hordeum murinum* ssp. *leporinum*). The oak woodland habitat located on the upland banks and slopes of the reservoir is dominated by live oak (*Quercus wislizenii*), blue oak (*Quercus douglasii*), and foothill pine (*Pinus* *sabiniana*) with several species of understory shrubs and forbs including poison oak, manzanita (*Arctostaphylos* sp.), California wild rose (*Rosa californica*), and lupine (*Lupinus* sp.).

Wildlife of Folsom Reservoir

Oak-pine woodlands and non-native grasslands in the reservoir area support a variety of birds, including acorn woodpecker (*Melanerpes formicivorus*), Nuttall's woodpecker (*Picoides nuttallii*), western wood pewee (*Contopus sordidulus*), scrub jay (*Aphelocoma californica*), Bewick's wren (*Thryomanes bewickii*), plain titmouse (*Parus inornatus*), hermit thrush (*Catharus guttatus*), loggerhead shrike (*Lanius ludovicianus*), black-headed grosbeak (*Pheucticus melanocephalus*), dark-eyed junco (*Junco hyemalis*), and Bullock's oriole (*Icterus bullockii*). A number of raptors will also use oak woodlands for nesting, foraging, and roosting. These include red-tailed hawk, American kestrel, sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*Accipiter cooperii*), red-shouldered hawk, great horned owl (*Bubo virginianus*), and long-eared owl (*Asio otus*). Mammal species likely to occur in the woodland habitat include mule deer (*Odocoileus hemionus*), coyote, bobcat (*Lynx rufus*), gray fox, Virginia opossum, raccoon, striped skunk, black-tailed jackrabbit (*Lepus californicus*), California ground squirrel, and a variety of rodents. Amphibians and reptiles that may be found in oak woodlands include California newt (*Taricha torosa*), Pacific tree frog, western fence lizard (*Sceloporus occidentalis*), gopher snake (*Pituophis melanoleucus*), common kingsnake (*Lampropeltis getulus*), and western rattlesnake (*Crotalus viridis*).

The non-native grassland surrounding Folsom Reservoir represents habitat for a variety of rodents, which in turn serve as a prey base for carnivores such as hawks and owls, coyote, bobcat, gray fox, and some snakes. Although very few birds will nest in the grassland areas, a number of species will forage in this habitat, including white-crowned sparrow (*Zonotrichia leucophrys*), lesser goldfinch (*Carduelis psaltria*), western meadowlark (*Sturnella neglecta*), and several raptor species. Migratory waterfowl are known to feed and rest in the grasslands associated with the north fork of Folsom Reservoir (USFWS, 1991a). Several of the reptiles and amphibians that inhabit the oak woodlands will also occur in the adjacent non-native grasslands.

SHASTA, KESWICK, TRINITY, AND WHISKEYTOWN RESERVOIRS

Vegetation Surrounding the Reservoirs

Habitats associated with these reservoirs include ponderosa pine forest, non-native grassland, oak-pine woodlands, and chaparral. Much of the vegetation surrounding the reservoirs consists of forested habitats, with small enclaves of oak woodlands, grasslands, and chaparral, particularly near the dams. Pine forest habitats are located on the upland banks, and slopes of the reservoirs are dominated by ponderosa pine (*Pinus ponderosa*), Jeffrey pine (*Pinus jeffreyi*), Douglas fir (*Pseudotsuga menziesii*), madrone (*Arbutus menziesii*), and incense cedar (*Calocedrus decurrens*). Chaparral occurs in openings in the forest, and is characterized by several native shrubs such as manzanita (*Arctostaphylos patula*) and various species of ceanothus (*Ceanothus* sp.). Non-native grasslands and oak-pine woodlands are similar to habitats described for Folsom Reservoir. Similar to Folsom Reservoir, the draw down zone of these reservoirs is expected to be devoid of vegetation and contiguous riparian communities are not present in these areas therefore, the draw down zones do not provide valuable plant communities or habitats.

Wildlife of the Reservoirs

Ponderosa pine forest and chaparral habitats associated with the reservoirs support a variety of birds, including western tanager (*Piranga ludoviciana*) and white-breasted nuthatch (*Sitta carolinensis*). Raptors that will use these habitats near water include osprey (*Pandion halibuts*) and bald eagle (*Halietus leucocephalus*). Mammal species likely to occur in these habitats include mule deer, bobcat, mountain lion (*Felis concolor*), ringtail (*Bassariscus astutus*), raccoon, striped skunk, black bear (*Ursus americanus*), and beaver (*Castor canadensis*).

UPPER AND LOWER SACRAMENTO RIVER

Vegetation of the Sacramento River

Much of the Sacramento River is confined by levees that reduce the natural diversity of riparian vegetation. Agricultural land (e.g. rice, dry grains, pastures, orchards, vineyards, and row and truck crops) is common along the lower reaches of the Sacramento River, but is less common in the upper portions (CDFG, 1988). The bands of riparian vegetation that occur along the Sacramento River are similar to that found along the Lower American River, but are somewhat narrower and not as botanically diverse. The riparian communities consist of Valley oak cottonwood, wild grape, box elder (*Acer negundo*), elderberry (*Sambucus mexicanus*), and willow. Freshwater, emergent wetlands occur in the slow moving backwaters and are primarily dominated by tules (*Scirpus acutus* var. *occidentalis*), cattails, rushes, and sedges (SAFCA and USBR, 1994). Although riparian vegetation occurs along the Sacramento River, these areas are confined to narrow bands between the river and the river side of the levee.

Wildlife of the Sacramento River

The wildlife species inhabiting the riparian habitats along the lower Sacramento River are essentially the same as those found along the Lower American River. These include, but are not limited to, wood duck, great blue heron, great egret, green heron, black phoebe (*Sayornis nigricans*), ash-throated flycatcher, sora rail (*Porzana carolina*), great horned owl, Swainson's hawk (*Buteo swainsoni*), California ground squirrel, and coyote. The freshwater/emergent wetlands represent habitat for many wildlife species, including reptiles and amphibians such as the western pond turtle, bullfrog, and Pacific tree frog. Agricultural areas adjacent to the river also represent foraging habitat for many raptor species.

SACRAMENTO-SAN JOAQUIN DELTA

Vegetation of the Delta

Most of the vegetation in the Delta consists of irrigated agricultural fields and associated ruderal (disturbed), non-native vegetation "finges" that border cultivated fields. Throughout much of the Delta, these areas border the levees of various sloughs, channels, and other waterways within the historic floodplain. Native habitats include remnant riparian vegetation that persists in some areas, with brackish and freshwater marshes also being present. Saline wetlands consist of pickleweed (*Salicornia virginica*), cord grass (*Spartina* sp.), glasswort (*Salicornia* sp.), saltgrass (*Distichlis spicata*), sea lavender (*Limonium californicum*), arrow grass (*Triglochin* spp.), and shoregrass (*Monanthochloe littoralis*). These wetlands are very sensitive to fluctuations in water salinity, which are determined by water flows into the Delta (San Francisco Estuary Project, 1993).

Wildlife of the Delta

The wetlands of the Delta represent habitat for a number of shorebirds and waterfowl species including killdeer, California black rail (*Laterallus jamaicensis coturniculus*), western sandpiper (*Calidris mauri*), long-billed curlew (*Numenius americanus*), greater yellow-legs (*Tringa melanoleuca*), American coot (*Fulica americana*), American wigeon (*Gallinula chloropus*), gadwall (*Anas strepera*), mallard, canvas back (*Aythya valisineria*), and common moorhen (*Gallinula chloropus*). These areas also support a number of mammals such as coyote, gray fox, muskrat, river otter (*Lutra canadensis*), and beaver (*Castor canadensis*). Several species of reptiles and amphibians also occur in this region.

SPECIAL-STATUS SPECIES

The following is a discussion of plant and wildlife species that have been afforded special recognition by federal, state, or local resource agencies and organizations. This discussion focuses on, and summarizes, species addressed in previous biological studies of the Study area, and those species that have been added to state and federal special-status species lists since the time those studies were conducted. Special-status biological resources also include unique habitats or plant communities that are of relatively limited distribution, or are of particular value to wildlife. Sources for determination of the status of these biological resources are:

- **Plants** – CDFG (1996a), CNPS (1994), and Hickman (1993).
- **Wildlife** – CDFG (1996b), CNDDB (1994), and Williams (1986).

A number of special-status plant and wildlife species are known to occur within the direct and indirect effect study areas (USFWS, 1991a; USFWS, 1996). These species are listed in Table 4.8-2, Special-status Species Potentially Occurring in the Study Area. The following discussion focuses only on those species occurring or potentially occurring within the study area that could potentially be affected by the WFP. A brief summary of the life history requirements of each species, and their occurrence within the study area, is discussed below.

Table 4.8-2
Special-status Species Potentially Occurring in The Study Area

Species	USFWS	CDFG	CNPS	Habitat	Potential For Occurrence
PLANTS					
PALMATE-BRACTED BIRD'S BEAK *Cordylanthus palmatus*	FE	CE	1B	saline alkali soils and chenopod scrub habitat	Potential habitat occurs in the delta portion of the study area.
HOOVER'S SPURGE *Chamaesyce hooveri*	PT	-	-	vernal pools	Unlikely to occur in the study area.
SUISUN THISTLE *Cirsium hydrophilum* var. *hydrophilum*	PT	-	-	salt marsh	Potential habitat occurs in the delta portion of the study area.
SUISUN MARSH ASTER *Aster lentus*	-	-	1B	brackish and freshwater marshes and swamps	Potential habitat occurs within the study area.
BRISTLY SEDGE *Carex comosa*	-	-	2	chenopod scrub, marshes, swamps, and lake margins	Potential habitat occurs within the study area.
SLOUGH THISTLE *Cirsium crassicaule*	-	-	1B	marshes, sloughs, and riparian scrub	May occur in the delta portion of the study area.
POINT REYES BIRD'S-BEAK *Cordylanthus maritimus* ssp. *palustris*	-	-	1B	coastal salt marsh	Potential habitat occurs within the delta portion of the study area.
SOFT BIRD'S-BEAK *Cordylanthus mollis* ssp. *mollis*	PE	CR	1B	coastal salt marsh	Potential habitat occurs within the delta portion of the study area.
WESTERN LEATHERWOOD *Dirca occidentalis*	-	-	1B	riparian forest and riparian woodland	Potential habitat occurs within the study area.
SMALL SPIKERUSH *Eleocharis parvula*	-	-	4	coastal salt marsh	Potential habitat occurs within the delta portion of the study area.
BOGGS LAKE HEDGE-HYSSOP *Gratiola heterosepala*	-	CE	1B	marshes, swamps, vernal pools, and lake margins	Potential habitat occurs within the study area.
MARSH GUMPLANT *Grindelia stricta* var. *angustifolia*	-	-	4	coastal salt marsh	Potential habitat occurs within the western delta portion of the study area.
DIABLO HELIANTHELLA *Helianthella castanea*	-	-	1B	riparian woodland, coastal scrub, and valley and foothill grassland	Potential habitat occurs within the western delta portion of the study area.
ROSE-MALLOW *Hibiscus lasiocarpus*	-	-	2	freshwater marshes and swamps	Potential habitat occurs within the study area.
WRIGHT'S TRICHOCORONIS *Trichocoronis wrightii* var. *wrightii*	-	-	2	meadows, marshes, swamps, riparian forest, and vernal pools	Extirpated in the Central Valley.

Table 4.8-2
Special-status Species Potentially Occurring in The Study Area

Species	USFWS	CDFG	CNPS	Habitat	Potential For Occurrence
CALIFORNIA SEABLITE *Suaeda californica*	PE	-	1B	coastal salt marsh and swamps	Potential habitat occurs in the western delta portion of the study area.
MAD-DOG SKULLCAP *Santellaria lateriflora*	-	-	2	meadows, marshes and swamps	Potential habitat occurs within the study area.
EEL-GRASS PONDWEED *Potamogeton zosteriformis*	-	-	2	freshwater marshes and swamps	Potential habitat occurs within the study area.
HAIRLESS POPCORN-FLOWER *Plagiobothrys glaber*	-	-	1A	coastal marsh and alkaline meadows	Presumed extinct.
DELTA MUDWORT *Limosella subulata*	-	-	2	marshes and swamps	Potential habitat occurs within the study area.
MASON'S LILAEOPSIS *Lilaeopsis masonii*	-	CR	1B	freshwater and brackish marshes and swamps, and riparian scrub	Potential habitat occurs within the study area.
DELTA TULE PEA *Lathyrus jepsonii* var. *jepsonii*	-	-	1B	freshwater and brackish marshes and swamps	Potential habitat occurs within the study area.
DELTA BUTTON-CELERY *Eryngium racemosum*	-	CE	1B	riparian scrub in vernally mesic clay depressions	Presumed extirpated within the study area.
SANFORD'S ARROWHEAD *Sagittaria sanfordi*	-	-	1B	shallow freshwater marshes and swamps	Two known occurrences along the lower American River (SAFCA 1994).
INVERTEBRATES					
VALLEY ELDERBERRY LONGHORN BEETLE *Desmocerus californicus dimorphus*	FT	-	-	elderberry shrubs	Critical habitat designated along the lower American River.
AMPHIBIANS					
CALIFORNIA TIGER SALAMANDER *Ambystoma californiense*	C	CSC	-	vernal pools and grasslands	Unlikely to occur within the study area; no appropriate habitat present.
WESTERN SPADEFOOT TOAD *Scaphiopus hammondii*	-	CSC	-	vernal pools and grasslands	Unlikely to occur within the study area; no appropriate habitat.
CALIFORNIA RED-LEGGED FROG *Rana aurora draytonii*	FT	CSC	-	deep-water ponds with overhanging vegetation	Extirpated in the Sacramento Valley.
REPTILES					
WESTERN POND TURTLE *Clemmys marmorata*	-	CSC	-	perennial wetlands	Known to occur along the lower American River.
GIANT GARTER SNAKE *Thamnophis gigas*	FT	CT	-	sloughs, streams, waterways, irrigation canals, and rice fields	Unlikely to occur within the study area; no appropriate habitat.

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Table 4.8-2
Special-status Species Potentially Occurring in The Study Area

Species	USFWS	CDFG	CNPS	Habitat	Potential For Occurrence
BIRDS					
BALD EAGLE *Haliaeetus leucocephalus*	FT	CE	-	open water habitats for foraging and large trees near open water for perching	Occasionally observed at Folsom Reservoir and the Lower American River during the winter (SAFCA and USBR, 1994).
SHARP-SHINNED HAWK *Accipiter striatus*	-	CSC	-	riparian woodlands and coniferous forests	Could occur in the riparian woodland along the lower American River during winter.
COOPER'S HAWK *Accipiter cooperii*	-	CSC	-	riparian woodland	Known to occur along the lower American River.
SWAINSON'S HAWK *Buteo swainsoni*	-	CT	-	riparian woodland and grasslands	Potential nesting habitat occurs along the lower American River; no recent nesting at Folsom Reservoir, and Lake Natoma (SAFCA. 1994).
AMERICAN PEREGRINE FALCON *Falco peregrinus anatum*	FE	CE	-	ledges or high, vertical cliffs near rivers and lakes	Potential foraging habitat occurs within the study area.
CALIFORNIA BLACK RAIL *Laterallus jamaicensis coturniculus*	-	CT	-	freshwater emergent wetlands	Potential habitat occurs within the delta portion of the study area.
BANK SWALLOW *Riparia riparia*	-	CT	-	steep, vertical banks for nesting and riparian habitat for foraging	Known nesting colony along the lower American River (SAFCA and USBR, 1994).
YELLOW WARBLER *Dendroica petechia brewsteri*	-	CSC	-	riparian habitat	Several known occurrences along the lower American River.
TRICOLORED BLACKBIRD *Agelaius tricolor*	-	CSC	-	freshwater marsh	Known to occur along the lower American River and Folsom Reservoir (SAFCA and USBR, 1994).
YELLOW-BREASTED CHAT *Icteria virens*	-	CSC	-	riparian habitat	Known to occur along the lower American River.
MAMMALS					
RIVER OTTER *Lutra canadensis*	-	CSC	-	large streams, lakes, estuaries, wetlands, and coastal areas	Likely to occur within the study area.

Table 4.8-2
Special-status Species Potentially Occurring in The Study Area

U.S. Fish and Wildlife Service (USFWS) Federal Listing Categories:

C	Candidate for listing
FT	Federal Threatened
PE	Federal Proposed Endangered
PT	Federal Proposed Threatened

California Department of Fish and Game (CDFG) State Listing Categories:

CT	California Threatened
CE	California Endangered
CR	California Rare
CSC	California Species of Special Concern

California Native Plant Society (CNPS) Categories:*

1B	Plants rare, threatened, or endangered in California and elsewhere.
2	Plants rare, threatened, or endangered in California, but more common elsewhere

* CNPS is a private non-profit organization that works closely with CDFG throughout the state. CNPS-developed information serves as an important source of data for consideration by CDFG and USFWS in recommendations for listing State or Federal threatened and endangered plant species.

Source: EDAW, 1998.

Special-Status Plants

Sanford's Arrowhead (*Sagittaria sanfordi*); CNPS List 1B. Sanford's arrowhead is a perennial herb that blooms from May to August and grows in shallow, slow moving or standing water in ponds and ditches. This species is found in two locations along the American River, near Watt Avenue and Rio Americana High School (SAFCA and USBR, 1994).

Special-Status Invertebrates

Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*); Federal Threatened. Adult beetles feed and lay eggs on elderberry shrubs, where the larvae remain within the elderberry stems until they emerge as adults through newly formed exit holes. USFWS has designated the American River Parkway as critical habitat for this beetle (USFWS, 1996). This species has been recorded in elderberry shrubs near backwater ponds along the Lower American River.

Special-Status Reptiles

Western Pond Turtle (*Clemmys marmorata*); California Species of Special Concern. This aquatic turtle generally occurs in still waters of ponds, freshwater marshes, and lakes, and in slow moving streams with sand bars or in stream emergent woody debris for basking sites. The western pond turtle is known to occur along the American and Sacramento rivers (Jennings and Hayes, 1994).

Special-Status Birds

Bald Eagle (*Haliaeetus leucocephalus*); Federal Threatened; California Endangered. Bald eagles winter throughout California, excluding the southern desert areas, and generally breed in the northern portion of the state. While most of the bald eagles in California are residents, many bald eagles migrate to the state for the winter. This species prefers mature wooded areas adjacent to or near large bodies of water or flowing rivers. Bald eagles feed primarily on fish, but will also eat birds, mammals, and carrion. Bald eagles are a common winter visitor to Folsom Reservoir and have been observed foraging along the Lower American River (SAFCA and USBR, 1994). Historically, bald eagles nested along the Lower American River; however, there are no recent nest records for this species within the study area (USFWS, 1991a).

Swainson's Hawk (*Buteo swainsoni*); State Threatened. Swainson's hawk is a migratory raptor that breeds in western North America and winters primarily in South America. This species is associated with riparian corridors adjacent to agricultural fields and grasslands in the Central Valley. They nest in trees, forage over pastures and agricultural fields, and prey largely on small mammals and insects. Both foraging and nesting habitat for Swainson's hawk exists throughout the study area (USFWS, 1991a). There are no recent records of nesting Swainson's hawks along the Lower American River, most likely due to the predominance of developed urban areas and general lack of large grassland and agricultural areas along the river. However, a number of active nests occur along the Sacramento River, including some nest sites near the confluence of these two rivers (CNDDB, 1994). Mature cottonwood, walnut, and willow trees along the Sacramento River, adjacent to agricultural areas, provide optimal nesting habitat for this species.

Bank Swallow (*Riparia riparia*); California Threatened. Bank swallows winter in northern and central South America and migrate to the United States and Canada to breed. Nesting colonies are present in the Sacramento Valley along the Sacramento and Feather rivers. This species occurs almost exclusively along watercourses that have steep, vertical banks and bluffs for nesting. Preferred nesting sites are sandy-loam soils or compactible gravels. Bank swallows have occasionally nested along the Lower American River. In 1985, nesting colonies were reported along the river north of Rancho Cordova and, in 1986, a colony was observed on the south side of the American River near Cal Expo (SAFCA and USBR, 1994). Because of major physical changes in the hydrology and stream channel conditions of the Lower American River, limited steep cut-bank habitat is present (USFWS, 1991a). The most suitable habitat for bank swallows now occurs along the river's edge near Discovery Park (USFWS, 1991a).

Tricolored Blackbird (*Agelaius tricolor*); California Species of Special Concern. A resident species in California, the tricolored blackbird is common locally throughout the Central Valley and in coastal districts south from Sonoma County. Preferred nesting habitat is dense cattails or tules associated with marsh and pond habitats. However, thickets of willows, blackberry, and wild rose may also be suitable (Zeiner, 1990). Tricolored blackbirds are known to occur in the riparian habitats along the Lower American River (SAFCA, 1994). Most reported nesting occurrences have been in canals, ponds, and marshes located adjacent to the river channel (SAFCA, 1994).

Yellow-breasted Chat (*Icteria virens*) and Yellow Warbler (*Dendroica petechia*); both California Species of Special Concern. These migratory species are summer visitors to riparian habitats. Both of these species are known to occur in the riparian habitats along the Lower American River.

Other Raptors. Raptors are considered sensitive by the California Department of Fish and Game. Removal or destruction of active raptor nests is considered a violation of the California Fish and Game Code (§3503.5). In addition to the above mentioned bald eagle and Swainson's hawk, raptors that are known to nest, or could potentially nest, in the study area include red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), Cooper's hawk (*Accipiter cooperii*), white-tailed kite, American kestrel (*Falco sparverius*), and great horned owl (*Bubo virginianus*).

Special-Status Mammals

River Otter (*Lutra canadensis*); California Species of Special Concern. River otters are an uncommon, yearlong resident of rivers, large streams, lakes, wetlands, estuaries, and coastal areas. Optimal habitat consists of riparian and other wetland vegetation associated with a large, permanent water source (Zeiner et al., 1990). They feed primarily on fish, crayfish and other crustaceans, but also eat amphibians, some mammals, and aquatic invertebrates. River otters are known to occur along both the Sacramento and American Rivers (CNDDB, 1994).

4.8.2 THRESHOLDS OF SIGNIFICANCE

Appendix G, the Environmental Checklist of the State CEQA Guidelines, provides general guidance in the identification of circumstances that may result in a significant effect on the environment related to biological resources. For purposes of this analysis, and in accordance with Part IV of the State CEQA Guidelines, biological impacts may represent a significant impact if implementation of the WFP would:

- have a substantial adverse effect, either directly or through habitat modifications, on any species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service;
- have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service;
- have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) Through direct removal, filling, hydrological interruption, or other means;
- interfere substantially with the movement of any resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors or impede the use of native wildlife nursery sites

Item XVII of the checklist, mandatory findings of significance, also states that a project would have a significant effect on the environment when "the project has the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, or reduce the number or restrict the range of a rare or endangered plant or animal." In addition, because of the sensitive nature and decline of wetland habitats throughout California, the removal, filling, dredging, or damage (directly or indirectly) to wetland or riparian areas would be considered a significant impact.

An evaluation of whether or not an impact on biological resources would be substantial must consider both the resource itself and how that resource fits into a regional or local context Substantial impacts would be those that would diminish, or result in the loss of, an important biological resource, or those that would obviously conflict with local, state, or federal resource conservation plans, goals, or regulations.

4.8.3 WATER FORUM PROPOSAL IMPACTS

The WFP's effects on terrestrial vegetation and wildlife are discussed below as they relate to the direct and indirect effect study areas. Vegetation and wildlife effects of urban development supported by the WFP diversions in the water service study area are not discussed, because their precise identification would be too speculative to be meaningful in the context of this program-level analysis of a long-term water supply plan (see Section 4.10, Land Use and Growth-Inducing Impacts). Also, the environmental effects of urban development are addressed in the general plan environmental impact reports of the cities and counties served by the water.

Lower American River Terrestrial Vegetation Impacts

Impact 4.8-1

Lower American River Riparian Vegetation. *Compared to existing conditions, the WFP would result in lower mean monthly flows below Nimbus Dam and at the H Street bridge during the critical growing season months of April through July; however, these flows would not be reduced with sufficient magnitude and frequency to significantly alter existing riparian vegetation dependent on flows in the Lower American River. Also, the higher flows needed for seed dispersal would occur with sufficient frequency to maintain the riparian forest community. For example, during a majority of the growing season months (April - July), flows would be above the minimum flow requirement of 1765 cfs between 61% and 83% of the time, depending on the month. Because WFP conditions would not result in the thinning of the riparian corridor, or the loss of valuable border zone vegetation and habitat, this impact would be considered* ***less than significant.***

Because cottonwoods are considered a "key" indicator species for overall health of the riparian vegetation, they are the focus of the evaluation of the potential impacts of various mean monthly flows on riparian vegetation. As discussed in Section 4.8.1 (Existing Conditions), the USFWS has indicated that a Lower American River mean monthly flow of 1,765 cfs represents the minimum flow required to maintain mature cottonwoods and 3,000 cfs is the minimum flow to ensure "optimal" growth (Caicco, 1996). The optimal range for riparian vegetation growth is between 3,000 to 4,500 cfs during the growing season. The flow range needed for at least minimal growth to optimal growth would be 1,765 to 4,500 cfs. These flow ranges have not been historically maintained in all years on the Lower American River, so cottonwoods have shown they can withstand occasional stress from inadequate flows in very dry years. For purposes of this analysis, a significant effect on riparian vegetation would occur if the WFP would result in a substantial decrease in the frequency of reduced flows at or above the minimum flow requirements for maintenance and growth of cottonwoods (1,765 cfs). Tables 4.8-3 (flows from Nimbus Dam) and 4.8-4 (flows at the H Street bridge) present a summary of the number of years within the 70-year hydrologic record in which mean monthly flows would be projected to remain within the optimal flow range for riparian vegetation growth (3,000 to 4,500 cfs) and the number of years when mean monthly flows are above the minimum flow requirement for maintenance of riparian vegetation under 1998 baseline and WFP conditions.

As the tables demonstrate, implementation of the WFP would result in mean monthly flows below the minimum and outside the optimal flow ranges more often than under base conditions. The effect of the WFP conditions is most evident during the later months of the growing season (June - October) resulting in 3 to 10 fewer years of the 70-year period of record in which flows would be above the minimum requirement necessary for riparian maintenance. However, based on the 70-year hydrologic record, mean monthly flows have historically been above the minimum flow requirement only a portion of the time, i.e., between 54% and 84% of the time. Under WFP conditions mean monthly flows would be above the minimum flow requirement between 40% and 84% of the time, throughout all months of the growing season, and between 61% and 83% of the time during the critical growing season months (April - July). While this condition does not negate the importance of the lower flows caused by the WFP diversions, it does indicate that the Lower American River flows would not vary substantially from existing conditions and, as a result, would retain sufficient flows for the maintenance of riparian vegetation. As a result, impacts on cottonwood growth (a key indicator species) and, therefore, vegetation growth in the riparian corridor of the Lower American River would be considered less than significant.

Previous field studies conducted on the Lower American River concluded that peak flows between 5,000 cfs and 13,000 cfs were necessary to inundate terraces that are essential for cottonwood germination, with the highest terraces inundated at 50,000 cfs. Implementation of the WFP would result in a slight reduction in the number of occurrences in which mean peak flows would be above 5,000 cfs. For example, in February (typically a high flow month), mean peak flows of at least 5,000 cfs occurred 23 years of the 70-year period of record. Under WFP conditions, this would be reduced to 22 years, a 1 year of 70 difference. Furthermore, with mean peak flows of at least 5,000 cfs, this implies that even higher instantaneous flows would occur, sufficient to inundate the terraces. As a result, this impact would be less than significant.

Table 4.8-3
WFP Impact on Riparian Vegetation in the Lower American River Below Nimbus Dam

Month[1]	Modeled Scenario	Number of Years of 70-year Record Within Specified Ranges[2]		% of Years Above Minimum Flow Range[5]
		# Years in Optimal Flow Range[3] (3,000-4,500 cfs)	# Years Above Minimum Flow Range[4] (1,765 cfs)	
March	Base	18	56	80%
	WFP	19	53	76%
April	Base	16	59	84%
	WFP	15	57	81%
May	Base	24	59	84%
	WFP	26	58	83%
June	Base	21	59	84%
	WFP	23	53	76%
July	Base	25	55	79%
	WFP	17	49	70%
August	Base	27	49	70%
	WFP	28	45	64%
September	Base	21	41	59%
	WFP	19	34	49%
October	Base	2	45	64%
	WFP	1	42	60%

1 The period from March through October is considered the cottonwood growing season.

2 Number of years during the 70-year record when the mean monthly river flows are within the specified ranges for cottonwood radial growth and maintenance on the Lower American River.

3 Number of years during the 70-year record when the mean monthly river flows below Nimbus Dam are between 3,000 and 4,500 cubic feet per second (cfs), which is considered the range for "reasonable" and "healthy" growth of cottonwoods.

4 Number of years during the 70-year record when the mean monthly river flows below Nimbus Dam are above 1,765 cfs, which is the minimum flow range for "healthy" growth of cottonwoods.

5 Percentage of years during the 70-year record when river flows are above the minimum flow range for cottonwood maintenance (1,765 cfs).

Base Modeled predictions of 70-year record based on 1998 diversions and operating rules.
WFP Modeled predictions of 70-year record based on WFP conditions.

Source: EDAW, 1998.

Table 4.8-4
WFP Impact on Riparian Vegetation in the Lower American River at H Street Bridge

Month[1]	Modeled Scenario	Number of Years of 70-year Record Within Specified Ranges[2]: # Years in Optimal Flow Range[3] (3,000-4,500 cfs)	# Years Above Minimum Flow Range[4] (1,765 cfs)	% of Years Above Minimum Flow Range[5]
March	Base	20	56	80%
	WFP	19	53	76%
April	Base	19	59	84%
	WFP	17	56	80%
May	Base	25	59	84%
	WFP	27	58	83%
June	Base	21	56	80%
	WFP	21	50	71%
July	Base	21	50	71%
	WFP	10	43	61%
August	Base	30	48	69%
	WFP	18	40	57%
September	Base	21	38	54%
	WFP	19	28	40%
October	Base	2	45	64%
	WFP	1	42	60%

1 The period from March through October is considered the cottonwood growing season.
2 Number of years during the 70-year record when the mean monthly river flows are within the specified ranges for cottonwood radial growth and maintenance on the Lower American River.
3 Number of years during the 70-year record when the mean monthly river flows below the H Street bridge are between 3,000 and 4,500 cubic feet per second (cfs), which is considered the range for "reasonable" and "healthy" growth of cottonwoods.
4 Number of years during the 70-year record when the mean monthly river flows below the H Street bridge are above 1,765 cfs, which is the minimum flow range for "healthy" growth of cottonwoods.
5 Percentage of years during the 70-year record when river flows are above the minimum flow range for cottonwood maintenance (1,765 cfs).

Base Modeled predictions of 70-year record based on 1998 diversions and operating rules.
WFP Modeled predictions of 70-year record based on WFP conditions.
n/c No change between Base and WFP conditions.

Source: EDAW, 1998.

For the WFP conditions in the growing season months (March-October), mean monthly flows exceed 5,000 cfs between 0 and 22 years of the 70-year record. Mean monthly flows exceed 10,000 cfs between 0 and 8 years of the record. Although mean monthly flows do not describe peak flows that occurred, this is an indication of why cottonwoods have not been regenerating on the highest terraces along the river. Therefore, a significant difference in the pattern of peak flows needed to generate cottonwoods would not be expected with the implementation of the WFP. Consequently, impacts of the WFP conditions related to cottonwood dispersal and regeneration are considered to be less than significant.

Impact 4.8-2

<u>Lower American River Backwater Ponds.</u> *Compared to existing conditions, the WFP would result in lower mean monthly flows below Nimbus Dam and the H Street bridge during the summer; however, these flows would not be reduced with sufficient magnitude and frequency to significantly alter existing backwater habitats dependent on the Lower American River flows. For example, the overall effects of the WFP would result in a greater number of years during the 70-year hydrologic record that flows are within the minimum/optimum range of 1,300 to 4,000 cfs (between 2 and 14 years more often in the 70-year record between March and September, depending on the month). Because flows high enough to promote recharge of the ponds would continue during the winter and/or spring, this impact would be considered* ***less than significant****.*

As discussed in section 4.8-1 Existing Conditions, previous field studies conducted on the Lower American River concluded that mean monthly flows of between 2,700 cfs and 4,000 cfs were necessary to recharge the ponds closest to and farthest from the river channel, respectively. During field surveys these areas were also examined at a flow rate of 1,300 cfs. Based on survey results, this lower rate was determined to be inadequate for pond recharge and the ponds began to rapidly dry up. In the physical solution outlined in the *EDF et al. v. EBMUD* decision, a flow level of 3,000 cfs during the spring was identified as necessary to protect Lower American River resources, including backwater ponds and associated vegetative communities. The availability of recharge flows is most important in the winter or spring months, based on historic flow patterns.

Tables 4.8-5 (flows below Nimbus Dam) and 4.8-6 (flows at H Street bridge) present a summary of the number of occurrences during the 70-year hydrologic record that mean monthly flows would be projected to remain within the optimal range for backwater recharge (2,700 to 4,000 cfs) and the minimum to optimal range for maintenance and adequate recharge of the ponds (1,300 to 4,000 cfs) under base 1998 and WFP conditions.

In the winter months (December, January, and February) the WFP would result in similar or slightly greater number of years (either 0 or 1 more year of the 70-year record, depending on the month and location on the river) when flows would be within the minimum/optimal range for backwater pond recharge, compared to base conditions, as indicated in the tables. Also, in the spring months (March, April, May), with WFP a greater number of years (1 to 5 more years of the 70-year record, depending on the month) are within the minimum/optimal flow range for backwater pond recharge.

Table 4.8-5
WFP Impact on Backwater Recharge in the Lower American River Below Nimbus Dam

Month	Modeled Scenario	Number of Years of 70-year Record Within Specified Ranges[1]		
		# Years in Optimal Flow Range[2] (2,700-4,000 cfs)	# Years in Min/Optimum Flow Range[3] (1,300-4,000 cfs)	% of Years Within Minimum/Optimum Flow Range[4]
March	Base	17	40	57%
	WFP	22	46	66%
April	Base	18	36	51%
	WFP	19	37	53%
May	Base	21	35	50%
	WFP	20	37	53%
June	Base	17	34	49%
	WFP	21	39	56%
July	Base	21	44	63%
	WFP	20	47	67%
August	Base	20	40	57%
	WFP	25	47	67%
September	Base	8	39	56%
	WFP	19	53	76%
October	Base	2	63	90%
	WFP	1	63	90%
November	Base	5	56	80%
	WFP	3	57	81%
December	Base	2	47	67%
	WFP	3	48	69%
January	Base	4	46	66%
	WFP	4	47	67%
February	Base	5	37	53%
	WFP	3	37	53%

1 Number of years during the 70-year record when the river flows are within the specified ranges for backwater recharge on the Lower American River.

2 Number of years during the 70-year record when the mean monthly river flows below Nimbus Dam are between 2,700 and 4,000 cubic feet per second (cfs).

3 Number of years during the 70-year record when the mean monthly river flows below Nimbus Dam are between 1,300 and 4,000 cfs.

4 Percentage of years during the 70-year record when river flows are within the minimum/optimum flow range for maintenance and adequate recharge of backwater ponds.

Base Modeled predictions of 70-year record based on 1998 diversions and operating rules.
WFP Modeled predictions of 70-year record based on WFP conditions.
n/c No change between Base and WFP conditions.

Source: EDAW, 1998.

Table 4.8-6
WFP Impact on Backwater Recharge in the Lower American River at H Street Bridge

Month	Modeled Scenario	Number of Years of 70-year Record Within Specified Ranges[1]		
		# Years in Optimal Flow Range[2] (2,700-4,000 cfs)	# Years in Min/Optimum Flow Range[3] (1,300-4,000 cfs)	% of Years Within Minimum/Optimum Flow Range[4]
March	Base	13	41	59%
	WFP	18	47	67%
April	Base	13	39	56%
	WFP	13	41	59%
May	Base	20	39	56%
	WFP	23	42	60%
June	Base	21	39	56%
	WFP	22	36	51%
July	Base	22	40	57%
	WFP	16	40	57%
August	Base	21	41	59%
	WFP	27	49	70%
September	Base	17	48	69%
	WFP	19	43	61%
October	Base	2	63	90%
	WFP	1	62	89%
November	Base	5	56	80%
	WFP	3	57	81%
December	Base	2	47	67%
	WFP	3	48	69%
January	Base	4	45	64%
	WFP	3	44	63%
February	Base	4	37	53%
	WFP	4	38	54%

1 Number of years during the 70-year record when the river flows are within the specified ranges for backwater recharge on the Lower American River.

2 Number of years during the 70-year record when the mean monthly river flows at H Street bridge are between 2,700 and 4,000 cubic feet per second (cfs).

3 Number of years during the 70-year record when the mean monthly river flows at H Street bridge are between 1,300 and 4,000 cfs.

4 Percentage of years during the 70-year record when river flows are within the minimum/optimum flow range for maintenance and adequate recharge of backwater ponds.

Base Modeled predictions of 70-year record based on 1998 diversions and operating rules.
WFP Modeled predictions of 70-year record based on WFP conditions.
n/c No change between Base and WFP conditions.

Source: EDAW, 1998.

Although projected flows under WFP conditions would be within the minimum/optimum flow range for fewer years, during the months of June, September, October, and January at the H Street bridge (1 to 5 fewer years of the 70-year record), overall, considering all months of the year, WFP would result in a greater number of years within the 70-year hydrologic record that flows are within the minimum/ optimum range (between 53% and 90% of years, depending on the month). Recognizing the relative greater importance of winter and spring for timing of recharge flows and the increase in frequency of those flows under the WFP conditions, the effects on backwater pond vegetation of the Lower American River would be less than significant.

Impact 4.8-3

Vegetation Associated with Reservoirs. *Compared to existing conditions, the WFP would result in lower mean monthly flows and, in many years, lower surface water elevations of reservoirs; however, because the draw down zone is vegetated with non-native herbaceous plants and scattered willow shrubs that do not form a contiguous riparian community, are not considered of high wildlife value, and will likely reestablish as water levels fluctuate, important habitat values are not adversely affected. For these reasons, this impact would be considered* ***less than significant.***

Folsom, Shasta, Keswick, Trinity, and Whiskeytown reservoirs have water levels that routinely fluctuate annually, and therefore non-native (weedy) vegetation becomes established in areas below the high water line during the growing season. The WFP would result in different water level fluctuations than base conditions, including many years with slightly lower elevations Non-native herbaceous vegetation is regionally abundant, is of low wildlife value, and is not considered a habitat of special concern. Furthermore, while individual willows have become established in some areas of Folsom Reservoir, such as small creek outlets to the lake, they do not form large contiguous stands, and therefore are not of high value to wildlife. While the WFP may change the distribution of vegetation, the potential alteration of non-native herbaceous vegetation and scattered willows would be considered less than significant, because of their limited habitat values.

Impact 4.8-4

Vegetation Associated with the Upper Sacramento River. *Compared to existing conditions, the WFP would result in some years with higher and some years with lower mean monthly flows on the Upper Sacramento River during the spring and summer growing season for riparian vegetation; in years with lower flows, they would not be reduced by sufficient magnitude and frequency to significantly alter existing riparian vegetation dependent on the Upper Sacramento River flows. For example, spring and summer flows on the Upper Sacramento River, under WFP conditions, vary from base conditions by less than one percent. Consequently, this impact would be considered* ***less than significant.***

The peak growing season for riparian vegetation is typically March through July with the remaining growing season from August through October. The analysis of effects on riparian vegetation within the Upper Sacramento River is based on the modeling of 1998 base conditions and the relative changes in river flows below Keswick Dam caused by the WFP conditions. In comparison to base conditions, WFP conditions would result in near equivalent to slightly increased mean monthly flows on the Upper Sacramento River. Under WFP conditions, mean monthly flows would decrease by 10.2 to 23.8 cfs during the months of April, June, September, and October and would increase by 5.5 to 36.0 cfs during the remaining months of the growing season (March, May, July, and August). In the context of riparian vegetation effects, the frequency and magnitude of flow decreases under WFP conditions would be small considering that mean monthly flows would be 5,406 to 12,968 cfs during the months of the growing season. Because spring and summer flows on the Upper Sacramento River under WFP conditions vary from base conditions by less than 1%, flows under the WFP conditions are not expected to adversely affect riparian vegetation along the river and impacts are considered less than significant.

Impact 4.8-5

Vegetation Associated with the Lower Sacramento River and the Delta. *Compared to existing conditions, Lower Sacramento River flows would be reduced during the growing season months of some years. However, in years with lower flows, they would not be reduced by sufficient magnitude and frequency to significantly alter existing riparian habitats dependent on the Lower Sacramento River flows and Delta inflows. For example, average decreases in mean monthly flows during the peak growing season (March-July) between the base and WFP conditions range from 159.9 cfs to 492.0 cfs. As it relates to riparian vegetation effects, these reductions in flow are not considered substantial. This impact would* ***less than significant****.*

The analysis of effects on riparian vegetation within the Lower Sacramento River is based on the modeling of WFP conditions and the relative changes in river flows below Freeport compared to 1998 baseline conditions. As previously mentioned, the primary growing season for riparian vegetation within this region occurs during the months of March through October. Based on a comparison of year 1998 base and WFP conditions, reductions of mean monthly river flows during the growing season would occur during the months of March through October.

The average difference in mean monthly flows during the peak growing season (March-July) between the base condition and the WFP condition ranges from 159.9 cfs to 492.0 cfs lower. Mean monthly flows under the WFP conditions are from 141.6 cfs to 309.1 cfs lower than base condition during the remaining months of the growing season (August through October). As it relates to riparian vegetation effects, the reductions in flow are not substantial, considering that mean monthly flows, under WFP conditions, range from approximately 11,840 cfs to over 33,258 cfs, depending on the month. Also, tidal action influences the river stage in this area. Because spring and summer flows would vary from base conditions by approximately 3% or less on the lower Sacramento River, flows under the WFP conditions are not expected to adversely affect riparian vegetation along the river and impacts are considered less than significant.

Lower American River Terrestrial Special-Status Species Impacts

Impact 4.8-6

Special-Status Species of Riparian and Open Water Habitats. *As discussed in Impacts 4.8-1 and 4.8-5, when compared to existing conditions, the WFP would result in reduced mean monthly flows during certain periods in the year. However, these flows would not be reduced by sufficient magnitude and frequency to significantly alter existing riparian vegetation dependent on the Lower American River. Because cottonwood forest vegetation would not be adversely affected and open water (river) habitat would be available, the* *special-status species dependent on riparian habitat would not be expected to be adversely affected; therefore, this impact would be considered **less than significant**.*

Bald eagle, bank swallow, yellow warbler, yellow-breasted chat, river otter, Swainson's hawk, and several species of raptors are special-status species known to occur, nest, or periodically forage in open water and cottonwood forest habitats along these rivers. Because cottonwood forest and open water habitats under the WFP were determined to not be adversely affected, special-status species that are dependent on these habitats are also not expected to be impacted; therefore, impacts would be considered less than significant.

Impact
4.8-7

Special-Status Species Dependent on Lower American River Backwater Pond/Marsh Habitats. *As discussed in Impact 4.8-2, when compared to existing conditions the WFP would result in reduced mean monthly flows during certain times of the year. However, these flows would not be reduced by sufficient magnitude and frequency to significantly alter existing backwater habitats dependent on the Lower American River. Because backwater habitats would not be adversely affected, the special-status species dependent on these habitats would not be expected to be adversely affected; therefore, this impact would be considered **less than significant**.*

Sanford's arrowhead, western pond turtle, and tricolored blackbirds are special-status species known to occur in several backwater pond areas along the Lower American River. Because impacts to backwater habitats under the WFP were determined to not be adversely affected, special-status species that are dependent on these habitats are also not expected to be impacted, therefore impacts would be considered less than significant.

Impact
4.8-8

Elderberry Shrubs and Valley Elderberry Longhorn Beetle. *As discussed in Impact 4.8-2 (backwater recharge), when compared to existing conditions the WFP would result in reduced mean monthly flows during certain months of the growing season. However, these flows would not be reduced by sufficient magnitude and frequency to significantly alter existing water fluctuations (pond levels) and vegetation dependent on these ponds. For these reasons, elderberries dependent on these habitats are not expected to be adversely affected. This impact would be considered **less than significant**.*

USFWS has designated the American River Parkway as critical habitat for VELB, and this species has been recorded in elderberry shrubs near backwater ponds along the Lower American River. Because impacts to backwater habitats under the WFP were determined to be less than significant, elderberry shrubs that are dependent on these habitats are also not expected to be adversely affected. Impacts would, therefore, be considered less than significant.

Impact
4.8-9

Sacramento-San Joaquin Delta Habitats of Special-Status Species (non-fish). *As discussed in Impact 4.8-6, when compared to existing conditions the WFP would result in reduced mean monthly flows in the Sacramento River during certain times of the year. However, these flows would not be reduced by sufficient magnitude and frequency to significantly alter existing habitats dependent on the Delta. Because Delta habitats would not be adversely affected, the special-status species dependent on these habitats would not be expected to be adversely affected; therefore, this impact would be considered **less than significant**.*

A number of special-status species included in Table 4.8-1 are known to occur in a variety of habitats associated with the Delta. Because impacts to Delta habitats under the WFP were determined to not be adversely affected, special-status species that are dependent on these habitats are also not expected to be impacted; therefore, impacts would be considered less than significant.

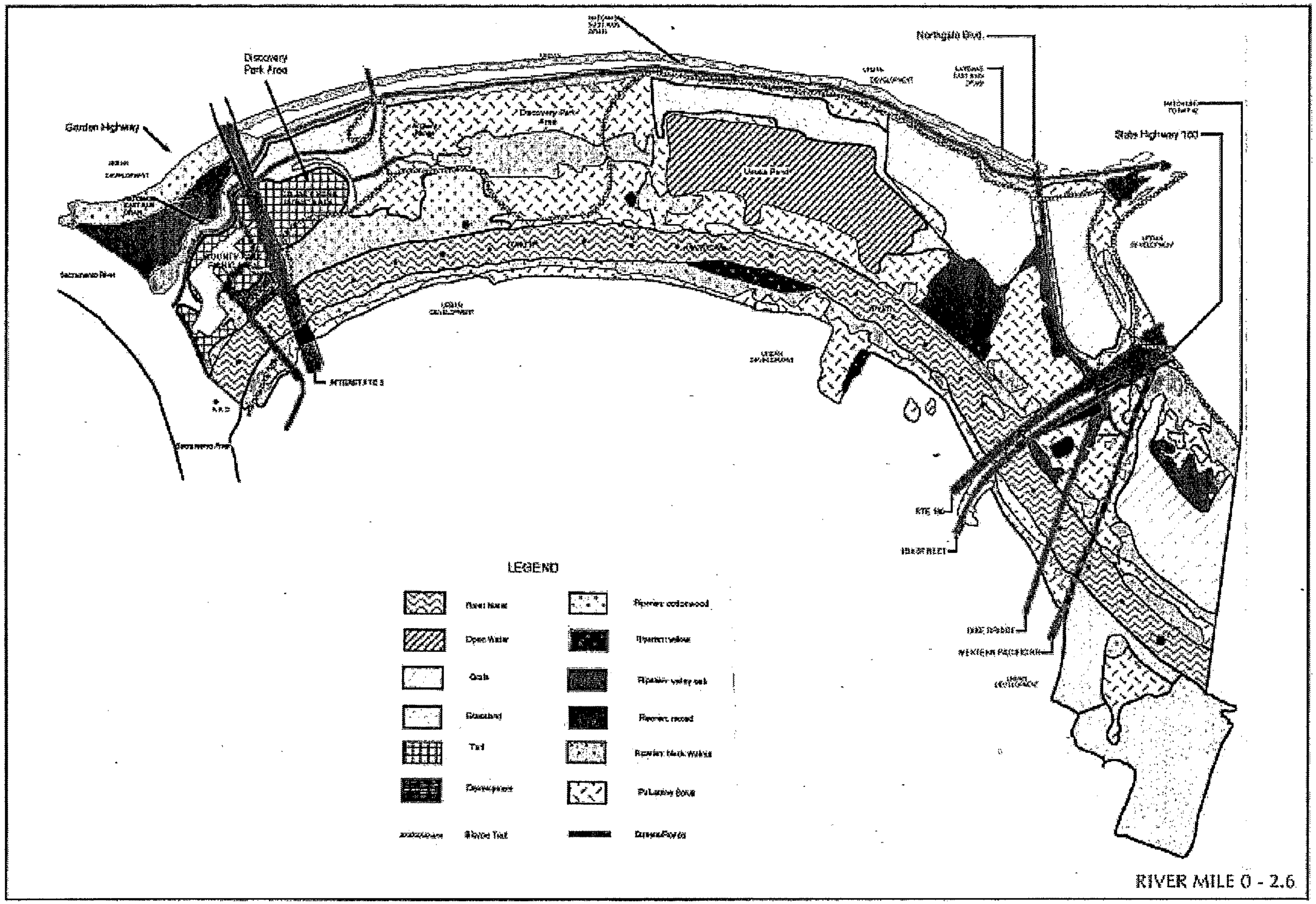
4.8.4 MITIGATION MEASURES

No mitigation measures are necessary for the following less-than-significant impacts:

- 4.8-1: Lower American River Riparian Vegetation
- 4.8-2: Lower American River Backwater Ponds
- 4.8-3: Vegetation Associated with Folsom, Shasta, Keswick, Trinity, and Whiskeytown Reservoirs
- 4.8-4: River Flow Effects on Riparian Vegetation Associated with the Upper Sacramento River
- 4.8-5: Riparian Vegetation Associated with the Lower Sacramento River and the Delta
- 4.8-6: Special-Status Species Dependent on Riparian Vegetation and Open Water Habitats of the Lower American and Upper and Lower Sacramento Rivers
- 4.8-7: Special-Status Species Dependent on Backwater Pond/Marsh Habitats of the Lower American River
- 4.8-8: Elderberry Shrubs (Potential Habitat for Valley Elderberry Longhorn Beetle)
- 4.8-9: Special-Status Species Dependent on Habitats of the Sacramento-San Joaquin Delta

4.8.5 LEVEL OF SIGNIFICANCE AFTER MITIGATION

No significant environmental effects would occur related to terrestrial vegetation and wildlife.



Source: Jeffrey A. Hart, Ph.D., for the Sacramento Area Flood Control Agency (SAFCA), 1997.

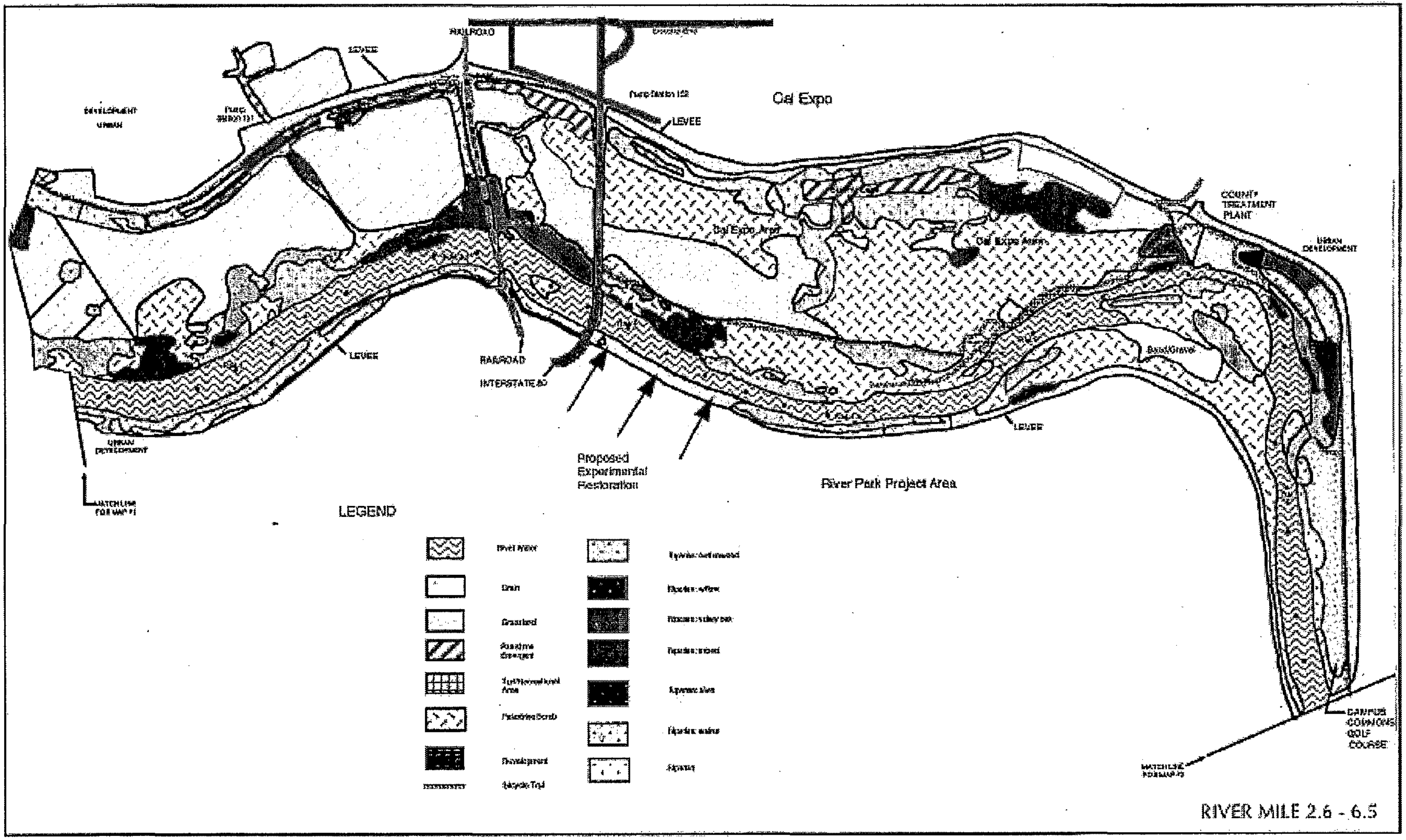
Lower American River Habitats

EXHIBIT 4.8-1a

WATER FORUM PROPOSAL EIR

0 600 1200 2400 FEET NORTH EDAW

C-090377



Source: Jeffrey A. Hart, Ph.D., for the Sacramento Area Flood Control Agency (SAFCA), 1997.

Lower American River Habitats

EXHIBIT 4.8-1b

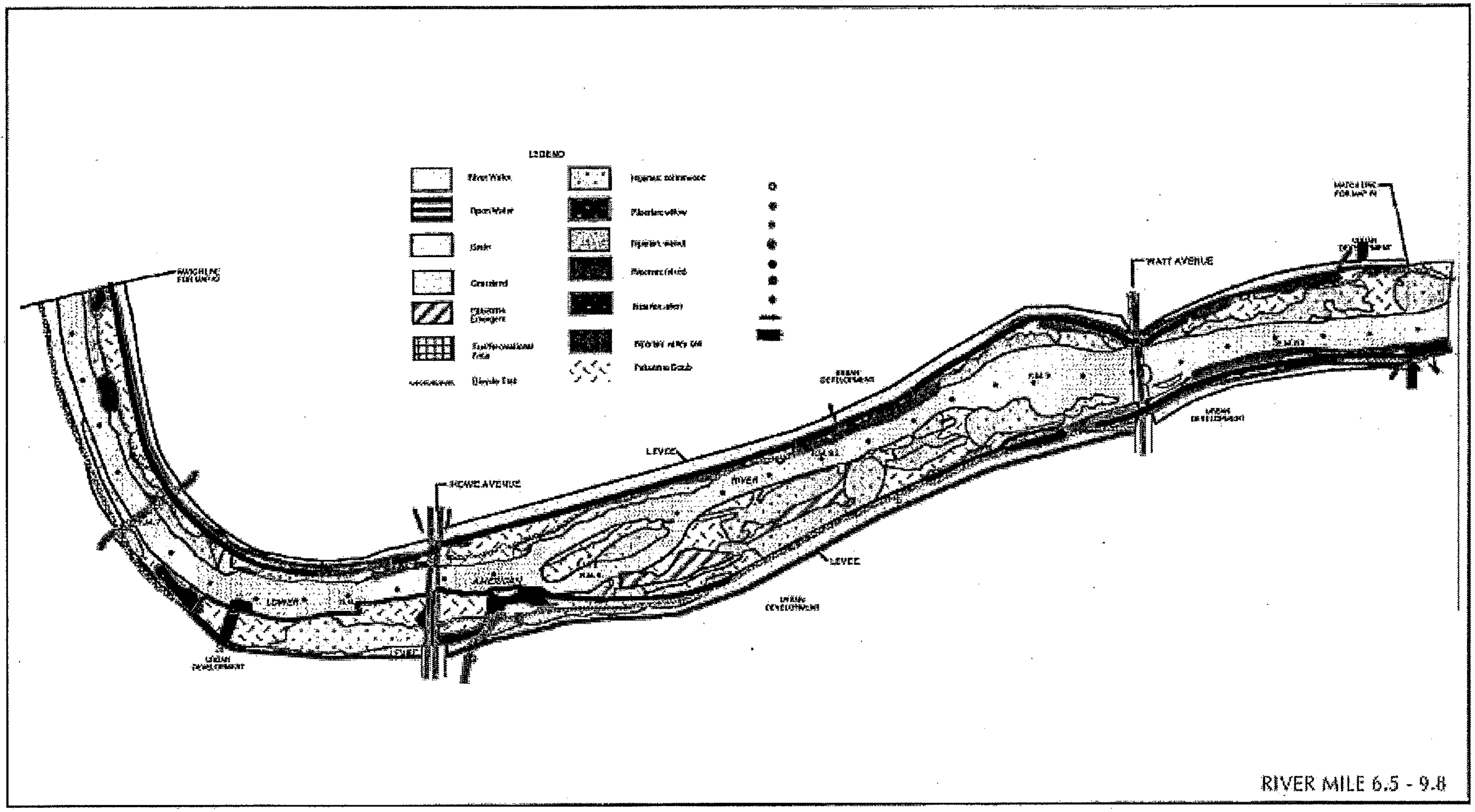
WATER FORUM PROPOSAL EIR

0 600 1200 2400 FEET

NORTH

EDAW

C-090378



Source: Jeffrey A. Hart, Ph.D., for the Sacramento Area Flood Control Agency (SAFCA), 1997.

Lower American River Habitats

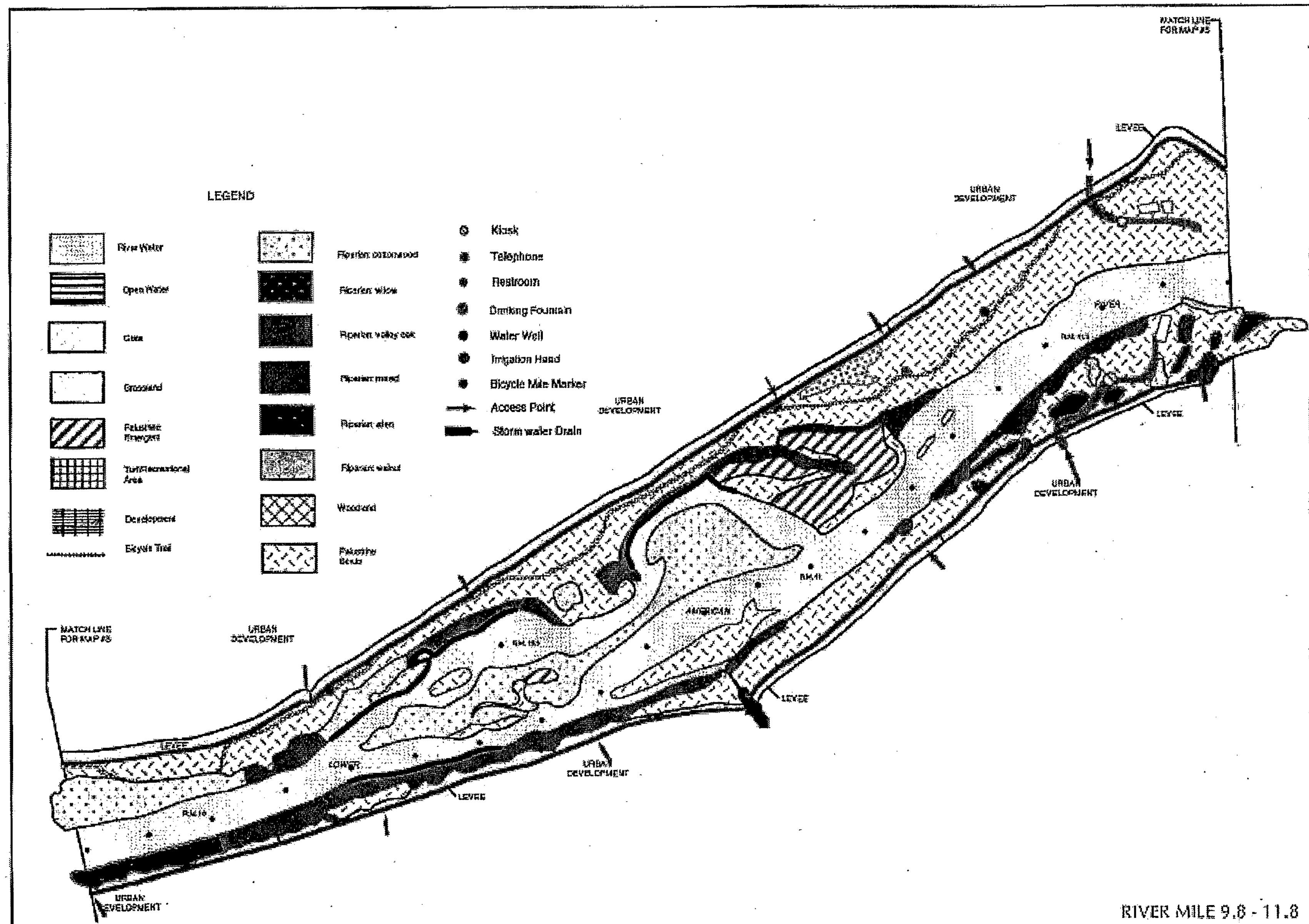
EXHIBIT 4.8-1c

WATER FORUM PROPOSAL EIR

0 600 1200 2400 FEET

NORTH

EDAW



Source: Jeffrey A. Hart, Ph.D., for the Sacramento Area Flood Control Agency (SAFCA), 1997.

Lower American River Habitats

EXHIBIT 4.8-1d

WATER FORUM PROPOSAL EIR

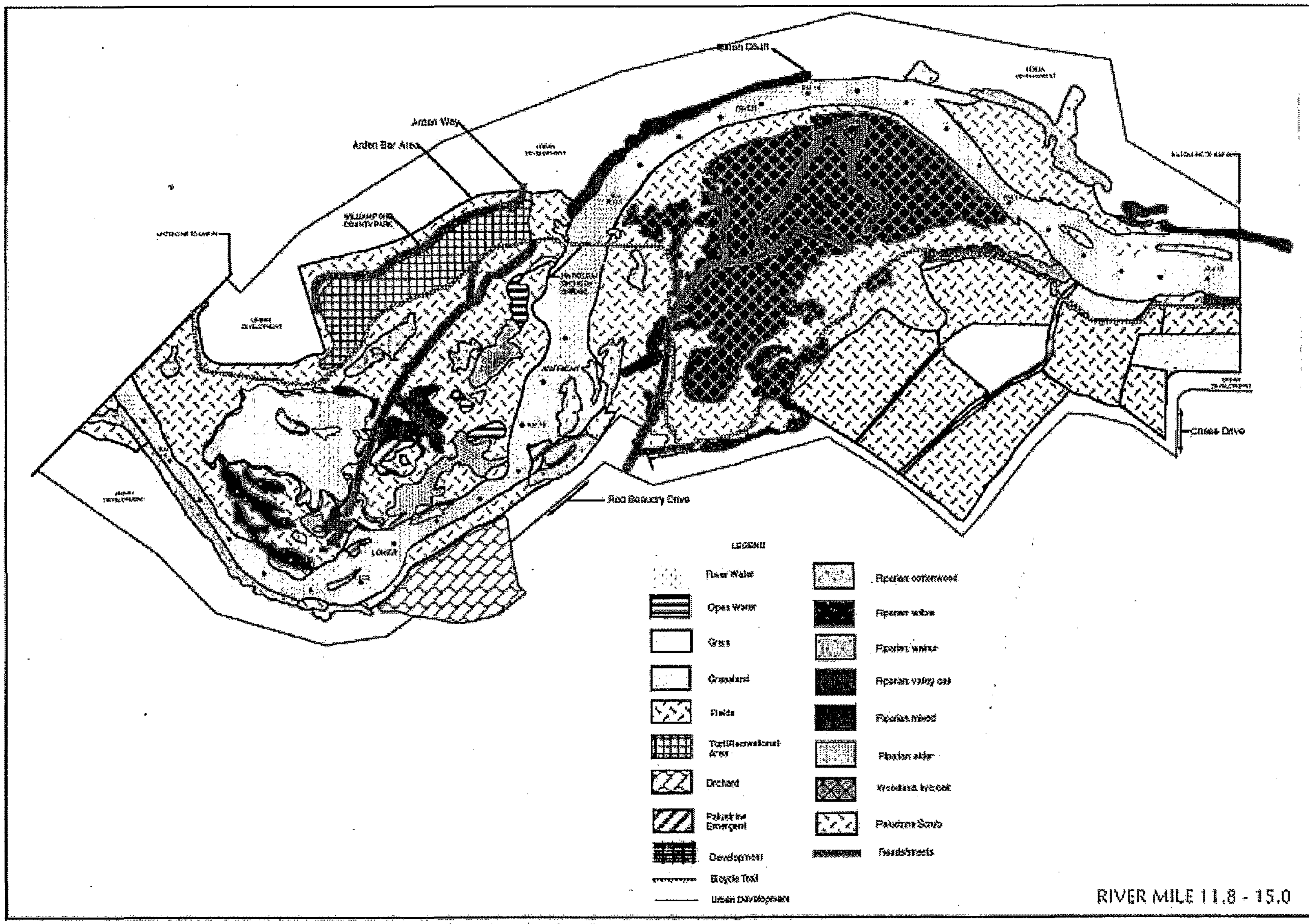
0 300 600 1200 FEET

NORTH

EDAW

C-090380

C-090380



Source: Jeffrey A. Hart, Ph.D., for the Sacramento Area Flood Control Agency (SAFCA), 1997.

Lower American River Habitats

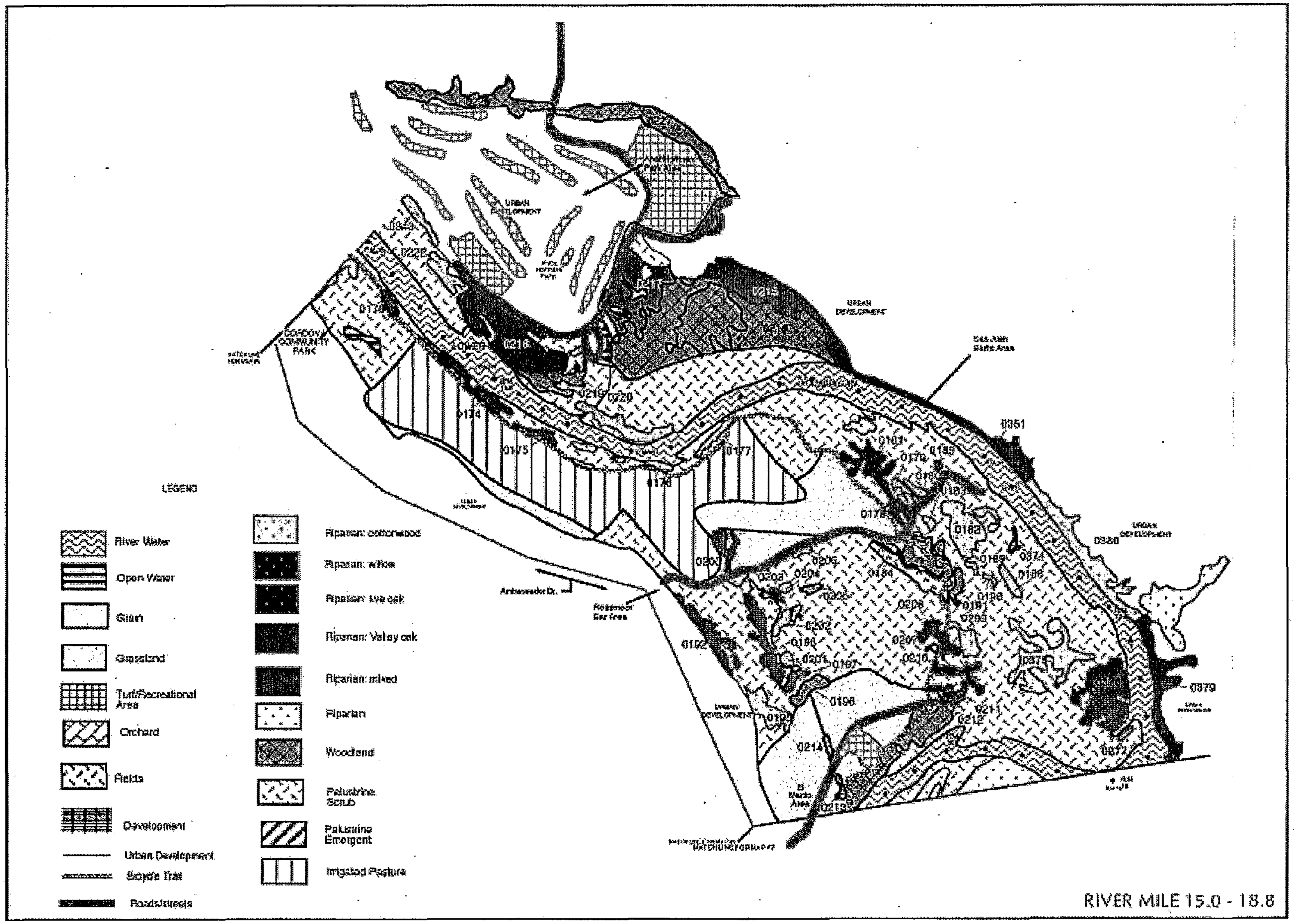
EXHIBIT 4.8-1e

WATER FORUM PROPOSAL EIR

0 600 1200 2400 FEET

NORTH

EDAW

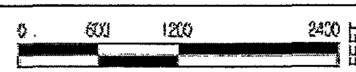


Source: Jeffrey A. Hart, Ph.D., for the Sacramento Area Flood Control Agency (SAFCA), 1997.

Lower American River Habitats

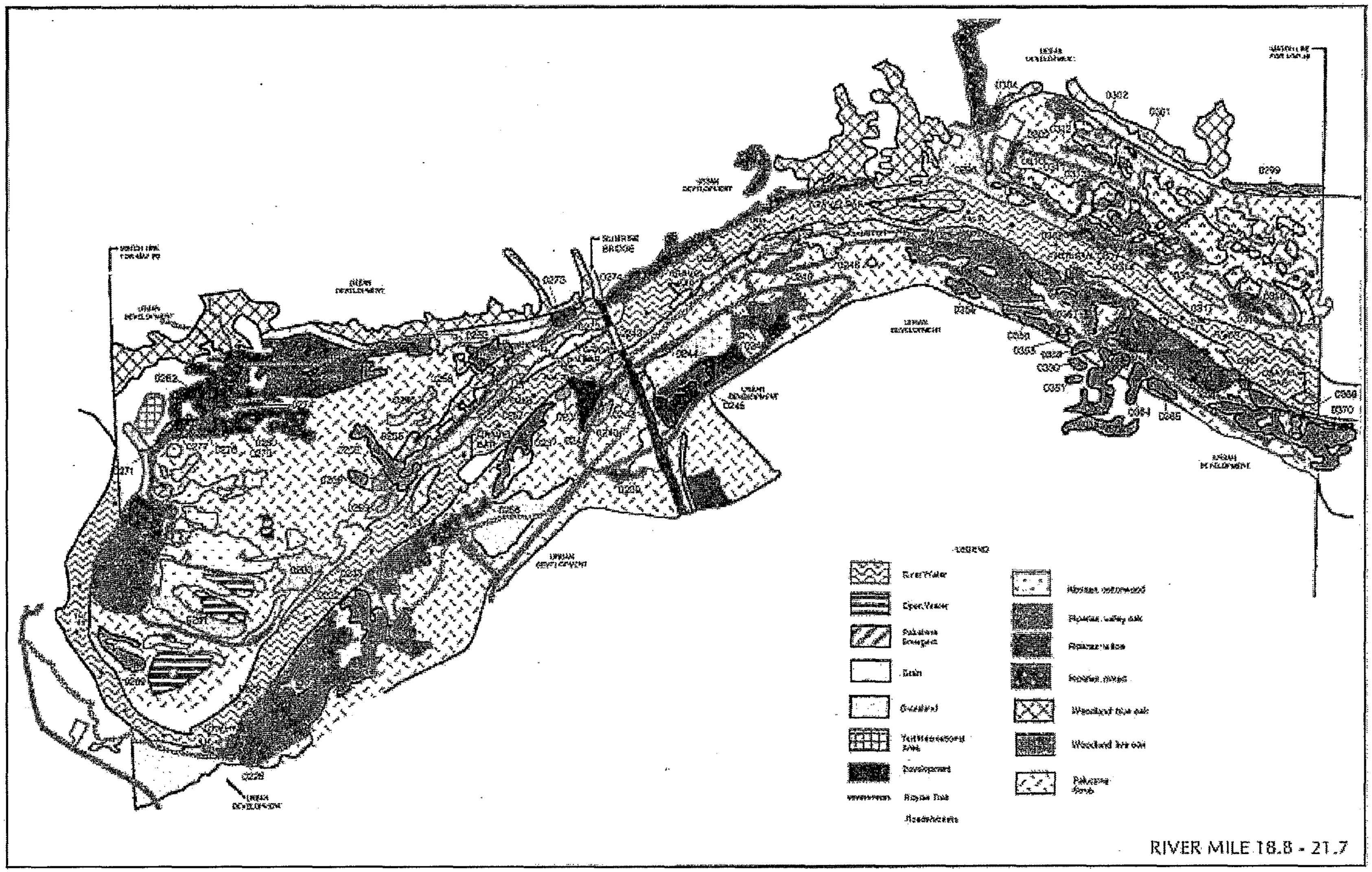
EXHIBIT 4.8-1f

WATER FORUM PROPOSAL EIR



NORTH

EDAW



Source: Jeffrey A. Hart, Ph.D., for the Sacramento Area Flood Control Agency (SAFCA), 1997.

Lower American River Habitats

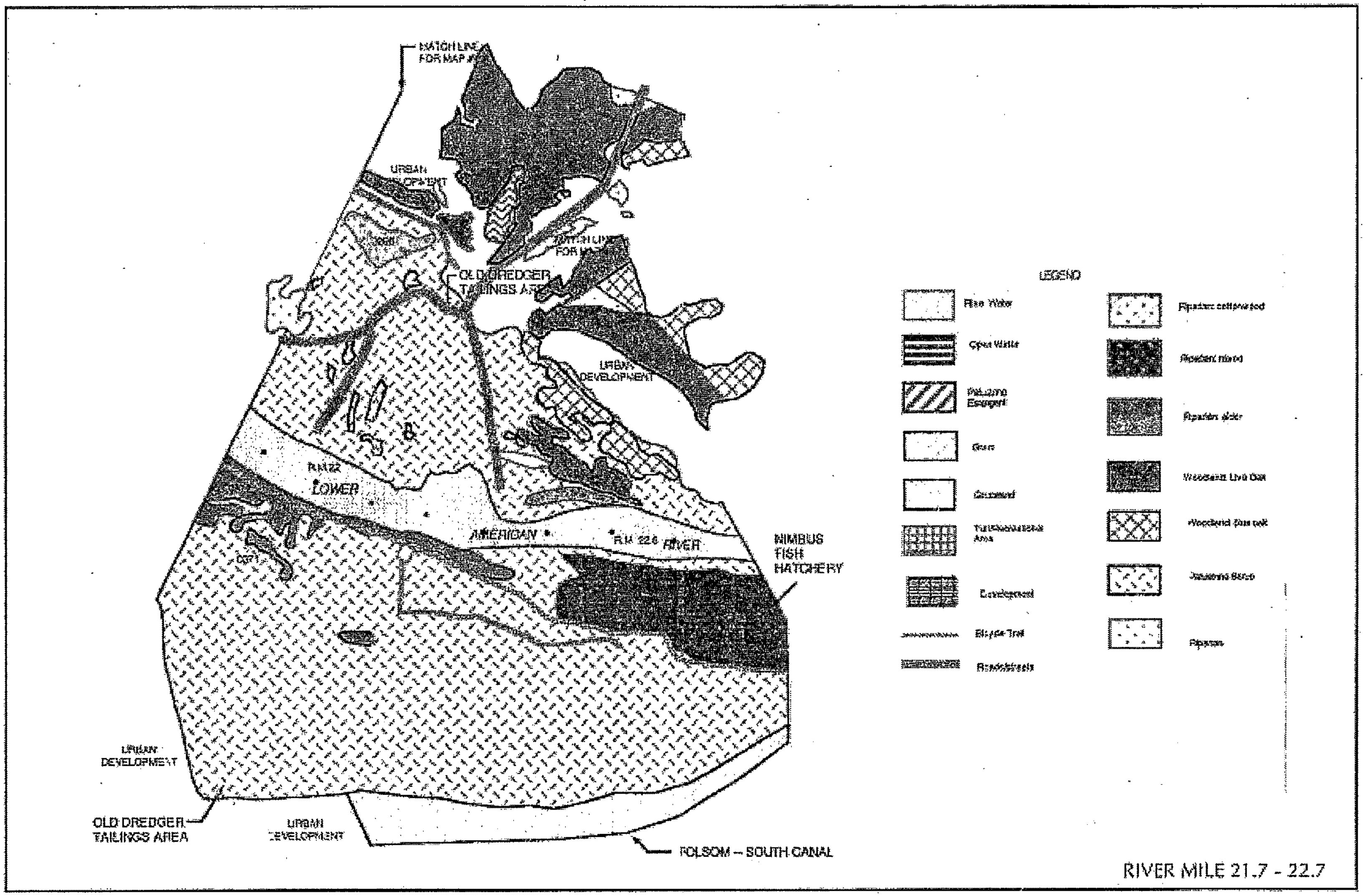
EXHIBIT 4.8-1g

WATER FORUM PROPOSAL EIR

0 600 1200 2400 FEET

NORTH

EDAW



Source: Jeffrey A. Hart, Ph.D., for the Sacramento Area Flood Control Agency (SAFCA), 1997.

Lower American River Habitats

EXHIBIT 4.8-1h

WATER FORUM PROPOSAL EIR

0 300 600 1200 FEET

NORTH

EDAW

4.9 RECREATION

An important issue related to the Water Forum Proposal (WFP) is whether it would result in changes to river flows or reservoir levels that could adversely affect water-dependent or water-enhanced recreation opportunities. This section of the EIR examines water recreation facilities and activities in the direct effect and indirect effect study areas. Because water management decisions primarily involve the American River, the analysis is focused on the recreation facilities and activities pertaining to three resources of the ***Direct Effects Study Area***: the Lower American River (including the American River Parkway), Lake Natoma, and Folsom Reservoir. In addition, information is presented about resources in the ***Indirect Effect Study Area***: the Delta, upper and lower Sacramento River, and reservoirs of the upper Sacramento River (Shasta Lake and Trinity Reservoir).

The analysis is focused on water-dependent and water-enhanced recreation opportunities; however, a detailed evaluation of effects on sport fishing activity is not presented in this section. Rather, sport fishing would be influenced most by the effects of the WFP on fisheries resources; therefore, please refer to Section 4.5, Fisheries Resources, for evaluation of fish population impacts.

4.9.1 EXISTING CONDITIONS

LOWER AMERICAN RIVER

Lower American River Resource Description

The Lower American River (LAR) extends approximately 23 miles from Nimbus Dam downstream to its confluence with the Sacramento River (see Exhibit 4.9-1). The river has a drainage area of approximately 120 square miles and supports of a wide variety of vegetative and aquatic communities. The upper reaches of the river are bordered by upland terraces and bluffs, and the lower reaches are bordered primarily by flood control levees. Most of the Lower American River supports an extensive riparian woodland corridor dominated by cottonwoods and willows. Urban development surrounds the riparian corridor and several arterial streets and highways cross the river (Hazel Avenue, Sunrise Boulevard, Watt Avenue, Howe Avenue, H Street, Capitol City Freeway, S.R. 160, and I-5). Land areas in the river corridor include several large gravel bars within the river meanders, including Sailor Bar, Sacramento Bar, Rossmoor Bar, and Arden Bar, and the floodway inside the levees of the lower reach of the river.

Lower American River Recreation Facilities

Recreation facilities on the Lower American River are generally located in the American River Parkway (Parkway). The Lower American River is the central focus of the Parkway and extends from Nimbus Dam on the east to Discovery Park on the west. The Parkway consists of 14 interconnected parks, a continuous trail system, and approximately 5,000 total acres of land.

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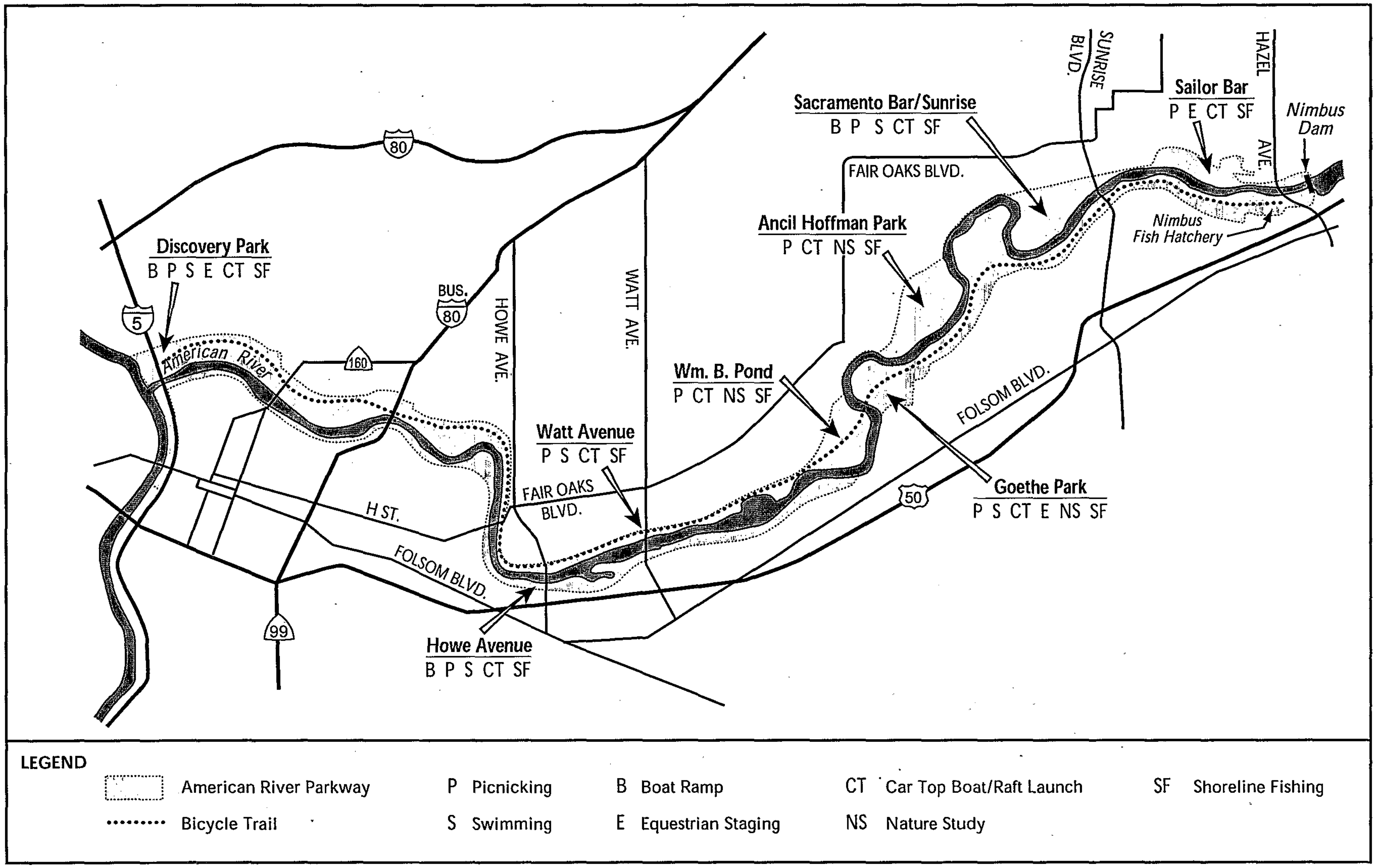

Major Lower American River Recreation Areas

EXHIBIT 4.9-1

WATER FORUM PROPOSAL EIR

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C-090386

Owned and managed by the County of Sacramento, the Parkway is linked to additional park lands, from Nimbus Dam to Folsom Reservoir, which are managed by the California Department of Parks and Recreation (CDPR).

The American River Parkway is recognized as one of the nation ' s premiere urban parkways The most popular feature of the Parkway is the Jedediah Smith Memorial Bicycle Trail which extends approximately 32 miles from Discovery Park on the Lower American River to Beals Point at Folsom Reservoir. Additional recreation facilities, including pedestrian and equestrian trails, and picnic areas are located throughout the Parkway. No commercial recreation facilities are located within the Parkway, although raft rental outfitters are located near the parkway at Sunrise Boulevard.

Recreation facilities located within the Parkway are presented in Table 4.9-1 and Exhibit 4.9-1. As indicated, water-enhanced and water-dependent recreation facilities are provided throughout the Parkway. Water-dependent facilities consist primarily of trailered-boat and car-top boat launching facilities. Trailered-boat launching ramps are located at Discovery Park, Howe Avenue, and Sunrise Boulevard recreation areas and car-top boat launching is permitted at various areas within the Parkway, including Watt Avenue and downstream of Sunrise Boulevard. Water-enhanced facilities consist primarily of picnic areas, and bicycle, equestrian, and pedestrian trails, which are dispersed throughout the Parkway.

Recreation Use and Activities of the Lower American River

In 1997, the Parkway had more than 6 million visitor-days of use. Visits are projected to increase to 9.6 million visitor-days by 2020, assuming stable river flows (Sacramento County and USBR, 1997). The Department of Water Resources (1994b) estimates that approximately 460,000 people use the Lower American River for rafting activities each year.

Annual public use and visitation at the Parkway is presented in Table 4.9-2. As shown, peak use of the Parkway is from June through September. Public use and visitation are influenced not only by the season of the year, but also by air temperature and river flows which are dependent on releases from Folsom Dam. Recreational use decreases during periods when the ambient air temperatures and flow rates decline.

The recreational activities within the Parkway are presented in Table 4.9-3 according to percentage of use. As indicated, water-enhanced activities account for approximately 69% of all recreation activities and water-dependent activities account for approximately 31%. The most popular activity in the American River Parkway is the category of nature study and sightseeing, accounting for approximately 30% of the total recreation demand. Of the remaining recreational uses listed, trail use (jogging, bicycling, hiking and equestrian) accounts for approximately 27%; picnicking accounts for about 12%; boating accounts for about 11%; and swimming and fishing-related activities each account for about 10% of the total recreation demand in the Parkway.

Table 4.9-1 Recreation Facilities Located Within the American River Parkway					
Recreation Area	Facility				
	Water Enhanced				Water Dependent
	Picnicking	Camping	Equestrian Staging	Bicycle & Pedestrian Trails	Boat Launching
Discovery Park	■	■	■	■	CT-B
Woodlake Area	■			■	
Cal Expo Area	■			■	
Paradise Beach				■	
Campus Commons Area	■			■	
Howe Avenue Area	■			■	CT-B
Watt Avenue Area	■			■	CT
Sara Park				■	
Arden Bar Area	■			■	CT
C.M. Goethe Park	■	N	■	■	CT
Ancil Hoffman Park	■			■	CT
Rossmoor Bar				■	CT
Sacramento Bar	■			■	CT
Sunrise Boulevard Area	■	■		■	CT-B
Sailor Bar	■	■	■	■	CT

Note: Table does not present all available recreational facilities. The following designations apply:

CT = Car-top boat and raft launching areas
N = Overnight use by permit only
B = Trailered boat launching ramps

Source: Sacramento County, 1985; SAFCA and USBR, 1994; SMWA and USBR, 1996; EDAW, 1998.

Table 4.9-2 Seasonal Public Use and Visitation — American River Parkway	
Period	Percentage of Use
January 1 - March 5	17.5
March 6 - June 9	26.3
June 10 - September 25	29.6
September 26 - December 31	26.6

Source: SAFCA and USBR, 1994.

Table 4.9-3 Recreation Activities by Percentage of Use - American River Parkway	
Use Type	Percentage of Use
Water-Enhanced Activities	
Picnicking and Relaxing	12.0
Nature Study and Sightseeing	30.0
Trail Use	27.0
Subtotal	**69.0**
Water-Dependent Activities	
Swimming and Wading	10.0
Rafting and Boating	11.0
Fishing	10.0
Subtotal	**31.0**
TOTAL	**100.0**
Source: SAFCA and USBR, 1994	

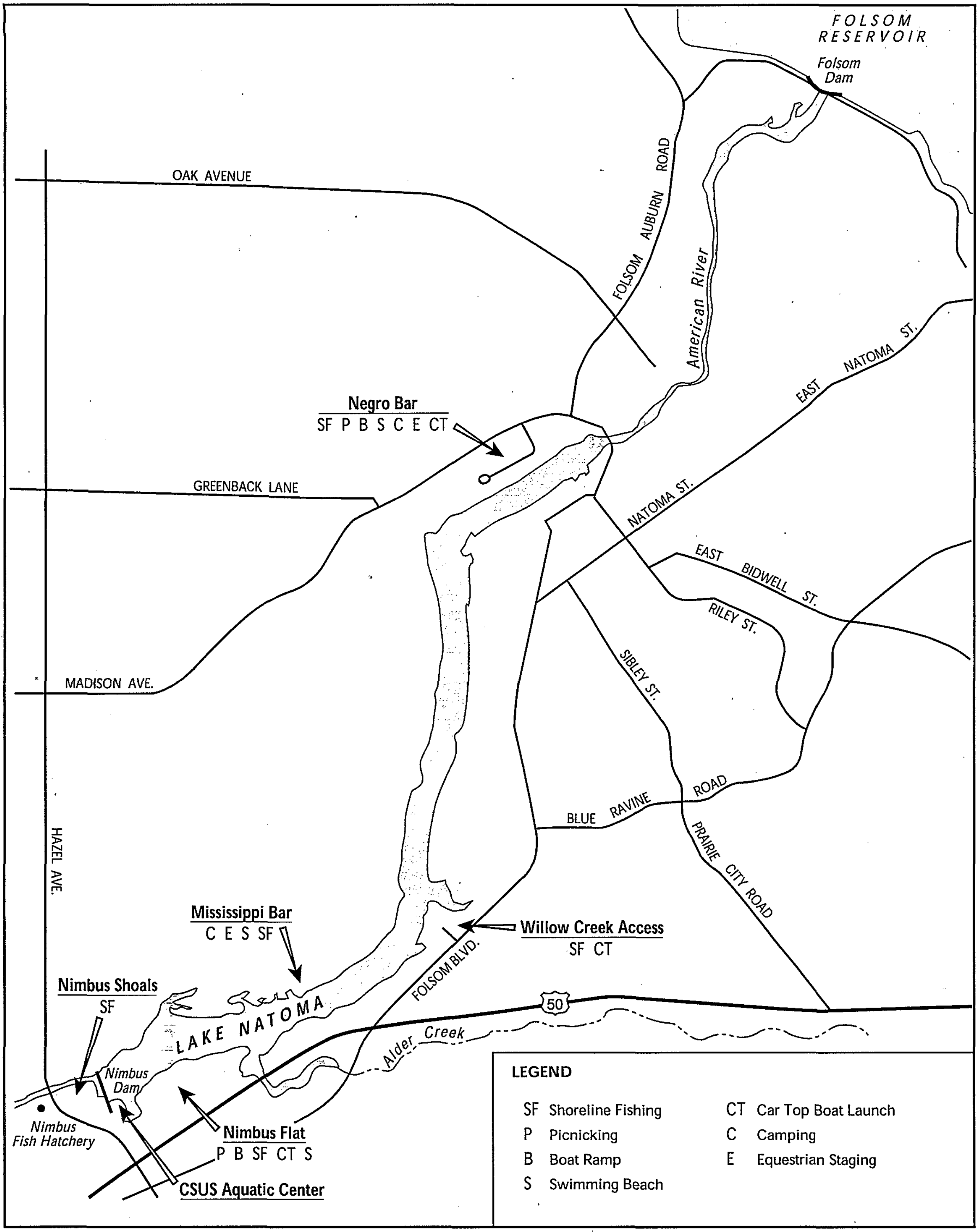
A majority of the recreation activities listed (including swimming/wading, picnicking, and trail use) are allowed throughout the Parkway. Boating and rafting activities occur most frequently between Sunrise Boulevard and Goethe Park/William Pond areas. Fishing is permitted year-round within the Parkway, except during fall and early winter when the river is closed from Ancil Hoffman Park on the west to the Hazel Avenue Bridge on the east to protect spawning fish.

Rafting on the Lower American River is supported by commercial outfitters who provide services such as daily tours, shuttle buses, instructional services, and rental equipment for rafting, boating, and fishing activities. Two major outfitters, both located near Sunrise Boulevard, put-in rafts just downstream of Sunrise Boulevard and use either Goethe Park and/or the Harrington Drive access as the primary take-out points. The boating and rafting season is generally between April and October, with peak raft rentals occurring in June, July (highest use month), and August (Gardner, pers. comm., 1997).

LAKE NATOMA

Lake Natoma Resource Description

Lake Natoma, the Folsom Dam afterbay, is a unit of the Folsom Lake State Recreation Area (SRA) (see Exhibit 4.9-2). At its full capacity, the lake consists of approximately 500 surface-acres of water. The lake is controlled by Nimbus Dam, which along with Folsom Dam, regulates water releases to the Lower American River. Nimbus Dam was built in 1955 by the Army Corps of Engineers and later transferred to the U.S. Department of Interior, Bureau of Reclamation, as part of the Central Valley Project.



Lake Natoma Recreation Areas

EXHIBIT 4.9-2

WATER FORUM PROPOSAL EIR

0 1/4 1/2 1 MILES

NORTH

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C—090390

As a regulating reservoir, Lake Natoma ' s water level fluctuations are typically limited to 4 to 7 feet, providing a relatively stable shoreline. Summer water temperatures are generally cooler than Folsom Reservoir. The lake is generally surrounded by riparian woodland vegetation Urban development abuts the edge of the Lake Natoma state-owned property in several locations. Recreation facilities on the lake are operated by the California Department of Parks and Recreation (SAFCA and USBR, 1994, CDPR, 1990).

Lake Natoma Recreation Facilities

Facilities at Lake Natoma include picnic areas, an 8-mile segment of the Jedediah Smith bicycle trail (which connects the American River Parkway with Folsom Reservoir), and pedestrian and equestrian trails. The Western States/Pioneer Express riding and hiking trail (which extends from Sacramento to Carson City, Nevada) is located along the western shore of the lake Additional facilities include the California State University Sacramento (CSUS) aquatic center, which provides instruction and equipment rentals for rowing, sail-boarding, canoeing, and small boat sailing (CDPR, 1990; Sacramento County, 1985; SAFCA and USBR, 1994). CSUS sponsors local, regional, and national rowing competitions on Lake Natoma and its intercollegiate and club teams use the lake for rowing practice. Recreation facilities located at Lake Natoma are presented in Table 4.9-4 and Exhibit 4.9-2.

Table 4.9-4
Recreation Facilities Located at Lake Natoma

Recreation Area	Facility					
	Water Enhanced				Water Dependent	
	Picnicking	Camping	Equestrian Staging	Bicycle & Pedestrian Trails	Swimming & Wading	Boat Launching
Willow Creek	■			■	ND	CT
Nimbus Flat	■			■	■	CT-B
Mississippi Bar		■	■	■	ND	
Negro Bar	■	G	■	■	■	CT-B

Note: Table does not present all available recreational facilities. In general, recreation facilities are for day use; overnight use is permitted where indicated. The following designations apply:

CT = Car-top boat and raft launching areas
B = Trailered boat launching ramps
G = Group camp only
ND = Non-designated swimming area

Source: Sacramento County, 1985; SAFCA and USBR, 1994; SMWA and USBR, 1996; EDAW, 1998.

As indicated, recreation facilities are provided primarily within the Mississippi Bar, Nimbus Flat, and Negro Bar recreation areas. Water-dependent facilities within the lake area consist primarily of trailered and car-top boat launching facilities, with both located at Nimbus Flat and Negro Bar. Car-top boat launching is allowed at Willow Creek. Swimming is permitted at designated beaches at Negro Bar and Nimbus Flat. Kayak rentals are available during the summer months at Negro Bar and the CSUS aquatic center. Group camping sites are provided at Negro Bar. (Family camping sites used to be available, but have been removed for the new Folsom Bridge at Lake Natoma.) Water-enhanced facilities consist primarily of picnic areas and bicycle, equestrian, and pedestrian trails, which are dispersed throughout the Lake Natoma area.

Improvements in Lake Natoma recreation facilities are under construction, in conformance with the state's 1980 master plan for the lake. Scheduled to be completed by 2001, the improvements include an expanded aquatics complex at the CSUS center, bicycle trails, a bicycle overcrossing of U.S. Highway 50, wetlands restoration, fishing access, and picnic grounds. Expanded recreation facilities are being added at Nimbus Flat and trail facilities are being built on the east side of the lake. The CDPR goal for the lake is to create a major multi-use recreational resource.

Recreational Use and Activities at Lake Natoma

Table 4.9-5
Public Use and Visitation — Folsom Lake State Recreation Area Seasonal Visitation

Season	Percentage of Visitation
Winter	
January	2.2
February	5.2
March	7.4
Subtotal	**14.8**
Spring	
April	10.4
May	13.8
June	15.5
Subtotal	**39.7**
Summer	
July	17.0
August	11.7
September	6.8
Subtotal	**35.5**
Fall	
October	5.0
November	3.2
December	1.8
Subtotal	**10.0**
TOTAL	**100.0**

Source: SAFCA and USBR, 1994; EDAW, 1998.

On average, Lake Natoma supports approximately a half million visitor-days per year (CDPR, undated). Monthly visitation data for the SRA, which includes Lake Natoma, are presented in Table 4.9-5. As indicated, visitation is greatest during the warmer spring and summer months (April through August), and least during the cooler fall and winter months (November - February). Approximately 75% of the annual visitation for the SRA occurs during the spring and summer seasons. In general, public use and visitation to Lake Natoma is dependent on the season of the year and ambient air temperature.

Lake Natoma is within an approximate 30-minute travel time zone of the Sacramento metropolitan area and within 2 to 3 hours travel time of the San Francisco Bay Area. Because of the lake's proximity to major metropolitan areas, approximately 95% of day-use visitation is from locations within the Central Valley area. For extended use activities (such as overnight camping), approximately one-third of the visitors are from the Central Valley area, one-third are from the San Francisco Bay area, and the remaining one-third are from other areas (CDPR, 1990).

The recreational activities within the Lake Natoma recreation area are presented in Table 4.9-6 according to percentage of use. As indicated, water-enhanced activities account for approximately 50% of all recreation activities and water-dependent activities account for the remaining 50%. Of the recreational uses listed, trail use accounts for about 33% of the total recreation demand in the Lake Natoma area. Rafting and boating activities (trailer and non-trailer launched) account for approximately 30%; swimming and wading account for a combined percentage of 12%; picnicking and related activities account for about 10%; fishing accounts for approximately 8%; and nature study/sightseeing accounts for about 7% of the total recreation demand.

The predominant recreational activity at Lake Natoma is trail use (jogging, bicycling, hiking and horseback riding), which is water-enhanced. Because of the lake's stable water level conditions, it is a popular destination for boating, rowing, canoeing, and wind surfing activities. Summer water temperatures at Lake Natoma are generally cooler than Folsom Reservoir (because colder water is typically released into Lake Natoma from the deeper parts of Folsom Reservoir) and it is therefore less intensely used for swimming and wading. The beaches at Negro Bar and Nimbus Flat are the primary swimming areas; they are buoy-marked and lifeguards are present during high-use periods.

Table 4.9-6
Recreation Activities by Percentage of Use — Lake Natoma

Use Type	Percentage of Use
Water-Enhanced Activities	
Nature Study and Sightseeing	7.0
Picnicking and Relaxing	10.0
Trail Use	33.0
Subtotal	**50.0**
Water-Dependent Activities	
Swimming and Wading (non-designated areas)	4.0
Swimming and Wading (designated areas)	8.0
Fishing	8.0
Rafting and Boating (non-trailer launched)	15.0
Boating (trailer launched)	15.0
Subtotal	**50.0**
TOTAL	**100.0**

Note: "Water-enhanced" percentages are expected to increase over the next 1-5 years as buildout of the Master Plan continues along the south and east sides of Lake Natoma. Numbers are observation-based only; CDPR staff does not routinely and systematically collect data according to the categories.

Source: LeFlore, pers.comm., 1997.

FOLSOM RESERVOIR

Folsom Reservoir Resource Description

Folsom Reservoir was formed with the construction of the Folsom Dam in 1955 (see Exhibit 4.9-3). Folsom Dam was constructed by the Army Corps of Engineers and later transferred to the U.S. Department of Interior, Bureau of Reclamation, for operation as part of the Central Valley Project. The dam was constructed for the purpose of controlling the waters of the American River and providing flood protection, power, and water supply. The entire reservoir is contained within the Folsom Lake SRA. Recreation facilities are operated by the California Department of Parks and Recreation (CDPR, 1997; SMWA and USBR, 1996).

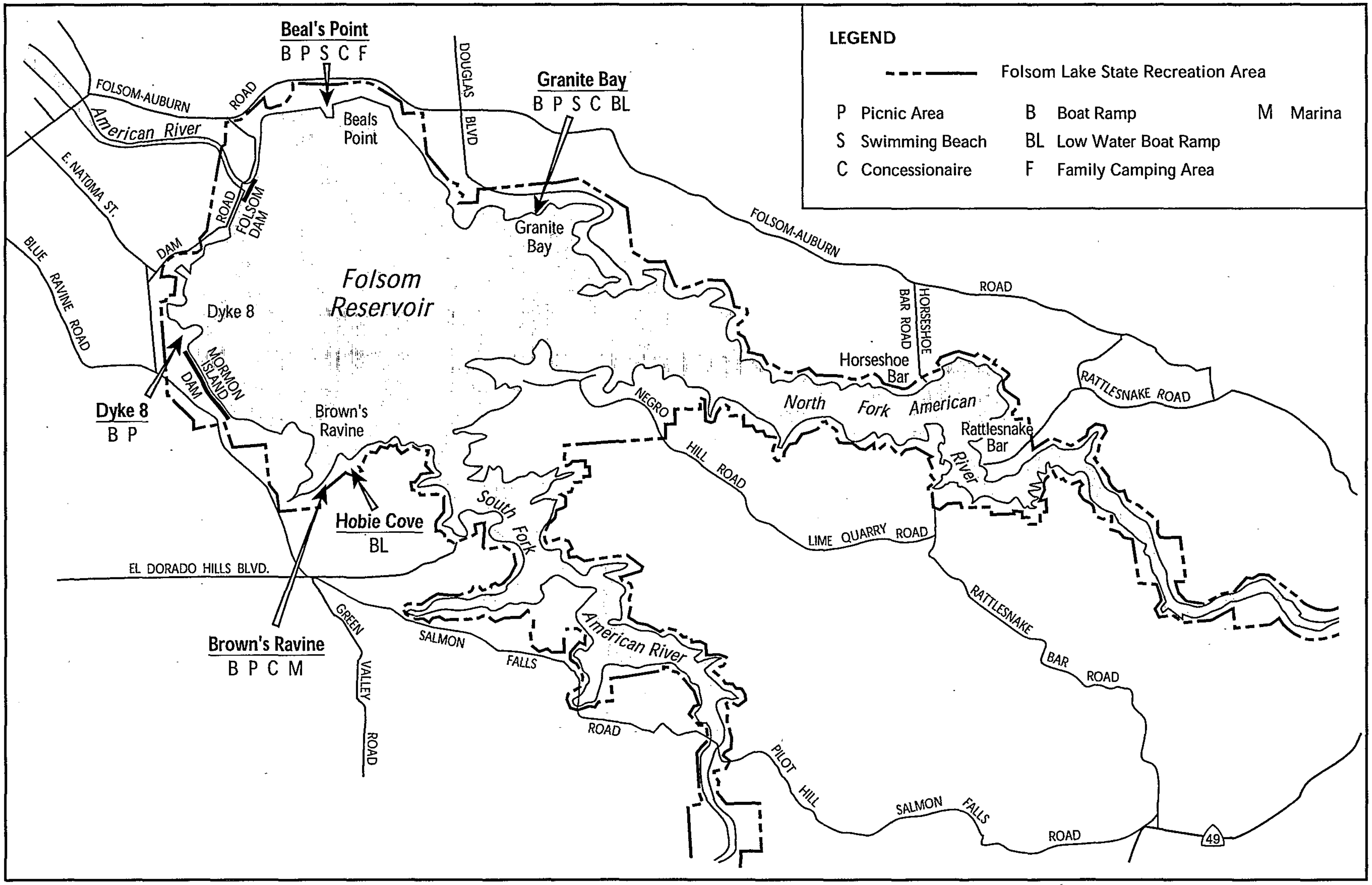
The Folsom Lake State Recreation Area, including Folsom Reservoir, is one of the most heavily used recreational facilities in the California State Park System. Folsom Reservoir is a very important recreation resource because of the high recreational interest of the surrounding population, the diminishing open space in the region, and its proximity to substantial population centers (SAFCA and USBR, 1994).

When full, Folsom Reservoir consists of approximately 11,900 surface-acres of water and extends nearly 15 miles up the north fork and 10.5 miles up the south fork of the American River (CDPR, undated; Water Education Foundation, 1992b). When full, Folsom Reservoir has 75 miles of undeveloped shoreline, including many areas available for swimming. Summer surface water temperatures become warm enough for comfortable swimming and are warmer than inflowing water or water released downstream to Lake Natoma. The elevation of reservoir levels can vary considerably from 466 feet when its gross pool is full to less than 375 feet when multiple dry years occur in a row.

Folsom Reservoir Recreation Facilities

Folsom Reservoir has recreation facilities for boat launching, mooring, swimming, hiking bicycling, picnicking, camping, fishing, and nature study. CDPR operates the facilities as part of the Folsom Lake SRA. Folsom Reservoir has approximately 80 miles of trails available for hiking and horseback riding; an 8-mile paved bicycle trail, which connects with the American River Parkway's 26-mile Jedediah Smith bicycle trail; and the Darrington Mountain Bike Trail (SAFCA and USBR, 1994). The Darrington Mountain Bike Trail is a 7.7-mile trail that follows the Folsom Reservoir shoreline from the South Fork of the American River to the Peninsula Campground.

Facilities within major recreation areas located at Folsom Reservoir are shown in Table 4.9-7 and Exhibit 4.9-3. As indicated, water-enhanced and water-dependent recreation facilities are provided throughout the Folsom Reservoir area. A majority of the water-dependent recreation facilities are located at Beal's Point, Granite Bay, Peninsula Campground, Brown's Ravine, and Dyke 8.



Folsom Lake State Recreation Area Facilities

EXHIBIT 4.9-3

WATER FORUM PROPOSAL EIR

0 1/2 1 2 MILES NORTH

EDAW

Table 4.9-7
Recreation Facilities Located at Folsom Reservoir

Recreation Area	Facility						
	Water Enhanced				Water Dependent		
	Picnicking	Camping	Equestrian Staging	Trails	Swimming & Wading	Boat Launching	Marina
Beal ' s Point	■	N		■	■	CT-B	
Granite Bay	■		■	■	■	CT-B	
Horseshoe Bar				■			
Rattlesnake Bar		■	■	■			
Peninsula		N		■	ND	CT-B	
Brown ' s Ravine	■		■	■	ND	CT-B	■
Dyke 8	■			■	ND	CT-B	

Note: Table does not present all available recreational facilities. In general, recreation facilities are for day use; overnight use is permitted where indicated. The following designations apply:

CT = Car-top boat and raft launching areas
N = Overnight use by permit only
B = Trailered boat launching ramps
ND = Non-designated swimming area

Source: Sacramento County, 1985; SAFCA and USBR, 1994; SMWA and USBR, 1996; EDAW, 1998.

The primary commercial recreation facility on Folsom Reservoir is the Folsom Lake Marina in Brown's Ravine. This is the only marina on the lake and it provides approximately 685 wet slips and 45 dry slips. The wet slips are operable when the lake level is at least 412 feet elevation (Christensen, pers. comm., 1997). The slips can accommodate boats up to 28 feet in length and both sailboats and power boats are moored at the marina. Small craft rental and supplies are also available at the marina (CDPR, undated). In addition, concessionaires operate snack bars and recreational equipment rentals at the Beal ' s Point and Granite Bay swimming beaches during the peak summer season.

Recreational Use and Activities at Folsom Reservoir

Folsom Reservoir is one of the most popular recreation areas of the State Park System averaging nearly 2.6 million visitors annually. Visitation is primarily dependent on air and water temperatures and on water surface elevation in the reservoir. As previously mentioned, the primary recreation season (April through September) coincides with the warmer spring and summer months when the daily high air temperatures average 90 to 100 degrees Fahrenheit (°F). Approximately 75% of the annual visitation for the SRA occurs during the spring and summer seasons.

C-090396

During these months, the reservoir experiences relatively high surface water temperature. Existing reservoir water has little movement and the newer (colder) water tends to sink to the bottom of the reservoir, resulting in noticeably warmer surface temperatures. Surface water temperatures during the peak visitation period (June through August) range from 68 to 76 °F.

The predominant recreational activities at Folsom Reservoir are water-dependent uses, such as boating, water-skiing, personal watercraft use, swimming, and fishing. The upper (easternmost) arms of the lake are designated as slow zones for quiet cruising, fishing, and nature appreciation. Folsom Reservoir is also an important source of scenic, natural, and cultural resources for water-enhanced recreational activities. Water-enhanced activities provided at the reservoir include camping, trail use, picnicking, and nature study.

Visitation by recreational use type for the Folsom Reservoir recreation area is presented in Table 4.9-8. As shown, the water-enhanced activities account for approximately 15% of the total recreational demand at the reservoir and water-dependent recreational activities account for nearly 85%. Of the recreation uses listed, the most popular is boating (trailer and non-trailer launched), which accounts for approximately 30% of the total recreation demand. Other recreation uses, such as swimming and wading (designated and non-designated areas) account for approximately 27%; fishing accounts for nearly 20% of the recreation demand at Folsom Reservoir. The remaining approximately 23% of the recreation demand consists of picnicking, camping, and miscellaneous water-dependent activities.

Table 4.9-8
Recreation Activities by Percentage of Use — Folsom Reservoir

Use Type	Percentage of Use
Water-Enhanced Activities	
Picnicking and Relaxing	8.7
Camping	3.1
Trail Use (equestrian, hiking, etc.)	3.5
Subtotal	**15.3**
Water-Dependent Activities	
Windsurfing	1.9
Swimming and Wading (designated areas)	14.0
Swimming and Wading (non-designated areas)	13.0
Personal Watercraft	2.7
Boating (trailer launched)	27.9
Rafting and Boating (non-trailer launched)	1.8
Berthing	2.6
Boat Camping	0.9
Fishing	19.9
Subtotal	**84.7**
TOTAL	**100.0**

Source: SAFCA and USBR, 1994.

Recreational visitors to Folsom Reservoir pay parking fees and camping permit fees, so the gate receipts of Folsom Lake SRA provide a general indicator of visitation by car (although not total use because bicyclists and pedestrians do not pay). The six highest months of gate receipts are typically, in order, July, June, August, May, April, and September. According to California Department of Parks and Recreation (CDPR) staff, gate receipts, and therefore visitation, are affected by lake elevation. A comparison of the summers of 1996 and 1997 is cited by CDPR as illustrating this conclusion (Kranz, pers. comm., 1997; LeFlore, pers.comm., 1998). In 1996, lake elevation in early April was 431 feet, with increasing elevation through April and May (447 feet on May 1) to a peak of about 462 feet in June, then gradually decreasing to 453 feet by the end of July, down to 442 feet by the end of September. Folsom Lake SRA gate receipts totaled $1,852,000 in April through September 1996. During the summer of 1997, lake elevation was consistently lower than 1996; it began in April at 412 feet and increased to 423 feet by May 1, then remained in the low 420s for the whole summer. Gate receipts for April through September 1997 totaled $1,340,000, which was 28% less than the same period in 1996. Considering the whole peak season, the reduction in gate receipts was $512,000 (Kranz, pers. comm., 1997), reflecting a substantial decrease in recreation visitation.

RECREATION RESOURCES OF THE UPPER SACRAMENTO RIVER RESERVOIRS, SACRAMENTO RIVER, AND THE DELTA

Upper Sacramento River and Upstream Reservoirs

The upper Sacramento River and its upstream reservoirs are important recreation resources for the Sacramento Valley. The major reservoirs are Shasta, Keswick, Whiskeytown, and Trinity. These resources support a broad range of water-dependent and water-enhanced recreation opportunities, including facilities for boating, fishing, swimming and camping.

Primary recreation areas along the northernmost reach of the Sacramento River (Shasta Dam to Red Bluff) are Caldwell Memorial Park, Turtle Bay recreation area, Kutras Park, Anderson River Park, Ball's Ferry Bridge, Jelly Ferry river access, Bend Bridge, Ide Adobe State Historic Monument, Red Bluff Marina and Park, and Red Bluff Diversion Dam recreation access. Major river access areas south of Red Bluff are located mostly around Woodson Bridge, Hamilton City, Princeton, and Colusa. Facilities include the Mill Creek Recreation Area, Woodson Bridge State Recreation Area, Tehama County River Park, Irving Finch River Access, Pine Creek Landing, Bidwell River Park State Recreation Area, Scotty's Boat Landing, Big Chico Creek Day Use Area, Butte City Launch Facilities, Colusa Weir Recreation Access, Colusa-Sacramento State Recreation Area, Colusa Levee Scenic Park, and Ward's Boat Landing.

Water-dependent activities (swimming, boating, fishing) account for approximately 52% of the recreation uses on the upper Sacramento River (Sacramento County and USBR, 1997). Fishing, rafting, canoeing, and kayaking are popular activities on the northern reach of the river. Fishing, canoeing, rafting, swimming, and power boating opportunities are available along most of the upper Sacramento River. Boating, rafting, and swimming use takes place primarily in summer months when air temperatures are high and fishing is a year-round activity.

Shasta, Keswick, and Trinity reservoirs are administered by the U. S. Forest Service and Whiskeytown Reservoir is administered by the National Park Service. All are a part of the Whiskeytown-Shasta-Trinity National Recreation Area (NRA). The NRA was established by Congress in 1965 with a total of 203,500 acres. Fishing, boating, sightseeing, picnicking hiking, sailing, and swimming are popular recreation activities on these reservoirs.

Shasta Lake is California's largest reservoir with 29,500 surface-acres at full pool. Recreation facilities on Shasta Reservoir include 7 public boat ramps, 22 developed campsites, 4 picnic areas, and numerous private marina resorts. The boat ramp facilities, operated by the U.S. Forest Service, are located at Antlers, Sugarloaf, Bailey Cove, Hirz Bay, Packers Bay, Centimundi, and Jones Valley. Some facilities have multiple ramps that are put in operation as the lake level declines. The four large arms of the lake are the Pit River, Squaw Creek, McCloud River, and Sacramento River arms. When full at elevation 1,067 feet, the lake has 370 miles of shoreline that provide scenic resources, fishing opportunity, and shoreline boat-in camping sites (Dirksen and Reeves, 1993). Boat-in camping is dispersed at many locations along the shoreline. Private marinas are designed to be movable as the lake level decreases and some may move multiple times in the course of a summer boating season (Stevens, pers. comm., 1997).

Trinity Reservoir has 17,000 surface-acres of water when full at elevation 2,370 feet. Many public and private recreation facilities are on the lake, including 21 public and private campgrounds, 4 picnic areas, 6 resorts, and 4 marinas (Dirksen and Reeves, 1993). Major boat ramps operated by the U.S. Forest Service include Minersville on the Stuart's Fork Arm, Trinity Center on the Main Arm, and Fairview near Trinity Dam.

Whiskeytown and Keswick Reservoirs are regulating reservoirs for Shasta Lake and Trinity/Lewiston Reservoir. Facilities at Whiskeytown Reservoir include 2 boat ramps, 3 campgrounds, and 2 picnic areas. One boat ramp is available but no campgrounds are located around Keswick Reservoir. Recreation activities on this lake are primarily related to boating and fishing (Sacramento County and USBR, 1997).

Sacramento - San Joaquin River Delta and Lower Sacramento River

As a complex of waterways affected by both fresh water inflows and tidal action, the Delta is a very important recreation resource that provides a variety of water-dependent and water-enhanced recreation opportunities, including fishing, boating, picnicking, and camping. It contains over 50,000 acres of water surface and nearly 1,100 miles of leveed shoreline (DWR and USBR, 1996). Sources of Delta inflows that provide water for recreation and other beneficial uses, include the Sacramento River basin (including the American River watershed), east side streams (such as the Mokelumne River), and the San Joaquin River basin. Total average annual Delta inflow is over 27,000,000 acre-feet (AF) (DWR, 1995). Water movement in Delta waterways used for recreation is also substantially influenced by tidal action, with the greatest influence in the western waterways (e.g., 330,000 cubic feet/second [cfs] typical summer incoming tide near Pittsburg) and lesser influence in the central and eastern waterways (e.g., 71,000 cfs typical summer incoming tide at Rio Vista on the Sacramento River or 58,000 cfs typical incoming tide near Venice Island on the San Joaquin River) (DWR, 1995).

Boating and related facilities are located throughout the Delta and include launch ramps, marinas, boat rentals, swimming areas, camping sites, dining and lodging facilities, and marine supply stores. Most recreation facilities are privately owned and operated commercially. In 1991, the State Lands Commission estimated that approximately 100 marinas provided 12,700 berths in the Delta (SLC, 1991). Public recreation resources include fishing access sites, parks, camping sites, and boat launch ramps in 22 areas (DWR and USBR, 1996).

Recreation visits exceed 12 million user-days per year (DWR, 1995). Boating is the most popular activity in the Delta region, accounting for approximately 17% of the visitation, with other popular uses including fishing (15%), relaxing (12%), sightseeing (11%), and camping (8%). Peak use periods are summer weekends; however, recreation use occurs over extended summer periods for vacationing visitors and some boating and sport fishing are year-round activities (DWR and USBR, 1996).

The lower Sacramento River is the reach between the American River confluence and the Delta. As a recreation resource, its use is closely associated with recreational use of Delta waterways. This section of the river, influenced by tidal action similar to the Delta, is an important boating and fishing area with extensive boat traffic, particularly in summer months. Several private marinas are located in the river. Between Colusa and Sacramento major recreation facilities are located at Colusa-Sacramento River Recreation Area, Colusa Weir access, Tisdale Weir access, River Bend Boating Facility, Knights Landing, Sacramento Bypass, and Elkhorn Boating Facility.

APPLICABLE PLANS AND POLICIES

The local plan that identifies recreation policies for the Lower American River is the County of Sacramento's American River Parkway Plan. Also, designation of the Lower American River as a recreational river under the Federal and State Wild and Scenic Rivers Acts establishes certain policy considerations. Policies related to recreation resources are summarized below.

American River Parkway Plan

The American River Parkway Plan was adopted by the County of Sacramento in 1985 (Sacramento County, 1985). The plan is an element of the Sacramento County General Plan. It establishes goals and policies for the Parkway, presents a description of Parkway resources, and provides Area Plans to guide resource protection and development. The plan contains a policy regarding water flows that is relevant to the WFP:

> *3.1 Water flow in the Lower American River should be maintained at adequate levels to permanently sustain the integrity of the water quality, fisheries, waterway recreation, aesthetics, riparian vegetation, wildlife, and other river-dependent features and activities of the Parkway. The required flow levels of the Lower American River should be established at higher levels than those required under Decision 1400 of the State Water Resources Control Board. State and Federal policy should provide for the maintenance of flows in the optimum range in the Lower American River.*

In Chapter 4, the plan explains that Decision 1400 flows (e.g., 1,500 cfs for recreation) are inadequate and that the decision has no legal effect without the completion of the then-proposed Auburn Dam. It acknowledges that research is ongoing to establish adequate flows for the Lower American River, including recreation flows. When required flows are determined, the plan states that "those flows will be incorporated into the policies of this Plan."

Lower American River "Recreational River" Designation - State Wild and Scenic Rivers Act

The State Wild and Scenic Rivers Act was passed by the California Legislature in 1972 (Public Resources Code §5093.50 *et seq.*). The Legislature declared that it was the State's intent that "certain rivers which possess extraordinary scenic, recreation, fishery, or wildlife values shall be preserved in their free-flowing state, together with their immediate environments, for the benefit and enjoyment of the people of the state." The Act restricts the construction of dams, reservoirs, diversions, and other water impoundments. A diversion facility may be authorized if the Secretary of the Resources Agency determines that (a) it is needed to supply domestic water to the residents of the county through which the designated river flows, and (b) it will not adversely affect the natural character of the river (PRC §5093.55[a]; DWR, 1994). The Lower American River was included in the State Wild and Scenic River System and was given the classification of "recreational river" (PRC §§5093.54[e], 5093.545 [h]). The State defines a recreational river as a river "readily accessible by road or railroad, that may have some development along [its] shorelines, and that may have undergone some impoundment or diversion in the past" (PRC §5093.53[c]).

Lower American River "Recreational River" Designation - National Wild and Scenic Rivers Act

The National Wild and Scenic Rivers System was established in 1968 with the enactment of Public Law 90-542 (16 USC 1271 *et seq.*). Under this system, rivers possessing "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values" can be protected as wild, scenic, or recreational. The Lower American River from Nimbus Dam to its confluence with the Sacramento River was added to the National Wild and Scenic Rivers System based on the State's petition in 1981 and is designated a "recreational river." Recreational rivers are ones "that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past" (16 USC 1273[6][3]).

As a result of its designation under the act, federally assisted projects affecting the Lower American River are subject to the Secretary of the Interior's determination that the project "will not invade the area or unreasonably diminish" the river's recreational value (16 USC 1278[a]; see also *Swanson Mining Corporation v. FERC*, 790 F.2d 96 [D.C. Cir. 1986]; the American River Parkway Plan). When seeking authorization or appropriations for a project which affects the protected values of the Lower American River, the relevant federal agency must notify the Secretary of the Interior of its intent, and report to Congress on the project's conformity with the act and its effect on the protected values of the river (16 USC 1278[a]).

4.9.2 THRESHOLDS OF SIGNIFICANCE

Appendix G, the Environmental Checklist of the State CEQA Guidelines, provides general guidance in the identification of circumstances that may result in a significant effect on the environment related to recreational opportunities. Item IX.b of the checklist identifies "conflict with any applicable ... policy ... of an agency with jurisdiction over the project ... adopted for the purpose of avoiding or mitigating an environmental effect." Item XIV of the checklist addresses the topic of recreation, but does not include questions relevant to potential effects to recreation opportunity or quality resulting from changes in surface water diversions. For purposes of this analysis, recreation impacts may represent a significant impact if implementation of the WFP would:

1. Substantially conflict with established water-dependent or water-enhanced recreational uses of Folsom Reservoir, Lake Natoma, or the Lower American River, as well as the Sacramento River, upper Sacramento River, and the Sacramento - San Joaquin Delta;

2. Conflict with adopted environmental plans and goals related to recreation, including those associated with the designation of the American River as a "Recreational River" under the National Wild and Scenic Rivers Act (U.S.C. 1271 *et seq.*), State Wild and Scenic system (Public Resources Code 5093.50, 5093.54 [3]), and the American River Parkway Plan.

LOWER AMERICAN RIVER RECREATION OPPORTUNITIES

The availability of adequate river flows to support boating, rafting, and swimming is the critical recreation impact issue for the Lower American River. Previously identified river flow criteria were reviewed and river raft rental outfitters were contacted to evaluate the appropriate criterion to use for determining a significant effect on the environment. A summary of the Lower American River flow criteria considered for use in this EIR is presented in Table 4.9-9.

Although opinions about optimum and minimum flows for recreation vary, the evaluation of previously identified criteria indicates that an appropriate minimum flow for use in this EIR would be 1,750 cfs. This flow rate was described in the Hodge decision as being "in large part responsive to recreation interest." It has also been incorporated into the Sacramento County General Plan Conservation Element related to rafting and boating. Also, flows above 6,000 cfs are recognized as unsafe and result in the broadcast of a warning by the County. Consequently, for purposes of this EIR analysis, the minimum and maximum flow range that is adequate for boating and rafting opportunity on the Lower American River is 1,750 to 6,000. If the WFP causes river flows to be above or below this range to a substantially greater extent than the base condition in the high recreation use periods of a substantial number of years, a significant effect on the environment would result.

Table 4.9-9
Lower American River Flow Criteria for Rafting and Boating

SOURCE	Flow Criteria for Rafting/Boating (cfs)		
	Minimum	Optimal	Maximum
Hodge Decision [1]	1,750	n/a	n/a
Sacramento County Data in *EDF v. EBMUD* [2]	1,500 - 2,000	3,000 - 6,000	6,000
EBMUD data in *EDF v. EBMUD* [3]	1,250 - 2,500	n/a	n/a
Water Education Foundation [4]	3,000	n/a	8,000
Sacramento County General Plan [5]	1,750 - 3,000	n/a	n/a
River Rat Raft Rentals [6]	1,200 - 2,000	3,000 - 4,000	6,000
American River Raft Rentals [7]	2,500	3,000 - 5,000	6,000
California Water Plan [8]	1,500	n/a	n/a
Interim Reoperation of Folsom Dam and Reservoir EIR/EA [9]	1,250 - 1,750	n/a	n/a
SWRCB Decision 1400 [10]	1,500	n/a	n/a

1 From Environmental Defense Fund et al. v. East Bay Municipal Utility District, for the period of July 1 through October 14. This flow is "in large part responsive to recreational interest."

2 From the State Water Resources Control Board's Technical Report, Lower American River Court Reference (SWRCB, 1988).

3 The low end is related to rafting and the high range is related to skilled canoeing (SWRCB, 1988)

4 The lower limit is attributed to Save the American River Association as the flow needed for a quality boating experience (WEF, 1988).

5 The lower limit of the minimum is for July through October 14 and the upper limit of the minimum is for March through June (Sacramento County, 1993). These are comparable to the Hodge flows.

6 Substantial decreases in trips occur at 2,000 cfs with very few trips below 1,200 cfs, because of slowness of trip, headwind problems, and water quality at low flows. County and media safety warnings at 6,000 cfs diminish trips substantially (Calvin, pers. comm., 1997).

7 Decrease in trips occurs at 2,500 cfs. County issues warnings at 6,000 cfs (Gardner, pers. comm, 1996).

8 From Table 9-1 (California Department of Water Resources, 1994).

9 The lower limit is described as the level of "insufficient flows" in the affected environment section, while the upper limit is taken from the Hodge decision as the threshold of significance (SAFCA and USBR, 1994).

10 D-1400, adopted contingent on the completion of the Auburn Dam, established a minimum recreation flow that could be eliminated in dry years (Somach, 1990). D-1400 has no current legal effect, because the dam has not been built.

Source: EDAW, 1997.

In addition to considering the minimum and maximum adequate flows for rafting and boating, the EIR addresses the potential for the WFP to result in river flows outside an optimum range. The optimum range provides an indication of flows needed to maintain high quality boating or rafting activity. Based on the opinions of raft rental outfitters and information provided by Sacramento County during the Hodge case (SWRCB, 1988), it appears that the appropriate low end of the optimum flow range for recreation would be 3,000 cfs. While opinion about the high end of the optimum range varies, using the 6,000 cfs safety warning flow rate is reasonable because information from the outfitters indicates that the County's safety warnings cause a substantial decrease in river rafting and boating use. Therefore, as part of its impact analysis, the EIR evaluates the extent to which the WFP would cause river flows to be above or below the optimum range for boating and rafting, which indicates an adverse effect on the quality of boating and rafting activities; however, the range of *adequate* flows for boating and rafting opportunities described above (1,750 - 6,000 cfs) is the primary threshold range for determining a significant impact.

In the technical report prepared as a court reference in the Hodge case, the minimum flow rate for swimming and wading activities on the Lower American River was identified as 1,250 cfs (SWRCB, 1988). This minimum is based on changes in usable shoreline and shallow water areas. Because the swimming minimum is less than the 1,750 cfs rafting and boating minimum, rafting and boating opportunities are less tolerable to low river flows. Therefore, it is reasonable to use the 1,750 cfs standard, rather than a swimming-based standard, as more indicative of environmental impact for recreation on the Lower American River. In summary, the primary significance thresholds for Lower American River recreation are:

Lower American River Recreation Thresholds of Significance

- When flows are within the optimum range of 3,000-6,000 cfs
- When flows are within the adequate, minimum/maximum range of 1,750-6,000 cfs
- Months of the summer when flow declines below the minimum of 1,750 cfs

LAKE NATOMA RECREATION OPPORTUNITIES

As a regulating reservoir, Lake Natoma's water level fluctuations are typically limited to 4 to 7 feet, providing for a relatively stable shoreline (SAFCA and USBR, 1994). The average surface water elevation for Lake Natoma is approximately 137 feet (USGS [Folsom Quadrangle], 1980). The lake is primarily used for low intensity, non-motorized water-dependent and -enhanced recreation, so the normal water level fluctuations of the lake have not substantially diminished recreation opportunities (LeFlore, pers. comm., 1997). If the WFP causes lake level fluctuations to be greater than the typical past amount for a substantial period of time during the high recreation use season, a significant effect on the environmental could result.

FOLSOM RESERVOIR RECREATION OPPORTUNITIES

Table 4.9-10 lists the water elevations needed for water-dependent recreation activities at Folsom Reservoir. As indicated, minimum lake elevation necessary for boating and swimming facilities varies from 420 feet for the boat ramp and swimming beach at Beal's Point to 360 feet for the low-water boat ramp at Granite Bay. As lake levels decline, various boat ramps, swimming beaches, or the marina at Brown's Ravine go out of service.

Table 4.9-10
Folsom Reservoir Water Level Criteria for Boat Launching and Swimming

Ramp or Use	Lake Level Criteria for Boating (feet above MSL)		
	Minimum	Optimal	Maximum
Encroachment into main swimming beaches[1]	n/a	n/a	455
Low end of optimal recreation pool for swimming/boating[2]	n/a	435	n/a
Beal's Point ramp out of service/swim beaches generally out of water[3]	420	n/a	n/a
Minimum level for Folsom Lake Marina (Brown's Ravine) wet slips[4]	412	n/a	n/a
Dyke 8 ramp out of service[5]	405	n/a	n/a
Brown's Ravine main ramp out of service[6]	395	n/a	n/a
Hobie Cove low-water ramp out of service (near Brown's Ravine)[7]	375	n/a	n/a
Granite Bay low-water ramp out of service/all ramps out of service[8]	360	n/a	n/a

1 From California Department of Parks and Recreation, Folsom Lake State Recreation Area information brochure (CDPR, n.d.). Above 455 feet, the high water substantially reduces the available area of swimming beach.

2 The optimal recreation pool is generally between 435 and 455 feet elevation (CDPR, n.d.).

3 Below 420 feet, the ramp and beach at Beal's Point and the beach at Granite Bay are not useable (SAFCA and USBR, 1994; Sacramento County and USBR, 1997). In 1997, a lower sand area was built at Granite Bay for swimming and a temporary, low-water parking area was built at Beal's Point; however, the distances to the water and concessionaires diminish levels of use.

4 All boats moored at wet slips must be removed when the lake level is less than 412 feet. The marina ceases most operations (Christensen, pers. comm., 1997).

5 Below 405 feet, the ramp at Dyke 8 is out of the water (SAFCA and USBR, 1994).

6 Below 395 feet, the main ramp at the Folsom Lake Marina at Brown's Ravine is out of the water; however, the low-water ramp at nearby Hobie Cove is still in operation (Christensen, pers. comm., 1997; SAFCA and USBR, 1994).

7 Below 375, the low-water ramp at Hobie Cove next to Brown's Ravine becomes inoperable (Christensen, pers. comm., 1997; SAFCA and USBR, 1994). At this level no boat ramps are available on the east side of the lake.

8 Below 360 feet, the lowest ramp at Granite Bay becomes inoperable (Sacramento County and USBR, 1997). All boat ramps on the lake are inoperable below 360 feet.

Source: EDAW, 1997.

In addition, a lake level above 455 feet reduces the amount of usable beach available, thereby reducing the capacity of the beach for swimming activities (California Department of Parks and Recreation, undated). As designated beaches are made smaller by high water, they become overly crowded and/or discourage swimming visitation.

The low end of an optimum surface water elevation range for recreational use at Folsom Reservoir is approximately 435 feet (above mean sea level). At this level the lake provides adequate recreational facilities for most water-dependent activities including fishing, swimming, and boating (LeFlore, pers. comm., 1997). Therefore, the optimum range of lake levels for boating and swimming at Folsom Reservoir is approximately 435 to 455 feet. The optimum range provides an indication of when high quality recreation activity and high levels of visitation are most likely to occur.

Because swimming beaches are generally operable down to 420 feet, the lake level range within which swimming beaches are useable is 420 to 455 feet. Although still useable, the quality of swimming beaches can begin to decline as the lake decreases below the optimum range of 435 feet. All boat ramps are useable until the lake level declines past 420 feet. Below 420 feet, boat launching opportunities begin to diminish as the lake level lowers. Below 412 feet, the wet slips at Folsom Lake Marina can no longer be occupied and this is the only marina on the lake Between 420 feet and 360 feet, individual ramps go out of service, as indicated in Table 4.9-10. Of note, as long as the lake is at least 375 feet, one of the low-water ramps is open on both the east (Hobie Cove) and west (Granite Bay) side of the lake. Between 375 and 360 feet, only the low-water ramp at Granite Bay remains in operation. Below 360 feet, all ramps for trailered boats are out of the water and inoperable.

To assess whether significant recreation impacts occur on Folsom Reservoir, the change in lake level is evaluated compared to five critical thresholds:

Folsom Reservoir Recreation Thresholds of Significance

- When all boat ramps are useable (420 feet or higher)
- When the marina wet slips are useable (412 feet or higher)
- When the swimming beaches are useable (420 to 455 feet)
- When at least one of the low-water ramps is useable on both the east and west sides of the lake (375 feet or higher)
- When the lake level is within its optimum range for high quality recreation activities (435 to 455 feet).

If the WFP causes a substantial reduction of recreation opportunity on Folsom Reservoir, as indicated by these thresholds, a significant effect on the environment would occur.

UPPER AND LOWER SACRAMENTO RIVER AND THE DELTA

Because the reservoirs of the Central Valley Project are operated in a coordinated manner to meet the various demands for water use in the State, changes to the operation of Folsom Dam in response to the WFP could indirectly result in altered releases from reservoirs on the upper Sacramento River, changed flows in the Sacramento River, and different inflows to the Delta. If the changes are of sufficient magnitude, recreation use of the river and Delta could be affected.

For purposes of this EIR, a relative magnitude approach is being used to assess potential recreational effects on the upper and lower Sacramento River and the Delta. Flows below Keswick Dam are used as an indicator for recreation effects on the upper Sacramento River and flows at Freeport are used as an indicator of recreation effects on the lower Sacramento River and Delta. The primary flow concern in the summer recreation season would be substantially reduced river flows, rather than flows that are excessively high. Average summer flows in the Sacramento River are on the order of approximately 10,000 cfs below Keswick Dam in the north and 15,000 cfs at Freeport approaching the Delta, some flow decrease would be tolerable without substantially hindering recreation opportunities. Also, the California Water Plan Update (DWR, 1994) indicates that 5,000 cfs is a minimum recreation (i.e., boating/rafting) flow for the Sacramento River, a rate that is well below average summer flows. Recognizing the high average flows, the potential for a significant effect on recreational boating, fishing, and swimming would not be expected with relatively small flow reductions on the order of 10% or less. If greater river flow reductions occur, the frequency of occurrence, the influence of tidal action (for the Delta and lower Sacramento River), and duration within the boating season are considered to determine if the effect could be significant.

For Shasta Lake and Trinity Reservoir, the key factor affecting recreation opportunity is water surface elevation. Seasonal fluctuations of lake level are common at these reservoirs, so boat ramp and marina operators plan for certain magnitudes of lake drawdown. Table 4.9-11 lists the major publicly-owned boat ramps on the two reservoirs and the lake drawdowns and elevations that require them to cease operations. Whether and how often the WFP causes the lakes to fall below these drawdown levels determines if the impact on recreational boating is significant.

Two important water surface elevation thresholds that affect recreation opportunity on Shasta Lake are 1,017 feet and 941 feet. All public boat ramps on the lake are operational until the water surface elevation falls to 1,017 feet--the level at which water surface elevation begins to adversely affect boat ramp capacity. At least one public ramp is operational on the three major arms of the lake (Sacramento Arm, McCloud Arm, and Pit Arm) until the water surface elevation falls to 941 feet. With at least one operational ramp in each arm of the lake, boaters have dispersed launching accessibility to the entire reservoir.

Table 4.9-11
Shasta Lake and Trinity Reservoir Water Surface Elevation Criteria for Boat Launching

Ramp [1]	Lake Level Criteria for Operable Boat Ramps [2]	
	Drawdown in Feet From Full	Elevation (feet MSL)
Shasta Lake (Full at 1067 ft.)		
Sacramento Arm		
Antlers	- 72	995
Sugarloaf #1	- 112	955
Sugarloaf #2	- 149	918
McCloud Arm		
Bailey Cove	- 50	1,017
Hirz Bay #1	- 47	1,020
Hirz Bay #2	- 94	973
Hirz Bay #3	- 126	941
Pit Arm		
Packers Bay	- 116	951
Centimundi #1	- 124	943
Centimundi #2	- 191	876
Centimundi #3	- 219	848
Jones Valley #1	- 87	980
Jones Valley #2	-143	924
Jones Valley #3	-211	856
Trinity Reservoir (Full at 2370 ft.)		
Fairview - Trinity Dam Area	- 60	2,310
Main Arm - Trinity Center	- 75	2,295
Stuart Fork Arm - Minersville	- 200	2,170

1 Public launch ramps for trailered craft; data are from the U.S. Forest Service which operates the ramps (Stevens, pers. comm., 1997).
2 Elevations shown are the levels at which launch ramps must be closed.
Source: EDAW, 1997; Stevens, pers. comm., 1997.

In addition, boat-in camping along the shoreline is a popular, water-dependent activity on both lakes. Campers have demonstrated the ability to tolerate commonly occurring drawdown levels, such as in the 30- to 60-foot range. Below a drawdown of 60 feet (or elevation 1,007 feet), recreational use of shoreline areas begins to be affected. By the time lake drawdowns reach approximately 100 feet (or elevation 967 feet), use of boat-in camp sites along the shorelines of the lakes diminishes substantially (Stevens, pers. comm., 1997).

4.9.3 WATER FORUM PROPOSAL IMPACTS

Water Forum Proposal (WFP) impacts are described below for the direct effects study area (in this case, the Lower American River, Lake Natoma, and Folsom Reservoir) and indirect effects study area (Delta, upper and lower Sacramento River, and upper Sacramento River reservoirs). Recreation effects in the water service study area are not discussed, because their analysis would be too speculative to be meaningful recognizing the considerable variations in location, timing, and intensity of development served by WFP diversions that could occur, as well as the uncertainty of the timing, location, nature, and extent of potential recreation resources and facilities demands created by that development.

Lower American River Recreation Impacts

Impact 4.9-1

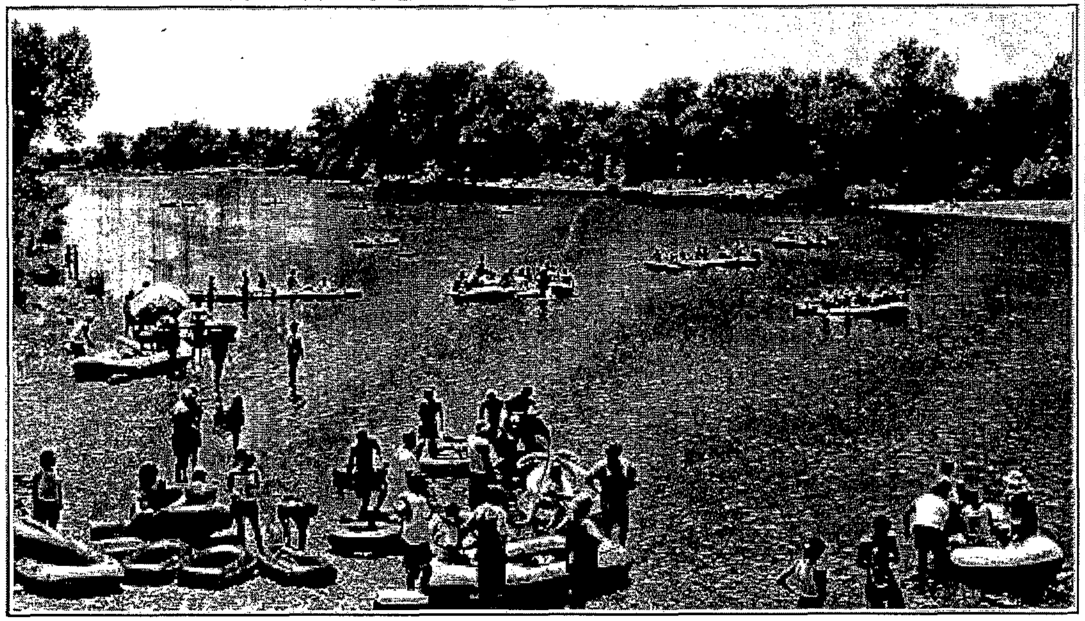
Reduced Rafting and Boating Opportunities on the Lower American River. *Compared to base conditions, additional diversions under the WFP would result in reduced summertime mean monthly flows below Nimbus Dam with a sufficient magnitude and frequency to diminish flows available for Lower American River rafting and boating during some high rafting and boating use months of the year (June, July, and September). For instance, in these months, flows would be within the minimum/maximum flow range for rafting and boating between 3 to 4 fewer years of the 70-year record. Reduced flows would result in a* ***significant effect*** *to rafting and boating opportunities on the Lower American River.*

Water-dependent and water-enhanced recreation use on the Lower American River is higher in May through September than in other months because of the warm, sunny weather. Therefore, the effect of the proposed future WFP diversions on May - September river flows below Nimbus Dam is important for understanding impacts on Lower American River recreation opportunities.

One of the coequal objectives of the WFP includes preserving both recreational and fishery values (among others) of the Lower American River. Protecting both values with the increased WFP diversions appears to create competing objectives for the use of instream flow in different months of the year. The F-pattern of releases, which is one of the cornerstones for protecting fishery resources, is configured, in part, to conserve water in Folsom Reservoir for release during the critical fall-run chinook salmon spawning period beginning in October and in the spring when juvenile salmon swim downstream. To preserve sufficient water for the fall salmon run in years with below average inflow to Folsom Reservoir, it would sometimes be necessary to detain water in the reservoir during the summer for release later in the year, or for release in the spring to keep water temperatures cooler. In those circumstances, flows in the Lower American River would be reduced in the high recreation use months, compared to base conditions.

Reduced flows would not necessarily preclude or substantially limit recreation use, unless the reduction diminished flows to less than the threshold for adequate recreation opportunities Exhibit 4.9-4 illustrates representative, substantial summer weekend recreation use when river flows are less than 3,000 cfs, a level that is considered the low end of the optimal range for recreation on the Lower American River (refer to Table 4.9-9). Flows below the optimal range can reduce the quality of river recreation, because raft trips can slow as flow volume decreases.

Sacramento Bar/
Sunrise Boulevard
rafting access
(flow: 2,800 cfs)



Discovery Park/confluence with
Sacramento River (flow: 2,300 cfs)

Summer Recreation on the Lower American River with Less than 3,000 cfs

EXHIBIT 4.9-4

If flows decrease to below the 1,750 cfs minimum for adequate rafting and boating opportunity, then significant adverse effects on recreation would occur.

Table 4.9-12 and Exhibit 4.9-5 present a summary of the number of years of the 70-year hydrologic record that mean monthly flows below Nimbus Dam would be projected to remain within the optimal range for river recreation (3,000 to 6,000 cfs) and the minimum and maximum range for adequate river recreation flow (1,750 to 6,000 cfs) under base and WFP conditions. Exhibits 4.9-6a through 6e illustrate the comparison of base and WFP mean monthly flows from the 70-year record for May, June, July, August, and September in relation to the minimum and maximum recreation flows. The table and exhibit demonstrate that overall, WFP conditions would result in mean monthly flows staying in the optimal and minimum/maximum recreation flow ranges less often than under base conditions over the course of the 70-year record. The effect is most evident in the later months of the season (July through September) in which WFP conditions result in 3 to 10 fewer years out of the 70-year record, in the optimal flow range, and 4 fewer years out of the 70-year record in July and September within the minimum/maximum range.

The impact is also evident in years when the base conditions would result in flows above the minimum threshold of 1,750 cfs, while the WFP conditions would result in flows below this threshold. Called "threshold impact years" in Table 4.9-12, they occur 1 of 70 years in May, 7 of 70 years in June, 6 of 70 years in July, 3 of 70 years in August, and 5 of 70 years in September. Altogether, the threshold impact takes place in a total of 22 out of 350, or 6% of the analyzed months (i.e, 350 months based on 5 months of each of the 70 years of record).

Although the future diversions and operating rules of the WFP would reduce flows available for recreation below minimum levels, it is important to note that in most years (i.e., over 64%), flows in the highest recreation use months of June, July, and August would be expected to remain within the minimum/maximum recreation flow range. This can be seen in Table 4.9-12, where 45, 49, and 51 years of the 70-year record mean monthly flows would remain within the minimum/maximum flow range in June, July, and August, respectively. While this condition does not negate the importance of the adverse recreation flow changes caused by the WFP diversions, it does indicate that the Lower American River would retain substantial recreation values nonetheless.

The magnitude of the flow reduction in these threshold months has been evaluated to determine if the flow decrease would be substantial. As indicated in Table 4.9-12, comparing the base with WFP conditions, the average flow reductions in the high recreation use months when the threshold impact occurs ranges from 250 cfs to 660 cfs. Expressed as a percent of flow, the reductions comparing the base with the WFP varied between a monthly average of 14% and 31%. Reductions of this magnitude would have an adverse effect on rafting and boating on the Lower American River.

Table 4.9-12
Water Forum Proposal Impact on Boating/Rafting Flows in the Lower American River

Month[1] [Rank in Use Level]	Modeled Scenario	# Years of 70-year Record Within Specified Ranges[2]		Magnitude of Flow Reduction in Threshold Impact Years[3]		
		# Years in Optimal Flow Range[4] (3,000-6,000 cfs)	# Years in Min/Max Flow Range[5] (1,750-6,000 cts)	Number of Years	Average Flow Reduction (cfs)	Percentage Flow Reduction
May	Base	35	51	1	-250	-14%
	WFP	34	52			
June [3rd highest use month][6]	Base	32	48	7	-373	-18%
	WFP	33	45			
July [highest use month][6]	Base	36	53	6	-641	-31%
	WFP	26	49			
August [2nd highest use month][6]	Base	35	51	3	-660	-30%
	WFP	29	51			
September	Base	23	42	5	-405	-20%
	WFP	20	38			

1 Only months in the highest boating/rafting season are included, based on consultation with rafting outfitters. Use is sufficiently less from October through April that river flows for boating and rafting are not an impact concern.

2 Number of years of the 70-year record when the river flows are within the specified ranges for boating and rafting on the Lower American River.

3 "Threshold impact years" are those years of the record when the mean monthly flows under base conditions are above the minimum 1,750 cfs threshold and would be reduced to less than 1,750 cfs under WFP conditions. The average flow reduction flow reduction is derived from the average change in mean monthly flow from the base to WFP conditions in those threshold impact years.

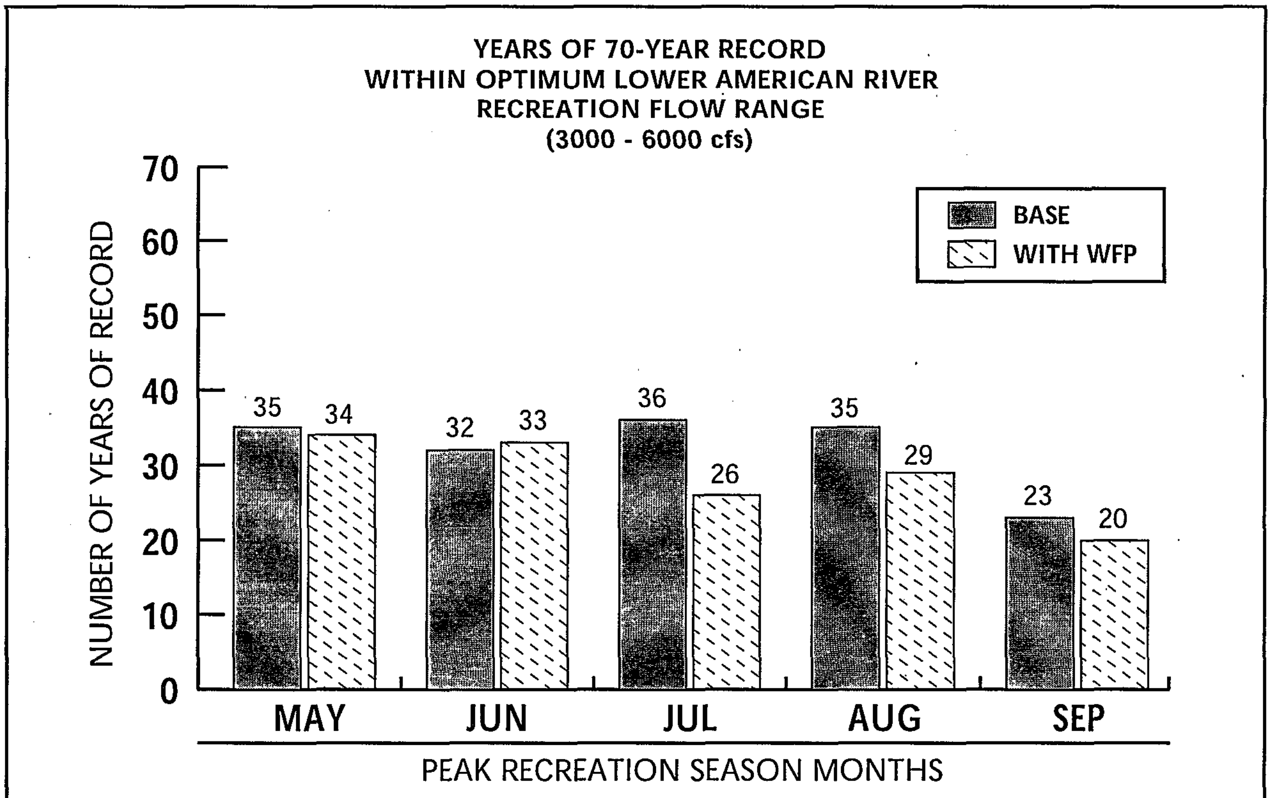
4 Number of years of the 70-year record when the mean monthly river flows below Nimbus Dam are between 3,000 and 6,000 cubic feet per second (cfs).

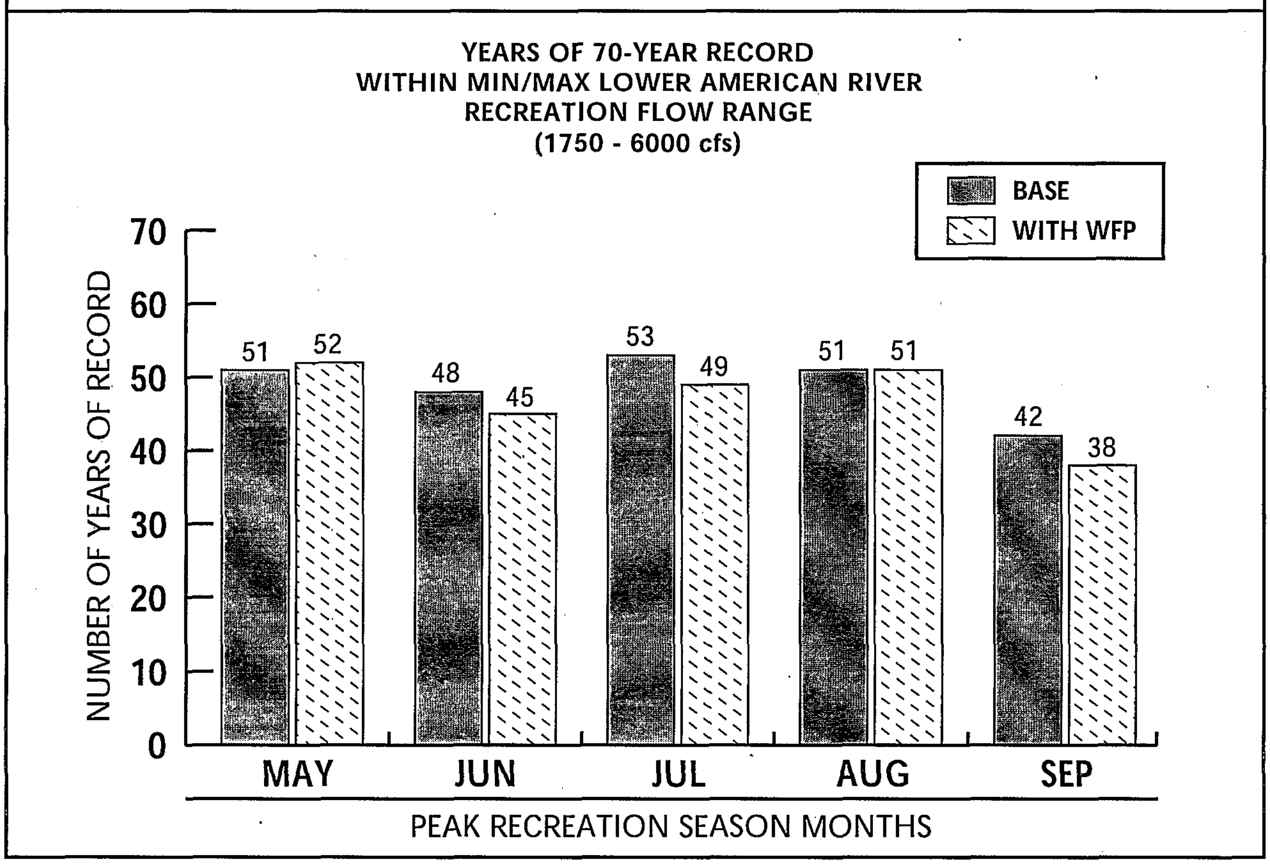
5 Number of years of the 70-year record when the mean monthly river flows below Nimbus Dam are between 1,750 and 6,000 cfs.

6 In terms of raft rentals, the months of highest use, from first to third, are July, August, and June, in that order (Gardner, pers. comm., 1997).

n/c No change between base conditions and the proposed project (WFP).
Base Modeled predictions of 70-year record based on existing diversions and operating rules.
WFP Modeled predictions of 70-year record based on the proposed Water Forum Proposal.

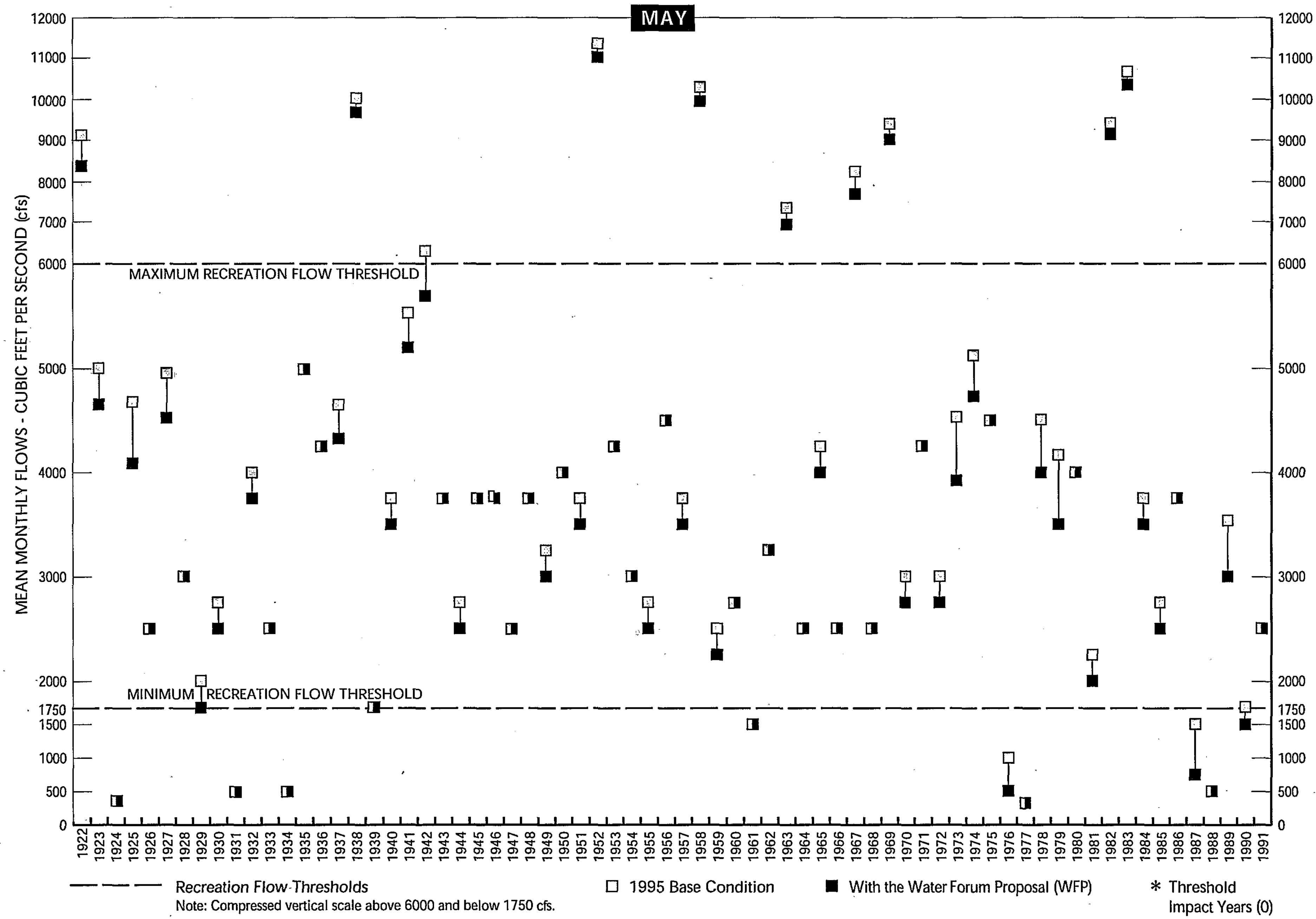
Source: EDAW, 1998; SWRI, 1998.





Summary of Recreation Flow Changes on the Lower American River

EXHIBIT 4.9-5



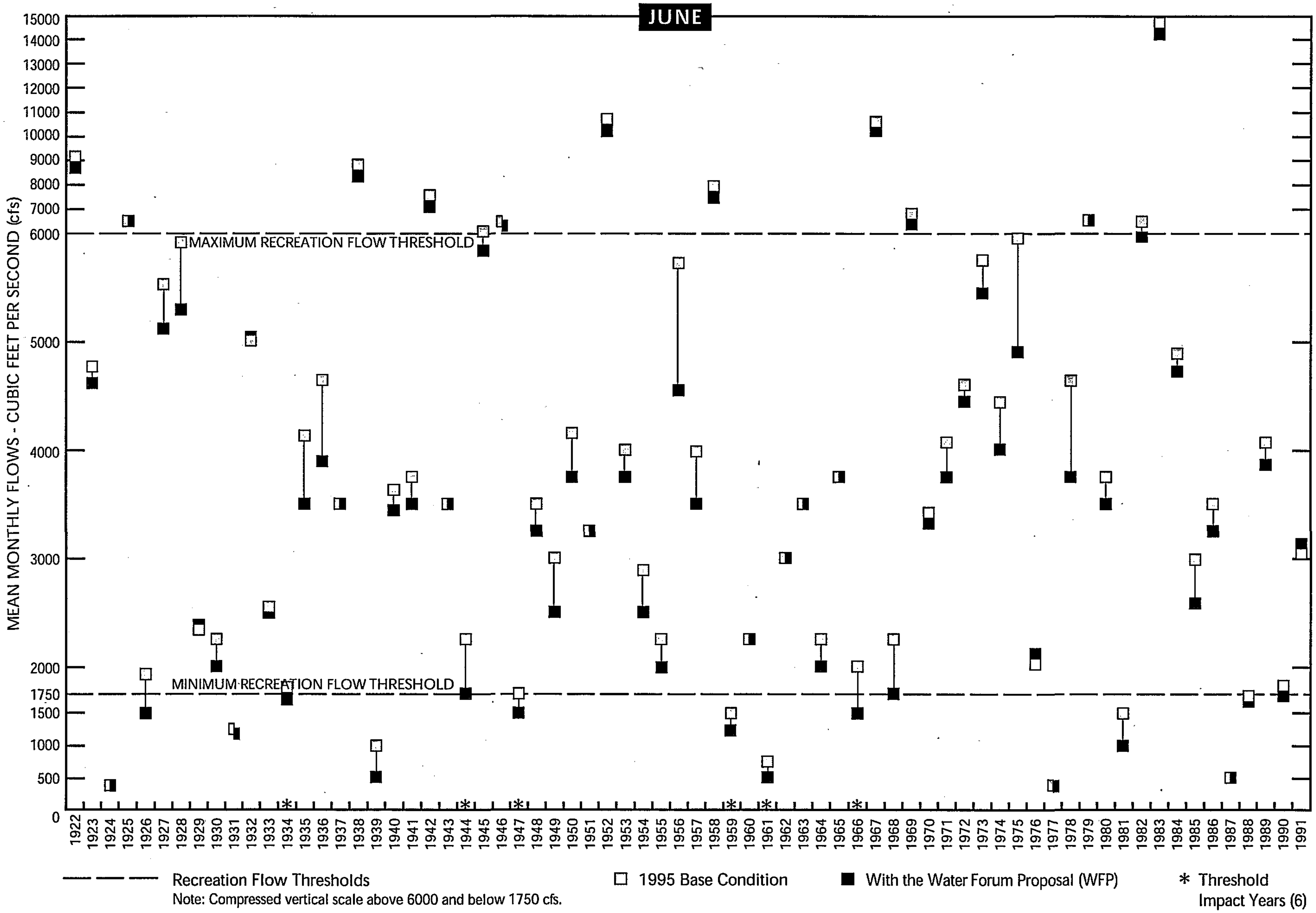
Lower American River Flows Compared to Recreation Thresholds in May

EXHIBIT 4.9-6a

WATER FORUM PROPOSAL EIR

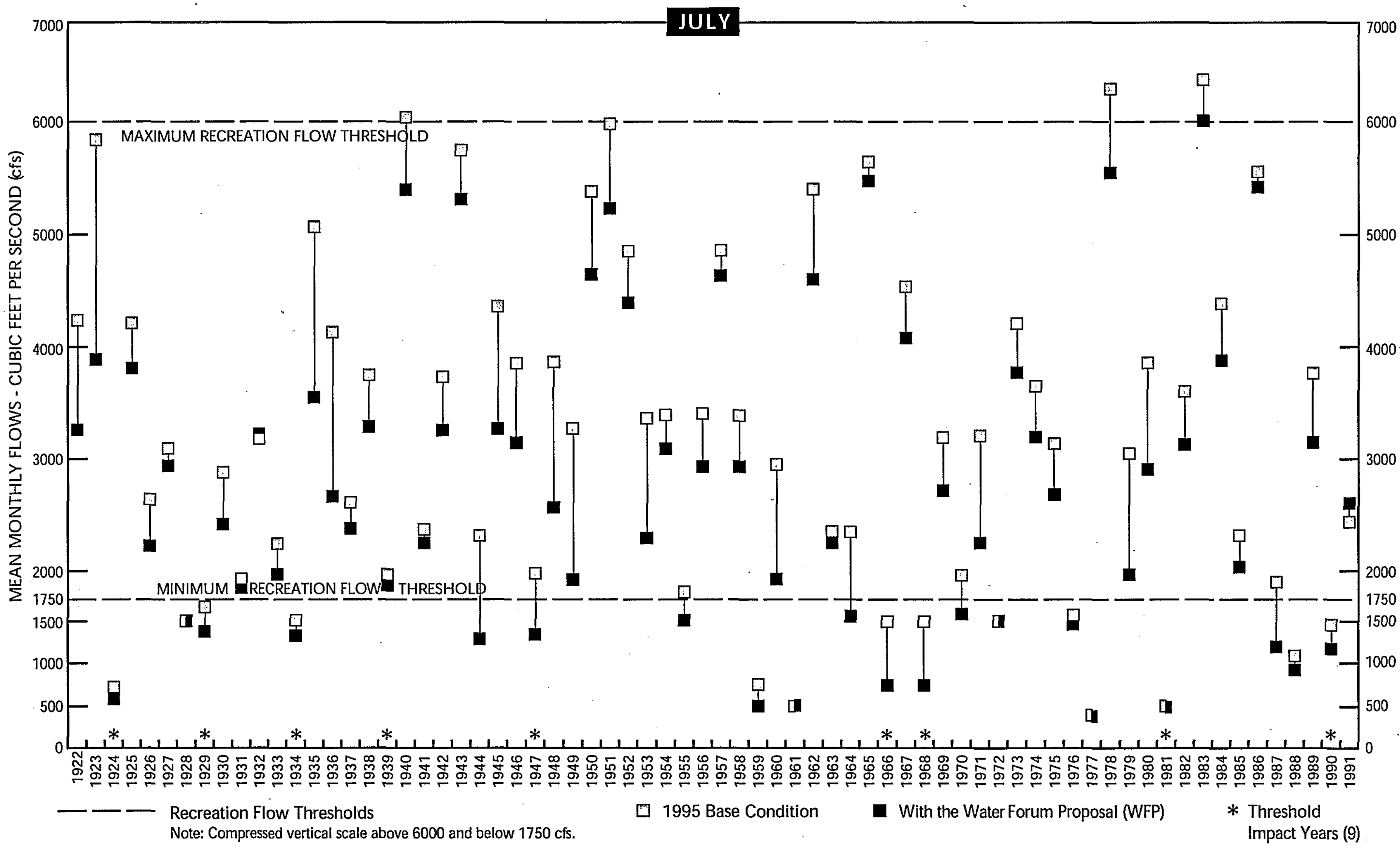
EDAW

C-090414



Lower American River Flows Compared to Recreation Thresholds in June

EXHIBIT 4.9-6b



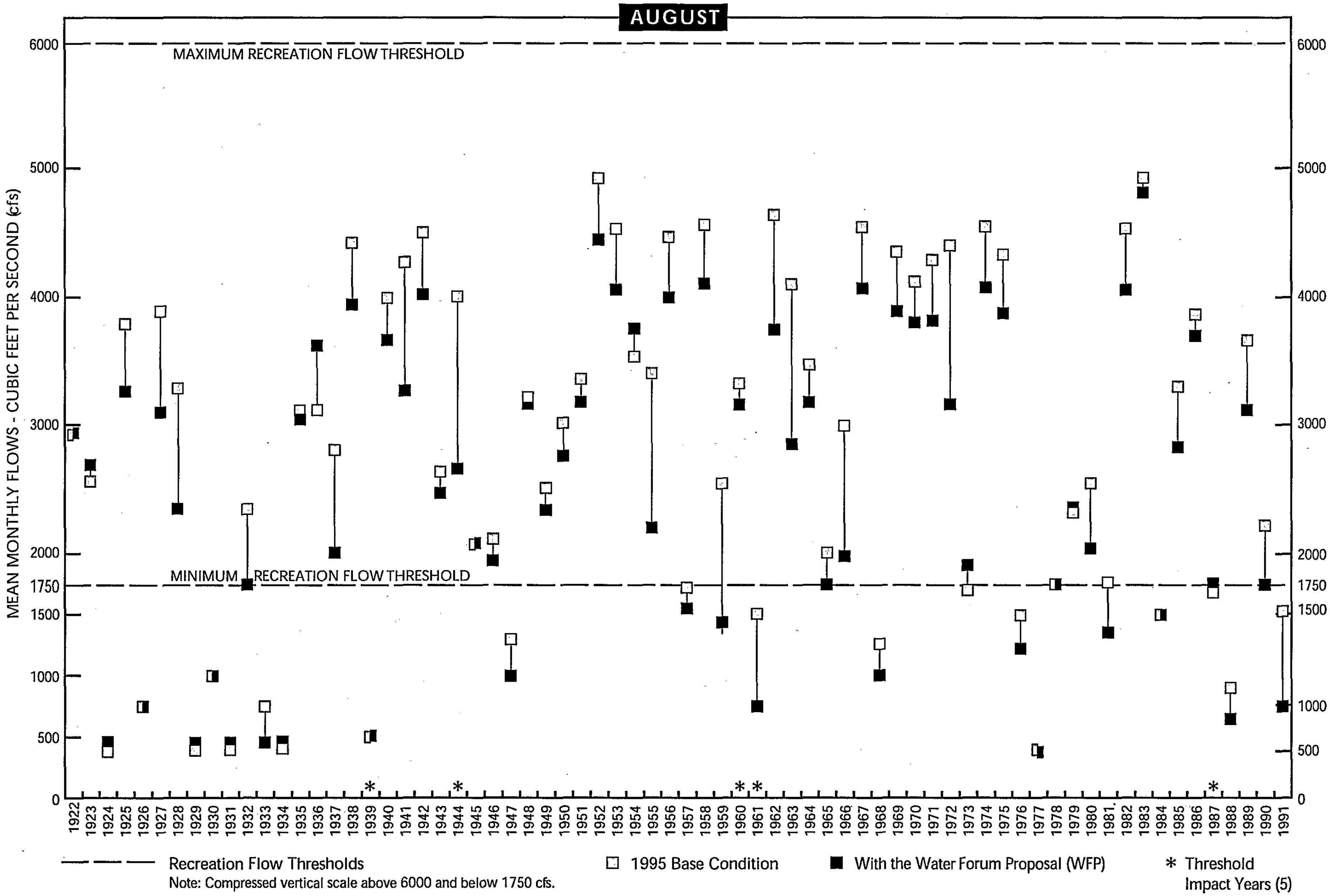
Lower American River Flows Compared to Recreation Thresholds in July

EXHIBIT 4.9-6c

WATER FORUM PROPOSAL EIR

EDAW

C-090416



Lower American River Flows Compared to Recreation Thresholds in August

EXHIBIT 4.9-6d

WATER FORUM PROPOSAL EIR

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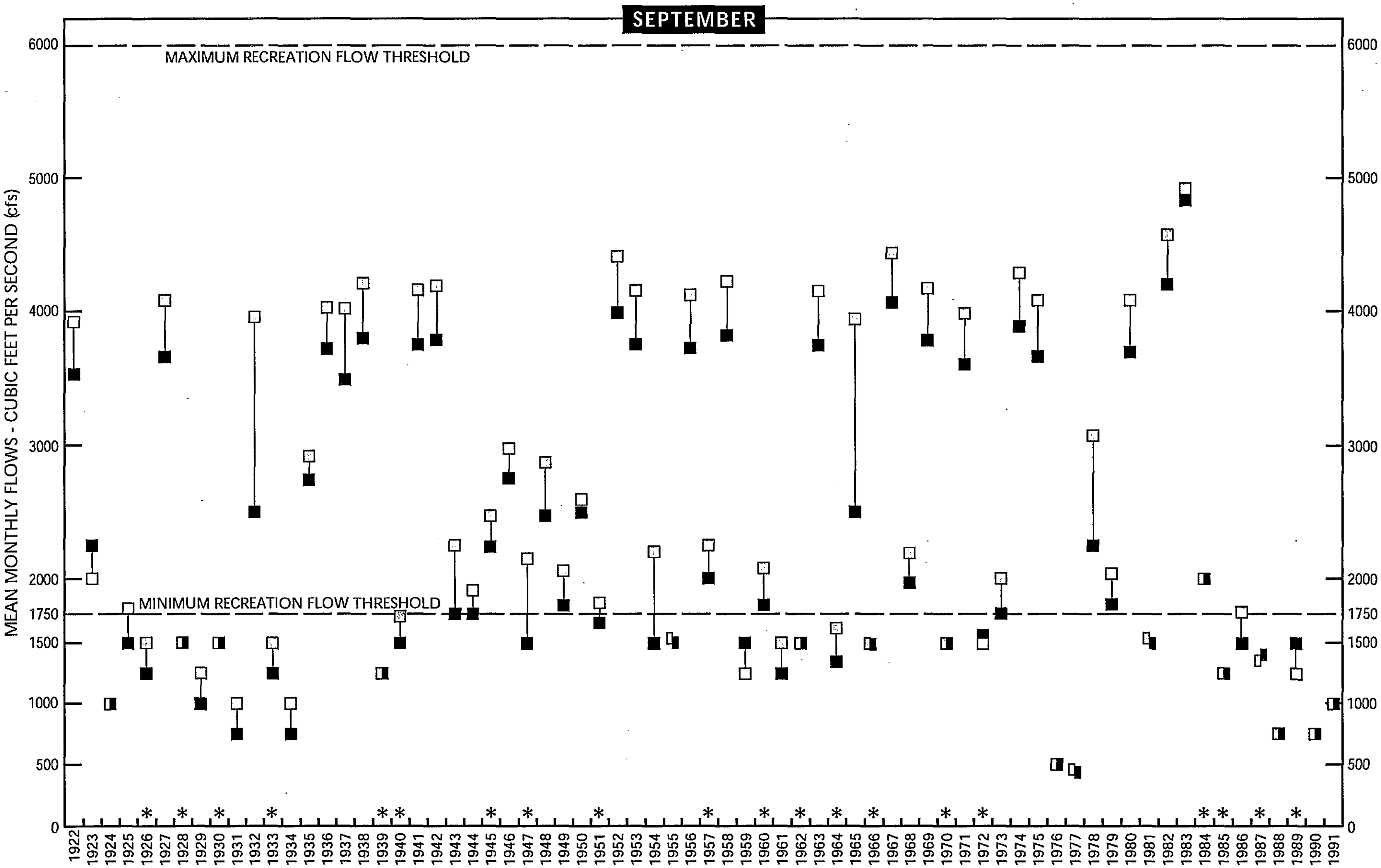
C-090417

C-090418



Recreation Flow Thresholds
Note: Compressed vertical scale above 6000 and below 1750 cfs.
1995 Base Condition
With the Water Forum Proposal (WFP)
* Threshold Impact Years (20)

C-090418

Lower American River Flows Compared to Recreation Thresholds in September

EXHIBIT 4.9-6e

WATER FORUM PROPOSAL EIR

EDAW

Comparing the WFP conditions with base conditions, overall decreases in the frequency of months when mean monthly river flows would stay in the optimal and minimum/maximum ranges and the magnitude of flow reductions in the important threshold impact years in the future would both be substantial. Based on a review of the unimpaired inflows to Folsom Reservoir, the adverse effect on Lower American River recreation flows would occur primarily during below average inflow, but not critically dry years. (In critically dry years, Lower American River flows would be below the minimum for recreation in the base condition, regardless of the WFP diversions.) Based on the frequency and magnitude of the reduction of mean monthly flows during high recreation use periods, this is considered a significant effect on the environment.

Lake Natoma Recreation Impacts

Impact **4.9-2**

Lake Natoma Recreation Opportunities. *Additional diversions under the WFP would not result in a different pattern of lake elevation fluctuations than under base conditions, because Lake Natoma would continue to serve as a regulating reservoir below Folsom Dam. Typically, lake elevation fluctuation stays within a range of 4 to 7 feet and does not substantially affect recreation. Therefore, effects on Lake Natoma recreation opportunities would be* ***less than significant****.*

Under current operating procedures, Lake Natoma serves as a regulating reservoir for Folsom Dam. This function enables releases from Folsom Dam to fluctuate as needed for electrical power or other purposes, while releases from Nimbus Dam to the Lower American River can be made to change less abruptly. As a result, the water level of Lake Natoma fluctuates regularly, but within a much smaller range of water surface levels than Folsom Reservoir. Typically, lake levels have changed only within a range of 4 to 7 feet. This creates relatively stable shoreline and launching ramp conditions for swimming, fishing, and boating.

Under the WFP, although diversions and release schedules would change, they would not alter the function of Lake Natoma as a regulating reservoir. As a result, even though water release patterns from Nimbus Dam to the Lower American River would be different than base conditions, Nimbus Dam and Folsom Dam operations would still be coordinated. Consequently, the historical range of water level fluctuations on Lake Natoma would be expected to continue into the future without substantial change. Therefore, recreation opportunities on Lake Natoma would also not change substantially, resulting in a less-than-significant effect.

Folsom Reservoir Recreation Impacts

Impact **4.9-3**

Reduced Folsom Reservoir Boating Opportunities. *Compared to base conditions, additional diversions by purveyors taking water from Folsom Reservoir and downstream under the WFP conditions would result in lower elevations of Folsom Reservoir. The declines would occur in more years than under base conditions, reducing the availability of boat ramps and marina wet slips more often during the primary boating season (March - September). For instance, lake levels would decline below the 412-foot elevation necessary for marina wet slips 4 to 6 more years of the 70-year record in the summer (June through September),* *depending on the month. More frequently reduced lake elevations would result in a **significant effect** to boating opportunities on Folsom Reservoir.*

The primary boating season on Folsom Reservoir is generally between March and September, with May, June, July, and August being the peak use months. Therefore, the effect of the proposed future WFP diversions and operating rules on lake levels during the boating season, and especially the peak use months, is important for understanding impacts on Folsom Reservoir recreation opportunities. Because boating opportunity is heavily influenced by boaters' access to the lake ramps and marina, the relationship of expected lake levels to the usability of these facilities is an important consideration.

Table 4.9-13 and Exhibit 4.9-7 present a comparison of lake elevations and usability of boat launching facilities between the base and WFP conditions. In the months of March through September, lake levels would decline more often below the 420-foot elevation necessary to keep all boat ramps operable with the WFP than under base conditions. Under WFP conditions, the most pronounced effects would occur during the months of August and September (4 fewer years of the 70-year period at or above 420 feet). During the remaining months of the season (April through July), lake levels stay at or above the 420-foot level in 1 or 2 fewer years of the 70-year record, depending on the month.

For the most part, as indicated in Table 4.9-13, the availability of low-water boat ramps on each side of the lake would not be affected by WFP conditions. In the months of March through August, lake levels would not decline more frequently below the 375-foot elevation necessary to keep at least one boat ramp operable on each side of the reservoir. During the remaining month of September, reductions in lake levels would be relatively minor (1 year less often of the 70-year record at or above 375 feet).

As indicated in Table 4.9-13 and Exhibit 4.9-8, the usability of the Folsom Lake Marina wet slips, which require a minimum of 412 feet elevation, would be affected more often in the boating season with the WFP when compared to base conditions. Exhibit 4.9-9 illustrates the constraints of relatively low lake levels (in this case 427 feet) on Folsom Lake Marina operations. The relative reduction of lake levels below the 412-foot minimum would occur in March through September with varying frequency. The most pronounced effects would be in June through September (4 to 6 fewer years of the 70-year record at or above 412 feet). The number of years that lake elevation would be above 412 feet decreases by 1 or 2 years of the 70-year record in all other months of the season (March through May) under the WFP.

Considering overall Folsom Reservoir boating opportunities for launch ramps and the marina during the entire season, WFP conditions would diminish boating opportunities more often compared to base conditions (primarily during the months of July through September). This would significantly reduce boating opportunities and the level of boating activity on Folsom Reservoir. Consequently, the overall effect of WFP conditions on Folsom Reservoir boating opportunities would be significant.

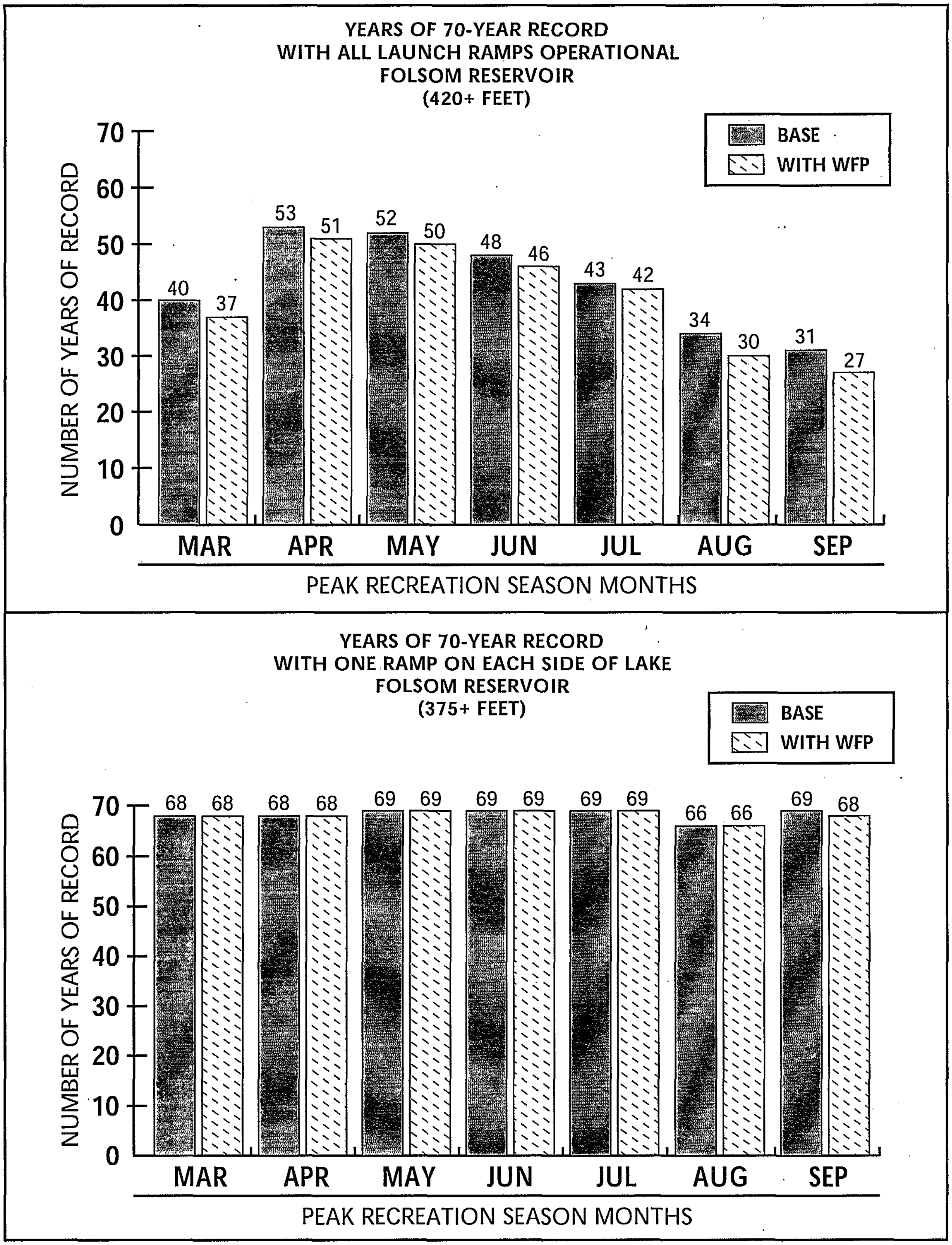
Table 4.9-13
Water Forum Proposal Impact on Recreation Facility Usability on Folsom Reservoir

Month[1]	% of Annual FLSRA Use in Month[2]	Modeled Scenario	# Years of 70-year Record (% Change in # of Years)			
			# Years All Boat Ramps Usable[3] (≥420 ft)	# Years at Least One East/West Ramp Usable[4] (≥375 ft)	# Years Marina Wet Slips Usable[5] (≥412 ft)	# Years Swim Beaches Usable[6] (420-455 ft)
March	7.4%	Base	40	68	48	n/a
		WFP	37	68	46	n/a
April	10.4%	Base	53	68	56	n/a
		WFP	51	68	55	n/a
May	13.8%	Base	52	69	57	22
		WFP	50	69	56	22
June	15.5%	Base	48	69	57	25
		WFP	46	69	51	23
July	17.0%	Base	43	69	51	27
		WFP	42	69	46	27
August	11.7%	Base	34	66	39	34
		WFP	30	66	35	30
September	6.8%	Base	31	69	37	31
		WFP	27	68	32	27

1 Only months with the highest visitation to Folsom Reservoir are included. Visitation is sufficiently less from October through February that usability of boating and swimming facilities is not an impact concern.
2 Data is the average percentage of visitation to Folsom Lake State Recreation Area (FLSRA) occurring during the specified month of the year (U.S. Army Corps of Engineers, 1991).
3 Number of years of the 70-year record when the lake elevation is 420 feet or greater.
4 Number of years of the 70-year record when the lake elevation is 375 feet or greater.
5 Number of years of the 70-year record when the lake elevation is 412 feet or greater.
6 Number of years of the 70-year record when the lake elevation is between 420 and 455 feet.

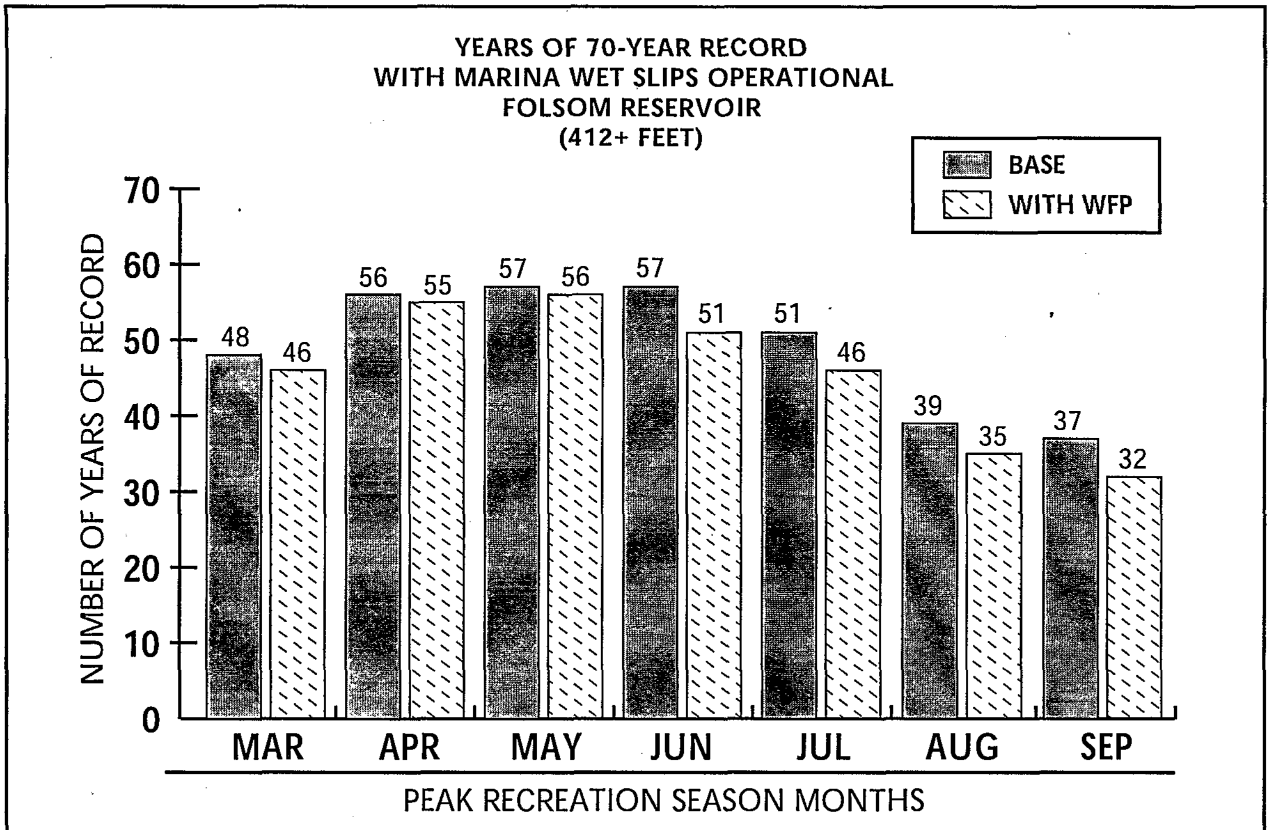
n/a Not applicable in these months, because little swimming occurs.
n/c No change between base conditions and the proposed project (WFP).
Base Modeled predictions of 70-year record based on existing diversions and operating rules.
WFP Modeled predictions of 70-year record based on the proposed Water Forum Proposal.

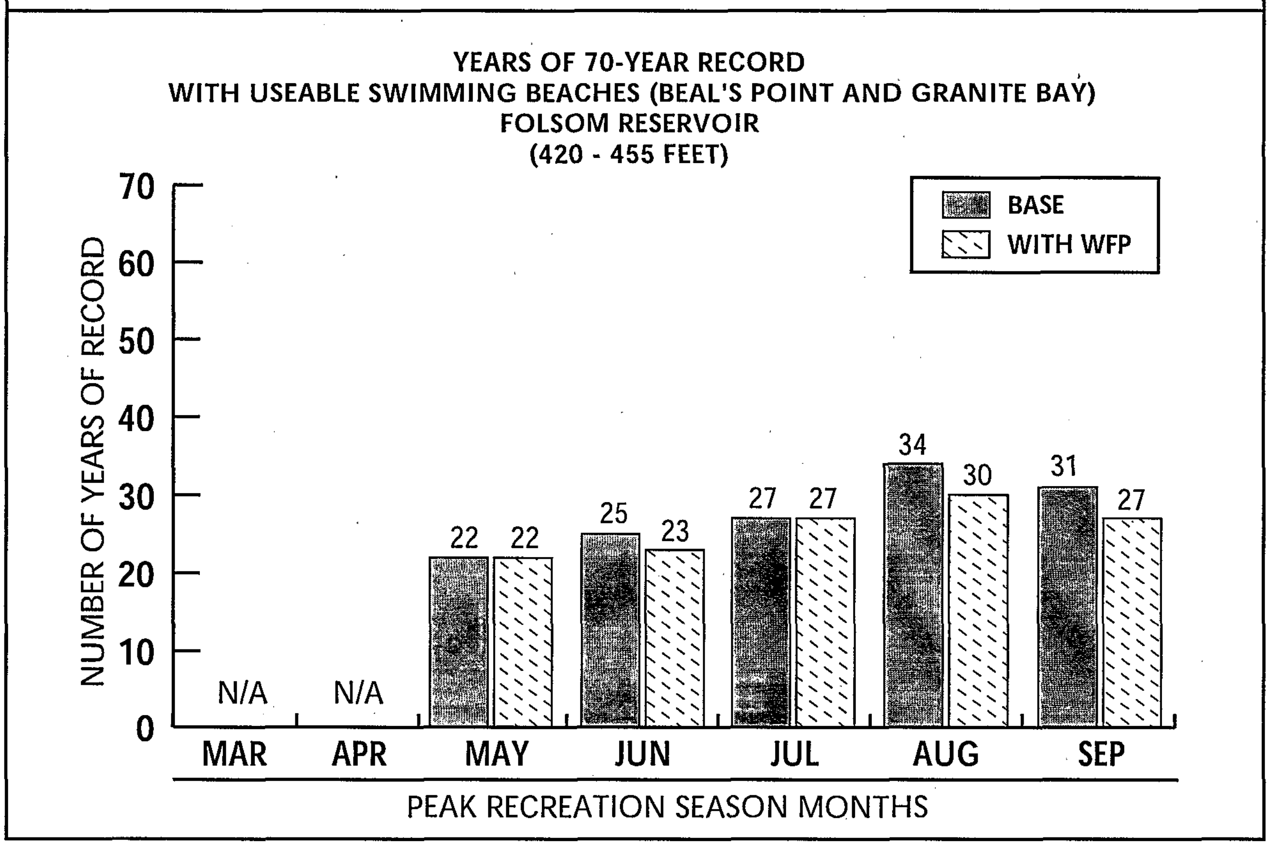
Source: EDAW, 1998; SWRI, 1998.



Boat Ramp Availability on Folsom Reservoir

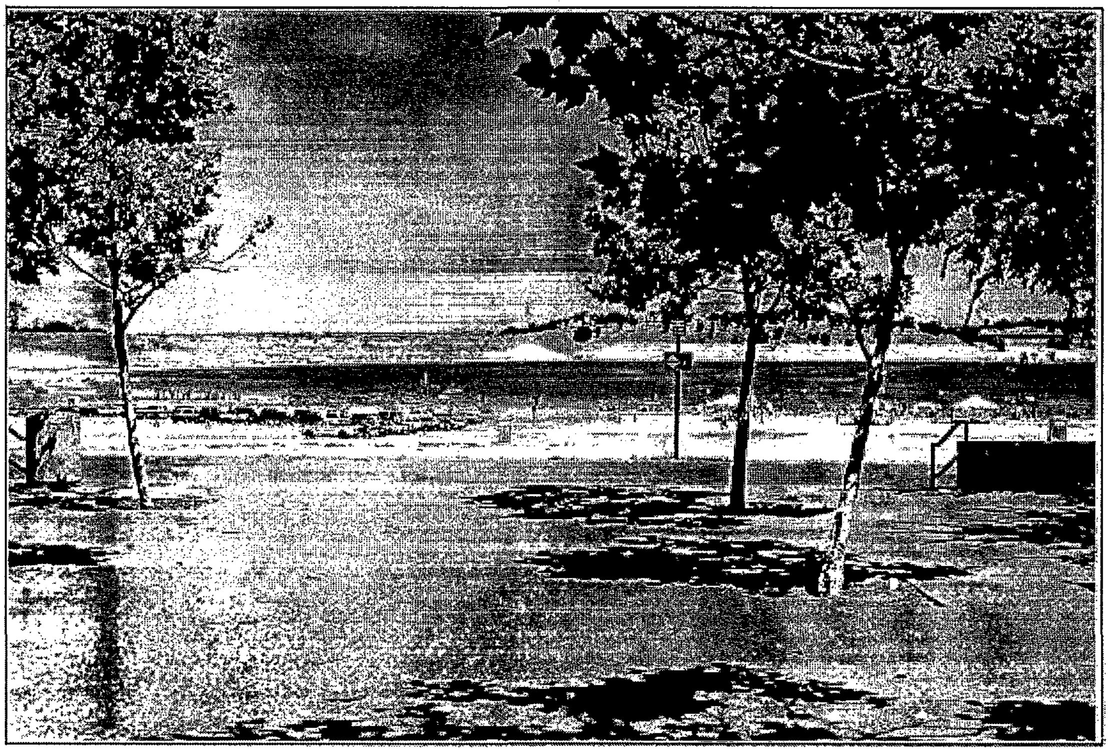
EXHIBIT 4.9-7



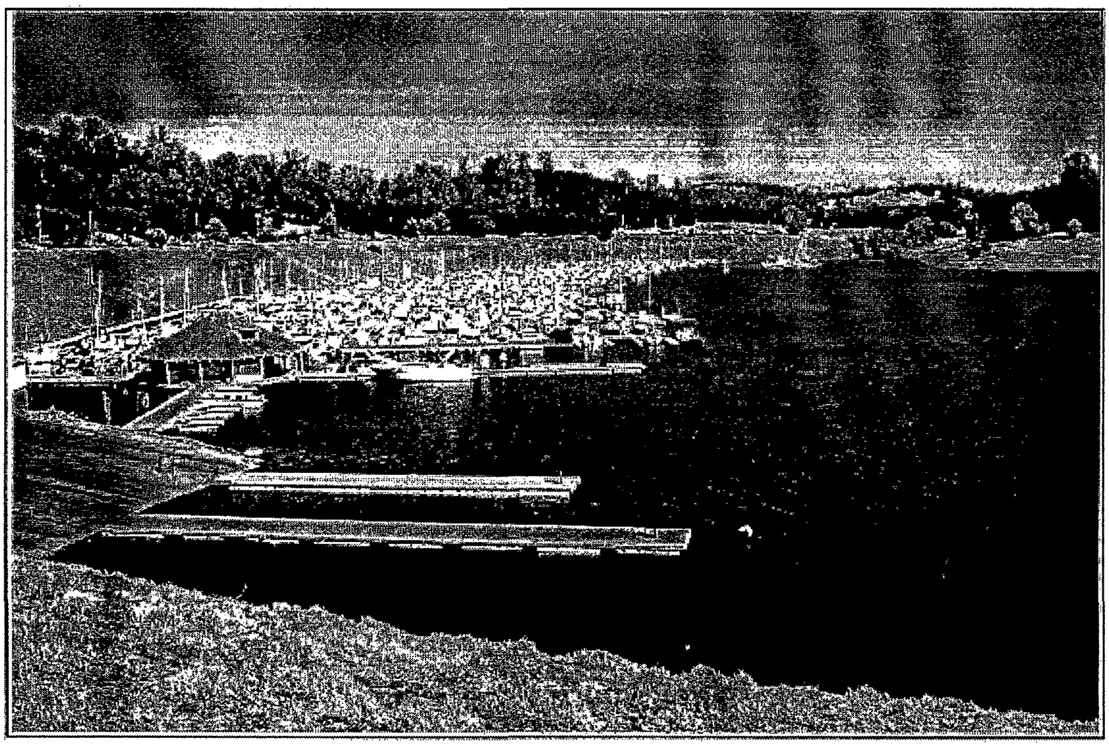


Marina Slip and Swimming Beach Usability on Folsom Reservoir

EXHIBIT 4.9-8



Beal's Point Beach (and temporary parking on beach). Lake Level: 428 feet



Folsom Lake Marina and main ramp at Brown's Ravine. Lake Level: 427 feet

Folsom Reservoir Recreation Facilities at Less than Optimal Lake Levels

EXHIBIT 4.9-9

Impact 4.9-4

Reduced Availability of Folsom Reservoir Swimming Beaches. *Compared to the base conditions, additional diversions under the WFP would result in more frequent declines in lake elevation below useable swim beach levels during most of the primary swimming season (June, August, September). For example, in those months lake elevations remain within the 420 to 455-foot range where swim beaches are usable in 2 to 4 fewer years of the 70-year period with the WFP. Although the availability of beaches during the remaining months of the swim season (May and July) would not be affected, the overall effect of reduced lake elevations on the availability of Folsom Reservoir swim beaches would be* ***significant.***

The most popular swimming months of the year at Folsom Reservoir are May through September when the summer weather is typically sunny and hot. Designated swimming beaches at Beal's Point and Granite Bay are generally usable between the elevations of 420 and 455 feet. Below 420 feet, the water declines below sandy areas and/or is too distant from parking and concessions; visitation decreases substantially when low-water conditions occurs. Even with lake levels in the vicinity of 430 feet, the water is relatively far from parking and concessions and some special low-water facilities are necessary to adequately accommodate swimmers, as illustrated with the temporary parking area on the beach at Beal's Point shown in Exhibit 4.9-9. Above 455 feet the capacity of the beaches is reduced as the high water limits the width of the available beach area. As a result, to understand the effects of the WFP on swimming opportunities, the number of months when water levels are in the usable range during the peak swimming period are examined.

As indicated in Table 4.9-13 and Exhibit 4.9-8, WFP conditions would result in diminished availability of swim beaches during the months of June, August, and September. Depending on the month, the number of years within the useable beach range would be reduced by 2 to 4 years of the 70-year period. The availability of swimming opportunities during the remaining months of the season (May and July) would not be affected. On balance, the overall effect of the WFP on Folsom Reservoir swimming opportunities would be significant, because the availability of swimming beaches would be diminished during some high-use months of the summer.

Upper Sacramento River Reservoirs, Sacramento River, and Delta Recreation Impacts

Impact 4.9-5

Shasta Lake Recreation Opportunities. *Compared to the base conditions, additional diversions under the WFP would result in some more frequent declines in lake elevation during the summer recreation season (May - September) which would decrease shoreline recreation use more often in late summer (August and September); however, the declines would not substantially reduce boat ramp availability or hinder boat-in camping activities. For instance, the number of years when all boat ramps are available would not be changed in any of the summer recreation season months. Altogether, the effects of WFP conditions on recreation opportunities of Shasta Lake during the May - September season are* ***less than significant****, compared to base conditions.*

The primary recreation use season for water-dependent and -enhanced recreation activities at Shasta Lake is from May through September. Therefore, the potential to affect lake levels during these months of the year is the key issue for assessing impacts on boating-related activities, shoreline recreation, and boat-in camping. Because boating opportunity is heavily influenced by access to launching ramps, the relationship of lake levels to operability of ramps is an important consideration. Also, the drawdown distance of water from the vegetated shoreline is an important factor in sustaining shoreline recreation use and boat-in camping.

Table 4.9-14 presents a summary of the relationship between certain water surface elevation thresholds and recreation facilities and uses, based on a comparison of base and WFP conditions. The most important threshold for boating appears to be elevation 941 feet, above which at least one public launching ramp is available on each of the three major arms of the lake. Also presented is the information for elevation 1,017 feet, above which all public ramps are operable. For boat-in camping and shoreline use, the key threshold appears to be elevation 967 feet, below which substantial decreases in use typically occur, because of the discouraging influence of the distance between the water and the vegetated shoreline. Also presented is an assessment of elevation 1,007 feet, below which shoreline use typically begins to decrease because of low water.

The WFP conditions would not result in a change in the number of years when when all boat ramps are usable during any month of the season (i.e., elevation 1,017 feet). Also, the number of years when at least one public ramp is maintained on each of the lake arms (i.e., elevation 941 feet) would not be substantially changed, compared to the base conditions. Both the WFP and base conditions result in the same number of years when lake levels would be sustained at or above 941 feet in May, June, August, and September. In July, WFP conditions would result in an increase of one year during the 70-year period of record in which this level would be sustained. Therefore, based on the comparison of WFP and base conditions for public ramps, along with the more flexible availability of private ramps, adequate boat launching opportunities would be maintained and no significant effect to boating and boating-related activities would occur.

Repeat visitors using the Shasta Lake shoreline and camping facilities have come to expect the lake level to decline as the summer progresses; therefore, they appear to exhibit some tolerance of low-water conditions, to a point. Using the 60-foot drawdown criterion where boat-in camping and shoreline use begin to decline (1,007 feet) and the 100-foot drawdown where substantial decreases occur (967 feet), the analysis indicates that WFP conditions would cause more frequent low-water conditions in some months of the recreation season and increased availability during other months of the season. As presented in Table 4.9-14, WFP conditions would result in reduced lake levels below the 60-foot criterion during the months of June, August, and September (2 to 5 fewer years of the 70-year period at or above 1,007 feet, depending on the month) and below the 100-foot criteria during the month of June (3 fewer years of the 70-year period at or above 967 feet). However, WFP conditions would also result in an increase in the number of years in which lake levels would be at or above the 100-foot elevation during the months of May and September (1 and 9 more years of the 70-year period at or above 967 feet, respectively). Consequently, the overall effect of WFP conditions on Shasta Lake recreation opportunities would be less than significant.

Table 4.9-14 Water Forum Proposal Impact on Recreation Facility Usability on Shasta Lake					
		# Years of 70-year Record			
Month[1]	Modeled Scenario	# Years All Boat Ramps Usable[2] (≥1,017 ft)	# Years at Least One Ramp Usable on Each Arm[3] (≥941 ft)	# Years Shoreline Use Levels Sustained[4] (≥1,007 ft)	# Years Boat-in Camping Use Levels Sustained[5] (≥967 ft)
May	Base	59	69	62	63
	WFP	59	69	62	64
June	Base	52	68	60	63
	WFP	52	68	58	60
July	Base	39	65	47	62
	WFP	39	66	47	62
August	Base	27	63	37	61
	WFP	27	63	34	61
September	Base	19	63	30	44
	WFP	19	63	25	53

1 Only months with the highest visitation to Shasta Lake are included. Visitation is sufficiently less from October through February that usability of boating facilities and shoreline areas is not an impact concern.

2 Number of years of the 70-year record when the lake elevation is 1,017 feet or greater, all public boat ramps are operable at this elevation.

3 Number of years of the 70-year record when the lake elevation is 941 feet or greater; allows at least one public boat ramp to be operable on each of the three major arms of the lake.

4 Number of years of the 70-year record when the lake elevation is 1,007 feet or greater; typically, shoreline recreation use diminishes substantially when lake level falls below this elevation.

5 Number of years of the 70-year record when the lake elevation is 967 feet or greater; typically, boat-in camping use diminishes substantially when lake level falls below this elevation.

n/c No change between base conditions and the proposed project (WFP).
Base Modeled predictions of 70-year record based on existing diversions and operating rules.
WFP Modeled predictions of 70-year record based on the proposed Water Forum Proposal.

Source: EDAW, 1998; SWRI, 1998.

Impact 4.9-6

Trinity Reservoir Recreation Opportunities. *Compared to the base conditions, additional diversions under the WFP would result in minimal declines in lake elevations in Trinity Reservoir during the summer recreation season (May - September). For example, reductions in mean monthly lake elevations would be no greater than 0.1 to 0.2 feet, depending on the month, which would not affect the availability of boat ramps at the reservoir. Consequently, with the minimal changes in lake elevations resulting from WFP diversions,* ***no significant effect*** *on Trinity Reservoir's recreation opportunities would occur.*

Similar to Shasta Lake, the primary recreation use season for water-dependent and -enhanced recreation activities at Trinity Reservoir is from May through September. Therefore, the potential to affect lake levels during these months of the year is the key issue for assessing impacts on boating related activities and shoreline recreation. Because boating opportunity is heavily influenced by access to launching ramps, the relationship of lake levels to operability of ramps is an important consideration. Also, the drawdown distance of water from the vegetated shoreline is an important factor in sustaining shoreline recreation use.

In the case of Trinity Reservoir, the most relevant analysis to determine the effects of the WFP is the comparison of base and WFP conditions. The data indicates that there is essentially no difference between these scenarios. For instance, the WFP would result in average month-end reservoir elevation declines of only 0.1 to 0.2 feet in each of the months of May through September, compared to base conditions. Also, the number of years when reservoir elevations are high enough to operate the three major public launching ramps (Fairview, Trinity Center, and Minersville) differs by only 1 or 2 years at most for one of the ramps in each of May, June, and August; often there is no difference. If any difference in lake level occurs, it would take place in the distant future as WFP diversions gradually increase. Because of the small magnitude and far off timeframe, lake level declines sufficient to affect recreation becomes somewhat speculative. Any lake level drawdowns affecting recreation opportunity on Trinity Reservoir would occur with essentially the same frequency during the summer recreation season, regardless of whether the WFP is implemented or not. Consequently, any decreases in recreation opportunity because of lowered water levels are not influenced by the WFP and the effect of the WFP is, therefore, less than significant.

Impact **4.9-7**

Recreation Opportunities on Whiskeytown and Keswick Reservoirs. *Whiskeytown and Keswick Reservoirs serve as regulating reservoirs, so while releases under WFP conditions would differ from base conditions, these differences would not substantially alter the existing seasonal pattern of lake elevations. Therefore, no substantial changes in recreation opportunities on Whiskeytown and Keswick Reservoirs would occur, resulting in a* ***less-than-significant*** *effect.*

Under current operating procedures, Keswick and Whiskeytown reservoirs serve as regulating reservoirs for Shasta Lake and Trinity/Lewiston Reservoir. This function enables releases from the larger upstream dams to fluctuate as needed for electrical power or other purposes while releases from the regulating dams on the downstream rivers can be made to change less abruptly. As a result, the water levels of Keswick and Whiskeytown reservoirs fluctuate regularly, but within a much smaller range of water surface elevation than Shasta Lake and Trinity Reservoir. This creates relatively stable shoreline and launch-ramp conditions for swimming, fishing, and boating.

Under the WFP, although dam release schedules would change, they would not alter the function of Keswick and Whiskeytown reservoirs as regulating reservoirs. As a result, even though water release patterns would be different than base conditions, the Shasta and Keswick dams and the Trinity and Whiskeytown dams would still be operated in a coordinated way. Consequently, the historical range of water level fluctuations on Keswick and Whiskeytown reservoirs would be expected to continue into the future without substantial change. Therefore, recreation opportunities on these reservoirs would also not change substantially, resulting in a less-than-significant effect.

Impact 4.9-8

Recreation Impacts on the Upper Sacramento River. *Compared to base conditions, in most years additional diversions under the WFP would not result in decreased flows in the upper Sacramento River during the summer recreation season (May through September). For example, during these months, flow downstream of Keswick Reservoir would be equal to or greater than the base condition in 59, 55, 41, 59, and 66 years of the 70-year record in May, June, July, August, and September, respectively. In years when flows are less than base conditions in these months, the difference would be insufficient to substantially reduce recreation opportunities. Therefore, changes in flow on the upper Sacramento River during summer recreation season would result in a* ***less-than-significant*** *effect on recreation opportunities.*

Water-dependent recreation use on the upper Sacramento River, between Keswick Dam and the confluence of the American River, is higher in May through September than in other months of the year, coincident with the warmer, summer weather. Consequently, effects of the WFP conditions on Sacramento River flows during this period would be most important for understanding recreation opportunity impacts.

A minimum recreation flow of 5,000 cfs is identified for the Sacramento River in the California Water Plan Update (DWR, 1994). This is an overall standard that is not related to specific reaches of the upper Sacramento River, so it provides only general guidance in assessing recreation impacts. Definitive optimum and maximum/minimum river flows for recreation uses are not available for the upper Sacramento River, so the relative change in river flows are compared between the WFP and base conditions to assess potential recreation impacts. If relative flows are not substantially less for the WFP conditions compared to the base conditions, boat ramps and access points along the river between Keswick Dam and Colusa would not be adversely affected.

During the months of highest recreation use (May through September), WFP conditions would result in equivalent or higher flows in a majority of years. During these months, flows downstream of Keswick Reservoir would be equal to or greater than the base condition in 59, 55, 41, 59, and 66 years of the 70-year record in May, June, July, August, and September, respectively. In most years, therefore, flow conditions resulting from the operation of the system in response to the additional WFP diversions would not affect recreation opportunities in the upper Sacramento River. When reductions in flow compared to base conditions would occur, the magnitude would not be sufficient to cause substantial adverse effects to recreation opportunities. For example, the most frequent reductions in flow would occur in July, when flows would be less than base conditions in 29 of 70 years. The flow volume is sufficiently high in July (7,400 to 17,200 cfs range, with at least 10,000 cfs in 64 of 70 years), such that substantial adverse effects to recreation opportunities would not occur. In other months of the season, the relative influence of the additional WFP diversions on upper Sacramento River flows is much less than in July. As an overall conclusion, the effect of flow differences on recreation opportunity on the upper Sacramento River resulting from operation of the system in response to additional WFP diversions would be less than significant.

Impact 4.9-9

Lower Sacramento River Recreation Opportunities. *Compared to base conditions, in most years additional diversions under the WFP would not result in decreased flows in the lower Sacramento River during the summer recreation season (May through September). For example, during these months, flows at Freeport would be equal to or greater than the base condition in 40, 38, 43, 51, and 48 years of the 70-record in May, June, July, August, and September, respectively. In years when flows are less than base conditions in these months, the reduction in flow would seldom be more than 1.0 percent, which would be insufficient to substantially reduce recreation opportunities. Also, substantial flow would remain in the river and tidal action would diminish the influence of the reduced flows on boating, fishing, and other water-dependent recreation activities. Therefore, changes in flow on the lower Sacramento River during summer recreation season would result in a* ***less-than-significant*** *effect on recreation opportunities.*

Similar to other water recreation areas of northern California, the highest recreation use period for the Lower Sacramento River, i.e., between the American River confluence and the Delta, is from May to September. Under base conditions, mean monthly flow in the Lower Sacramento River at Freeport averages from 13,900 to 18,600 cfs during this period. No definitive thresholds for optimal or minimum/maximum recreation flows are available for the Lower Sacramento River; therefore, the relative difference between the base and WFP conditions is evaluated and considered in light of tidal influences, which could affect recreation opportunity.

WFP conditions would result in relatively no change in many years and minor reductions in mean monthly flows in some years along the lower Sacramento River during the high recreation use months (May through September), in comparison to base conditions. During these months, compared to the base condition, equal or higher flows at Freeport occur in most years. For instance, flows at Freeport would be equal to or greater than the base condition in 40, 38, 43, 51, and 48 years of the 70-record in May, June, July, August, and September, respectively. In years when reduction in flow would occur, the magnitude would seldom be greater than 1.0 percent. Flows at Freeport would be decreased by more than 1.0 percent in 3, 8, 6, 10, and 9 years of the 70-year record in May, June, July, August, and September, respectively. The minor reductions in flow resulting from WFP conditions in some years would not have a substantial effect on recreation opportunities, considering the other hydrologic factors that have a more important influence, such as tidal action.

The hydrology of the lower Sacramento River is not related just to flow from upstream. Tidal action also affects this section of the river. Both need to be considered in assessing the opportunities for water-dependent recreation activities. Under WFP conditions, the flows from upstream remaining in the river during high recreation use months would continue to be substantial, despite the reductions occurring in many years compared to the base condition The average of the mean monthly flows under WFP conditions varies from approximately 18,600 cfs in May to 13,900 cfs in September. This amount of flow provides considerable opportunity for boating, fishing, and other water-dependent activities. In addition, tidal action heavily influences the river stage (i.e., water surface elevation in the river) in the lower Sacramento River, so the effect of reduced river flows on water-dependent recreation opportunities would be generally overshadowed by the height and flow of the tide. Tidal action contributes substantially to flows in the lower Sacramento River, often with greater magnitude than the flow from upstream. For instance, near Rio Vista, tidal action contributes approximately 70,000 cfs to the river (compared to the 13,900 to 18,600 cfs flow from upstream during the recreation use period). Consequently, recognizing the continued occurrence of substantial flows from upstream in the Sacramento River and the considerable influence of tidal action, recreation opportunities would not be significantly affected by WFP conditions on the lower Sacramento River.

Impact
4.9-10

<u>Delta Recreation Opportunities.</u> *Compared to base conditions, in most years additional diversions under the WFP would not result in decreased inflows in the Delta during the summer recreation season (May through September). For example, during these months, flows at Freeport would be equal to or greater than the base condition in 40, 38, 43, 51, and 48 years of the 70-record in May, June, July, August, and September, respectively. In years when inflows are less than base conditions in these months, the reduction in flow would seldom be more than 1.0 percent, which would be insufficient to substantially reduce recreation opportunities. Also, substantial inflow to the Delta would remain and tidal action would diminish or overshadow the influence of the reduced flows on boating, fishing, and other water-dependent recreation activities. Therefore, changes in inflow to the Delta during summer recreation season would result in a* ***less-than-significant*** *effect on recreation opportunities.*

Like other water resources of northern California, the highest period of recreational use of the Delta is between May and September. The discussion regarding Impact 4.9-9 indicates that Delta inflow differences from the Sacramento River would occur between the WFP and base conditions in the high recreation use period of many years.

The Delta's hydrology is complex and influenced by other water sources, specifically tidal action, San Joaquin River inflows, and east side tributary inflows. Consequently, differences in flows from the Sacramento River would not translate directly into Delta water recreation effects. For instance, incoming tidal action in the summer contributes approximately 70,000 cfs in the Sacramento River near Rio Vista and 58,000 cfs in the central Delta reach of the San Joaquin River (DWR, 1994).

These tidally influenced flows are substantially more than the mean monthly flows from the lower Sacramento River at Freeport, which would average approximately 13,900 to 18,900 cfs flow during the period of May to September. As a result, any effect the lower Sacramento River flows could have on water-dependent and water-enhanced recreation would be at least moderated and potentially overshadowed completely, depending on the location in the Delta. Consequently, the differences in summertime inflow to the Delta resulting from the WFP conditions (as summarized in Impact 4.9-9 above) would not cause a significant effect on Delta recreation opportunities.

Consistency with Applicable Plans and Policies

Impact
4.9-11

Consistency with the American River Parkway Plan. *The WFP would be consistent with the American River Parkway Plan and no significant environmental impact related to conflict with plans and policies for the avoidance of environmental effects would occur. This would be a **less-than-significant** impact.*

The American River Parkway Plan Policy 3.1 on water flow anticipates that flow requirements are being researched and should be defined in the Plan once the research is completed. The policy and its supporting discussion in Chapter 4 also indicate that flow standards associated with the SWRCB's D-1400 (e.g., 1,500 cfs for recreation) would be too low if they went into effect. The analysis in this EIR indicates that the minimum flow for adequate recreation opportunity on the Lower American River, based on a review of known flow criteria, would be 1,750 cfs. The low end of an optimum flow range appears to be 3,000 cfs. As part of the WFP implementation, the WFP Successor Effort will be seeking approval of new flow standards by the SWRCB.

Both the minimum and optimum flow criteria used in this EIR are higher than the D-1400 standard. Either or both could be incorporated into the American River Parkway Plan by Sacramento County, if they are approved as part of the WFP implementation process Therefore, the WFP would be consistent with the American River Parkway Plan and no conflicts with environmental goals or plans of the Parkway Plan would occur.

Impact
4.9-12

Consistency with Lower American River's Recreational River Designations. *While the WFP conditions would reduce flows available for recreation on the Lower American River during the summer months in a some additional years, adopting Mitigation Measure 4.9-1 would minimize the effect on recreation opportunities for rafting or boating during high recreation use periods. The Lower American River would retain substantial recreation value. The recreation values of the Lower American River would be protected to the maximum extent feasible and the WFP would be consistent with the State and Federal recreational river designations, resulting in a **less-than-significant** impact.*

The WFP conditions would result in summertime flows being reduced below optimal and minimum flow criteria for recreation on the Lower American River more often in some future years as increased diversions occur than would be the case in the base condition (see Impact 4.9-1). The effect would occur primarily in dryer than average years, not critically dry years. (In critically dry years, summertime flows would already be below the minimum adequate for recreation even with base conditions.) Despite the increased diversions associated with the WFP, however, during the three highest boating and rafting months of June, July, and August mean monthly flows would remain within the minimum/maximum range for recreation in most years (i.e., at least 64 percent of years). Therefore, the river would retain substantial recreation values. In addition, with the adoption of the recreation mitigation in the Habitat Management Plan (HMP) as part of the WFP, as is recommended in this EIR, compensation for the recreation effects on the river would occur. The mitigation could include measures to enhance water-dependent and/or water-enhanced recreation opportunities, such as developing boating access or trail facilities in the American River Parkway.

One of the coequal objectives of the WFP includes preserving the recreational values of the Lower American River. The underlying goal includes maintaining the recreation values upon which the State and Federal recreational river designation of the Lower American River is based. With the maintenance of flows within the minimum and maximum flow ranges at least 64% of years in June, July, and August, the recreation values of the Lower American River would be generally sustained. With the adoption of the suggested mitigation the loss of recreation opportunity could be compensated. Also, major new water supply facilities are not necessary, so facilities would not be added to the Lower American River where they are not already present. Therefore, the WFP would not unreasonably diminish the recreational values Lower American River, consistent with the State and Federal recreational river designations.

4.9.4 MITIGATION MEASURES

No mitigation measures are necessary for the following less-than-significant impacts:

- 4.9-2: Lake Natoma Recreation Opportunities
- 4.9-5: Shasta Lake Recreation Opportunities
- 4.9-6: Trinity Reservoir Recreation Opportunities
- 4.9-7: Whiskeytown and Keswick Reservoir Recreation Opportunities
- 4.9-8: Upper Sacramento River Recreation Opportunities
- 4.9-9: Lower Sacramento River Recreation Opportunities
- 4.9-10: Delta Recreation Opportunities
- 4.9-11: Consistency with the American River Parkway Plan
- 4.9-12: Consistency with Lower American River's Recreational River Designations

The following mitigation measures are provided for significant and potentially significant impacts:

impact **4.9-1** mitigation

Reduced Lower American River Boating Opportunities

Improvements to the American River Parkway Recreation Facilities

The WFP includes features intended to lessen potential environmental impacts to the American River, consistent with the coequal objective to protect its natural values. These mitigating features include water conservation, dry-year diversion restrictions, and conjunctive use of ground water and surface water. Adoption of the WFP with these features would reduce flow effects on Lower American River recreation opportunities. In addition, *improvements to recreation facilities in the American River Parkway are identified to compensate for the reduction in quality of and opportunity for rafting/boating on the Lower American River. Actions would occur in cooperation with the Sacramento County Department of Parks and Recreation and could include one or both of the following: (A) contributing to the purchase and development of the Uruttia property to provide water-dependent recreation opportunities and (B) developing recreation facilities to improve water-dependent and water-enhanced recreation opportunities in the American River Parkway. The improvements would involve projects that are consistent with the American River Parkway Plan, or that would be implemented subject to an amendment to the parkway plan by Sacramento County.*

Description

One or both of the measures described below could be implemented in cooperation with the Sacramento County Department of Parks and Recreation, the agency responsible for implementing the American River Parkway Plan. The measures could be part of the Habitat Management Plan adopted by the Water Forum participants as an implementation tool for the Habitat Management Element of the Water Forum Proposal. Funding for the recreation measures may include money from within or outside the Water Forum Successor Effort. Because activities by a number of agencies are underway to restore and enhance the Lower American River, this recreation mitigation should be coordinated with the broader ecosystem partnership efforts. Other agencies involved in the Lower American River may participate in funding and/or implementation of recreation mitigation, as appropriate, to promote a well-coordinated program of restoration and enhancement of the river.

a) *Uruttia Property. The Uruttia Property, located on the north side of the Lower American River near CalExpo, could be acquired and/or developed to provide public access, opportunities for water-dependent recreation activity related to the river (such as canoe and kayak use and instruction), and enhanced environmental values which can provide opportunities for water-enhanced recreation, such as sightseeing and nature study. The property and facilities would be incorporated into the American River Parkway and reflected by amendment in the American River Parkway Plan.*

b) *Recreation Facility Improvements to the American River Parkway. The American River Parkway Plan describes in several Area Plans the resources and facilities intended to provide for water-dependent and water-enhanced recreation, including river access, trails, parking, swimming areas, and other facilities. The facilities could include improvement of river access for rafting/boating in the less intensively used sections of the river, such as downstream of Goethe Park; trail improvements to increase the opportunity for water-enhanced recreation, such as a linkage between the Fairbairn plant and the Sutter's Landing Park site; or interpretive resources to improve water-enhanced nature study and appreciation of the Parkway.*

c) *Update of the American River Parkway Plan. The update could consider the flow regime resulting from the WFP and appropriate actions to take in the Parkway to support improvement of both recreation opportunities and riparian habitat.*

d) *Enhancement of the Condition and Quality of Existing Recreation Facilities. Past and current budget constraints have limited the County's ability to maintain some existing recreation facilities. Enhancement of the condition and quality of existing facilities could improve the attraction of the Parkway for both water-dependent and water-enhanced recreation activity.*

Performance Criteria

The improvements to recreation facilities in the American River Parkway would accomplish the following criteria:

- *Facilities would improve opportunities for water-dependent recreation, particularly rafting/boating, such that the river is made more accessible when flows are appropriate and/or the quality of rafting/boating is improved; or facilities would improve opportunities for water-enhanced recreation, such that the quality and visitation associated with recreation activity in the Parkway is increased.*
- *Improvements would be consistent with the American River Parkway Plan.*

Timing

The final selection of facilities for improvement would occur during the 18-month preparation period of the Habitat Management Plan. Facilities would be developed as soon as feasible after completion of that plan, recognizing the need to assemble funding, secure facility approvals, and prepare designs.

impact **4.9-3** mitigation

Reduced Folsom Reservoir Boating Opportunities

Improvement of Boating Facilities at Folsom Reservoir

The WFP includes features intended to lessen potential environmental impacts on the Lower American River, which would also serve to decrease environmental effects to other resources. These mitigating features include water conservation, dry-year diversion restrictions, and conjunctive use of ground water and surface water. Adoption of the WFP with these features would reduce water surface elevation effects on Folsom Reservoir recreation. In addition, boating facility improvements would enhance boating access during periods of higher water to compensate for reduced availability of boat ramp and marina facilities from Water Forum Proposal diversions. Actions would occur in cooperation with the California Department of Parks and Recreation (CDPR) and would be consistent with the General Plan for Folsom Lake State Recreation Area (CDPR, 1978). Mitigation should also be consistent with the objectives of CDPR proposals for measures to mitigate lower lake levels from flood storage reoperation (Kranz, 1997). The actions could be added into the recreation section of the Habitat Management Plan as a means to implement them.

Description

One or more of the following recreation measures described below could be implemented in cooperation with the CDPR. Funding for the recreation measures may include money from within or outside the Water Forum Successor Effort. A number of agencies are involved in water resources and recreation facility decisions affecting Folsom Reservoir, so this recreation mitigation should be coordinated with other actions, as appropriate. Consequently, other agencies involved in Folsom Reservoir may participate in funding and/or implementation of recreation mitigation.

a) Boating Facilities to Increase Access and Use During Higher Water Periods. Construction of boating facilities, consistent with the General Plan for Folsom Lake State Recreation Area would increase boating access and use of the reservoir during higher water periods. To compensate for reduced availability of boating facilities during lower water periods, this measure would improve boating facilities for use when higher water *conditions allow for high-quality water recreation and the greater reservoir surface area availability; at higher water levels, visitation can be increased when the larger reservoir surface area can support more intensive use. Examples of potential boating facility improvements suggested by CDPR staff include boat parking and shore facilities at Dyke 8 or a launch ramp and dock at New York Cove (on the east side of the reservoir, north of Brown's Ravine). The final selection of facilities would occur in cooperation between the Water Forum Successor Effort and the CDPR.*

b) *Improvement to the Marina Area. Construction of facility improvements in the Brown's Ravine area would enhance the operation of the marina. Improvements would be consistent with the Folsom Lake State Recreation Area General Plan. The intent of these improvements would be to help enhance marina operations during periods of sufficiently high water to offset the reduced availability of wet slips. The final selection of facilities would occur in cooperation between the Water Forum Successor Effort, the operator of the marina, and the CDPR.*

Performance Criteria

The improvements to recreation facilities on Folsom Reservoir will accomplish the following criteria:

- *Facilities serving higher water conditions will increase boating visitation to Folsom Reservoir when the surface area is large enough to support the increased use.*
- *Marina facility improvements will help enhance operation of the marina when water level is high enough to support the wet slips.*
- *Improvements are consistent with the General Plan for Folsom Lake State Recreation Area.*

Timing

The final selection of facilities for improvement would occur during an period following adoption of the Water Forum Proposal. Facilities would be developed as soon as feasible after completion of that plan, recognizing the need to assemble funding, secure facility approvals, and prepare designs.

impact
4.9-4
mitigation

Reduced Availability of Folsom Reservoir Swimming Beaches

Improvement of Swimming and Landside Recreation Facilities at Folsom Reservoir

The WFP includes features intended to lessen potential environmental impacts on the Lower American River, which would also serve to decrease environmental effects to other resources. These mitigating features include water conservation, dry-year diversion restrictions, and conjunctive use of ground water and surface water. Adoption of the WFP with these features would reduce lake level effects on shoreline recreation and swimming. In addition, improvements to swimming or other shore recreation facilities that attract increased visitation to landside recreation areas around the reservoir should be implemented. Actions would occur in cooperation with the CDPR and would be consistent with the General Plan for Folsom Lake State Recreation Area. Mitigation should also be consistent with the objectives of CDPR proposals for measures to mitigate lower lake levels for flood storage reoperation

(Krantz, 1997). The actions could be added into the recreation section of the Habitat Management Plan as a means to implement them.

Description

One or more of the following landside recreation measures described below could be implemented in cooperation with the CDPR. Funding for the recreation measures may include money from within or outside the Water Forum Successor Effort. A number of agencies are involved in water resources and recreation facility decisions affecting Folsom Reservoir, so this recreation mitigation would be coordinated with other actions, as appropriate. Consequently, other agencies involved in Folsom Reservoir may participate in funding and/or implementation of recreation mitigation.

a) Impoundments for Swimming. Construction of earthen dams at approximately 450 feet elevation at Beal's Point, Dyke 8, and/or Granite Bay would impound water for swimming opportunities close to day-use parking and concessionaires regardless of reservoir elevation. The CDPR has considered this concept as a way to provide dependable swimming opportunities throughout the summer. Water would need to be drained and replenished by pumps weekly. Because this concept would involve considerable engineering and construction, it could cause environmental effects and would be subject its own environmental review. The impoundments would also have to comply with health regulations for water contact use. As such, it is not yet certain whether this concept could be feasibly implemented at Folsom Reservoir.

b) Landside Recreation Improvements. Construction of landside facilities supporting other recreation uses would help offset reduction in swimming opportunities. Facilities could include a bicycle trail connection included in the General Plan between Beal's Point and Granite Bay. Construction of this three-mile paved trail connection would substantially increase bicycle use, and therefore visitation, regardless of reservoir level, according to CDPR staff. The bicycle trail would improve access to shore facilities and remote beach areas. Also, the Water Forum Successor Effort could contribute to other shoreline recreation facility improvements, such as temporary parking, beach areas, or concession facilities for low-water access or other facilities consistent with the General Plan.

c) Update of the Folsom Lake State Recreation Area General Plan. With changes in future reservoir levels, the General Plan could be updated to reflect the expected pattern of reservoir elevations. This could help update the recreation area's approach to attract and serve local and non-local recreation users. This effort would need to be led by CDPR with support of the Water Forum Successor participants.

Performance Criteria

The improvements to landside recreation facilities on Folsom Reservoir would accomplish the following criteria:

- *Facilities could provide opportunities for swimming in low-water conditions below an elevation of 435 feet (approximate optimum swimming beach level); or facilities would increase landside recreation visitation to Folsom Reservoir with activities.*
- *Improvements would be consistent with the General Plan for Folsom Lake State Recreation Area.*
- *Recreation facility improvements would not conflict with habitat enhancement actions of the Habitat Management Plan.*

Timing *The final selection of facilities for improvement would occur during a period following adoption of the Water Forum Proposal. Facilities would be developed as soon as feasible after completion of that plan, recognizing the need to assemble funding, secure facility approvals, and prepare designs.*

4.9.5 LEVEL OF SIGNIFICANCE AFTER MITIGATION

Although the WFP contains features that lessen recreation impacts (including water conservation, dry-year diversion restrictions, conjunctive use of ground water and surface water), the WFP does not entirely avoid significant effects on the environment. The mitigation measures identified in this EIR would further reduce impacts; however, these measures would not reduce impacts to a less-than-significant level. Consequently, to fulfill the disclosure requirements of CEQA, this EIR must indicate impacts on recreation resources would remain significant and unavoidable related to reduced summertime flows on the Lower American River for rafting/boating (Impact 4.9-1), decreased lake elevations on Folsom Reservoir for boating (Impact 4.9-3), and decreased swimming beach opportunities on Folsom Reservoir (Impact 4.9-4).

4.10 LAND USE AND GROWTH-INDUCING IMPACTS

Because one of the coequal objectives of the WFP is "to provide a reliable and safe water supply for the regions's economic health and planned development through the year 2030," it is important to examine the WFP's potential land use effects in relation to the adopted general plans of the communities in the water service study area. This section presents a summary of existing and planned land uses in the three counties and the major cities served by the WFP's water supply and presents the consistency of the WFP with applicable water supply-related general plan policies.

As a first-tier, program-level analysis, this EIR does not evaluate the potential direct land use changes related to the construction of facilities needed to implement the WFP. Construction-related impacts and site specific facility impacts would be addressed in the appropriate project-level environmental documents prepared for each facility. Nor does this EIR examine the precise impacts of the growth on the environment anticipated to occur as a result of future development. Physical environmental effects of urban development are appropriately evaluated in each jurisdiction's general plan EIR. The emphasis in this section is on the overall land use effects in the water service study area, the relationship of growth expected to be accommodated under the WFP to growth contemplated under existing general plans, and overall growth-inducing impacts.

4.10.1 EXISTING CONDITIONS

DIRECT EFFECT STUDY AREA

Land uses in the direct effect study area consist of the water-related facilities and activities associated with Folsom Reservoir, Lake Natoma, and the in-stream and riparian areas of the Lower American River (from Nimbus Dam to the confluence with the Sacramento River). Folsom Reservoir, created in 1955 as part of the federal Central Valley Project, provides water resources, flood control, electricity, and recreational opportunities. Downstream from Folsom Reservoir, Lake Natoma provides flood control, water supply, and recreation, and has picnic, bikeway, equestrian staging areas, and swimming areas along its lakeshore. The in-stream areas of the Lower American River are used primarily for recreation and water supply. A continuous bikepath along the river's edge connects Nimbus Dam to a bikepath along a portion of the Sacramento River. A few commercial recreation uses (e.g., raft rentals, golf courses), restaurants, office, residential (e.g., in the Sailor Bar area), and public facility uses (e.g., water treatment plants), are located along the Lower American River, but the land uses are dominated by undeveloped lands and recreational facilities such as picnic areas, trails, and park facilities. Notable parks and nature areas include, from Folsom Reservoir downstream: Ancil Hoffman Park and Effie Yeaw Nature Center, Cordova Community Park, C.M. Goethe Park, William B. Pond Recreation Area, Bushy Lake - Cal Expo, and Discovery Park.

INDIRECT EFFECT STUDY AREA

The indirect effect study area is generally defined as the Central Valley Project (CVP) and State Water Project (SWP) systems upstream from the confluence of the American River and Sacramento River, exclusive of the direct effect study area, and the reservoirs and rivers associated with these waterways. The Sacramento-San Joaquin Delta is also included in the indirect effect study area. These river areas and the delta include a very large and diverse geographic area.

The land uses along the upper stretches of the Sacramento River are dominated by undeveloped riverbanks in more rural areas, with some limited commercial, residential, and agricultural uses in areas close to urban centers and cities. A number of reservoirs found in the upper Sacramento River area are used primarily for flood control, water supply, and recreation including boating, fishing, swimming, and camping. These reservoirs include: Shasta, Keswick, Whiskeytown, and Trinity (in Shasta, Trinity, and Butte counties). These reservoirs are located within the Whiskeytown-Shasta-Trinity National Recreation Area (NRA), a designation that provides protection of their recreational and scenic values. The upper Sacramento River near the City of Chico, (in Butte and Glenn counties) and southward through Colusa, and Sutter counties, supports agricultural and limited rural uses.

Approaching the City of Sacramento (Yolo and Sacramento counties), a higher proportion of "urban" uses can be found along the east side of the Sacramento River including: houseboat and recreational boat marinas, restaurants, residential, and some office uses. Sacramento (including Old Sacramento) and West Sacramento front the river in this stretch. A sheriff's training facility is located on the west side of the river in Yolo County. Office and residential uses are also developing along the west side of the river, in West Sacramento. Other land uses along both sides of the river in this stretch include: residential, parks, picnic facilities, camp sites, agricultural, and industrial uses, and a water taxi.

A number of small communities such as Clarksburg, Hood, Courtland, and Locke, are the gateway towns to the Delta area. These communities support agricultural, residential, commercial, and industrial uses, with boating facilities along the waterways. Walnut Grove, Isleton, and Rio Vista are the major communities in the northern portion of the Delta and have a higher density of residential, commercial, industrial, agricultural uses and marinas than the gateway communities.

WATER SERVICE STUDY AREA

The water service study area is consistent with the service areas of stakeholder purveyors (including purveyors with procedural agreements as described in Section 3, Project Description) and includes the cities of Sacramento, Folsom, Galt, Citrus Heights, and Roseville; most of the unincorporated County of Sacramento; South Placer County and western El Dorado County. The following is a general discussion of existing land uses, planned land uses, agricultural lands, and applicable General Plans and General Plan policies for the various jurisdictions included in the water service study area.

Existing Land Use Within the Water Service Study Area

Unincorporated Sacramento County

Sacramento County encompasses approximately 636,000 acres of land, approximately 81,000 acres of which are within the cities of Sacramento, Folsom, Citrus Heights, and Galt. The remaining 555,000 acres of unincorporated Sacramento County lands include the following existing land uses: 360,000 acres of agriculture (65%); 116,000 acres of residential (21%); 39,000 acres of industrial (7%); 17,000 acres of recreation area (3%); 14,000 acres of waterways (3%); 7,000 acres of commercial and office (1%); and 2,000 acres of urban reserve (less than 1%) (Sacramento County, 1993). These figures include the entire unincorporated area of the county, including the Delta area generally west of Interstate 5 and south of Freeport, which is outside the WFP study area.

The City of Sacramento is the Core Area in the county, which the county defines as "mixed uses within close proximity of major activity centers of the urban (downtown) area." Substantial urbanized development also occurs outside the Sacramento city limits, as well as undeveloped land and low density residential development (i.e., agricultural-residential). Agricultural-residential land uses lie south and east of Elk Grove-Florin Road, south of the Cosumnes River, near Folsom and Rio Linda, and in the northernmost portion of the county. Commercial and office uses within Sacramento County are located primarily along Interstate 80 (I-80), State Route 99, Interstate 5 (I-5), and U.S. Highway 50 corridors. Unique in the mix of county land uses are Mather Air Force Base (AFB), located in the central portion of the county, and McClellan AFB, located in the northern portion of the county. Both of these bases are undergoing conversion to civilian uses. The Aerojet industrial facility (approximately 13,500-acre total landholding) is also located in the eastern portion of the county, south of U.S. Highway 50. Agricultural land uses occur at the outskirts of the county, with particularly large areas in the southern and eastern sections of the county. Aside from agricultural land, the majority of open space within Sacramento County exists within the American River Parkway and along the Sacramento River (Sacramento County, 1992).

According to estimates contained in the Sacramento County General Plan EIR, there are approximately 360,000 acres of agricultural land within Sacramento County (Sacramento County General Plan EIR, 1992). The county contains lands identified by the State Department of Conservation as Prime Farmland and Farmland of Statewide Importance. Prime Farmland is defined by the State Department of Conservation as land that has the best combination of physical and chemical characteristics for crop production. Farmland of Statewide Importance is defined as similar to Prime Farmland, except that it has some shortcomings, such as greater slopes or lower moisture storage capacity. Prime Farmland is concentrated along the Sacramento River in the Delta and North Natomas areas, and in the Cosumnes River floodplain. Large areas of Farmland of Statewide Importance occur in the southern part of the county. Most of the undeveloped land in the southern and eastern portions of the county are now subject to Williamson Act contracts (Sacramento County, 1992).

City of Sacramento

The City of Sacramento contains approximately 63,115 acres of land (Sacramento County, 1995). The city is bordered on the west by the Sacramento River, and the American River and the Sacramento River converge at the City's western-central border. Several freeways and highways cross the city, including: U.S. Highway 50, I-5, I-80, Business 80 (Capitol Freeway), State Route 160, and State Route 99. The city is dominated by 23,512 acres of residential uses (37.3%), followed by 22,061 acres of vacant and agricultural uses (35%); 4,145 acres of public, quasi-public, cemeteries and miscellaneous (6.6%); 3,388 acres of right-of-way (5.4%); 3,298 acres of industrial (5.2%); 3,203 acres of public recreation (5.1%); and 3,213 acres of commercial and office, and high-rise regional office (5%); and 295 acres of unknown non-agriculture (0.5%) (Sacramento County, 1992).

The land use pattern reflects a typical aging pattern for a city with the most intensive uses located in the "downtown" area (nearest the State Capitol) surrounded by older built-out residential neighborhoods (e.g., East Sacramento, Land Park, East Broadway, and Mid-town). The Southern Pacific Railroad provides the backbone for existing and vacant industrial uses located in the northern downtown area and extending for some distance east from the downtown area. The Arden-Arcade area in the northeast portion of the city contains a fairly high proportion of residential, commercial, and office uses. Other areas within the city are in varying stages of development. In the southern portion of the city, the South Sacramento, Meadowview, and Pocket areas range from 59% to 75% developed, primarily in residential uses. Land north of the American River (South Natomas and North Sacramento) are similarly developed (59% and 61% respectively), primarily in residential uses. North Natomas is dominated by vacant and agricultural land and is only approximately 7% developed. Community Plan areas of the City of Sacramento are shown in Exhibit 4.10-1.

The existing agricultural uses in the City of Sacramento occur primarily along the northern and southern perimeters, the western corner of the South Natomas area (north of the American River, near the Sacramento River), and the eastern portion of East Broadway (near the City's outskirts). Agricultural uses surrounding the city are located north (primarily rice fields), and to the east (ranchettes, grazing and low intensity agriculture).

City of Folsom

The City of Folsom encompasses 15,160 acres of land (23.7 square miles) including Folsom Lake. The city is generally situated north of U.S. Highway 50 and west of El Dorado County. Much of the city is undeveloped, but is undergoing rapid change and urban development (City of Folsom, 1993).

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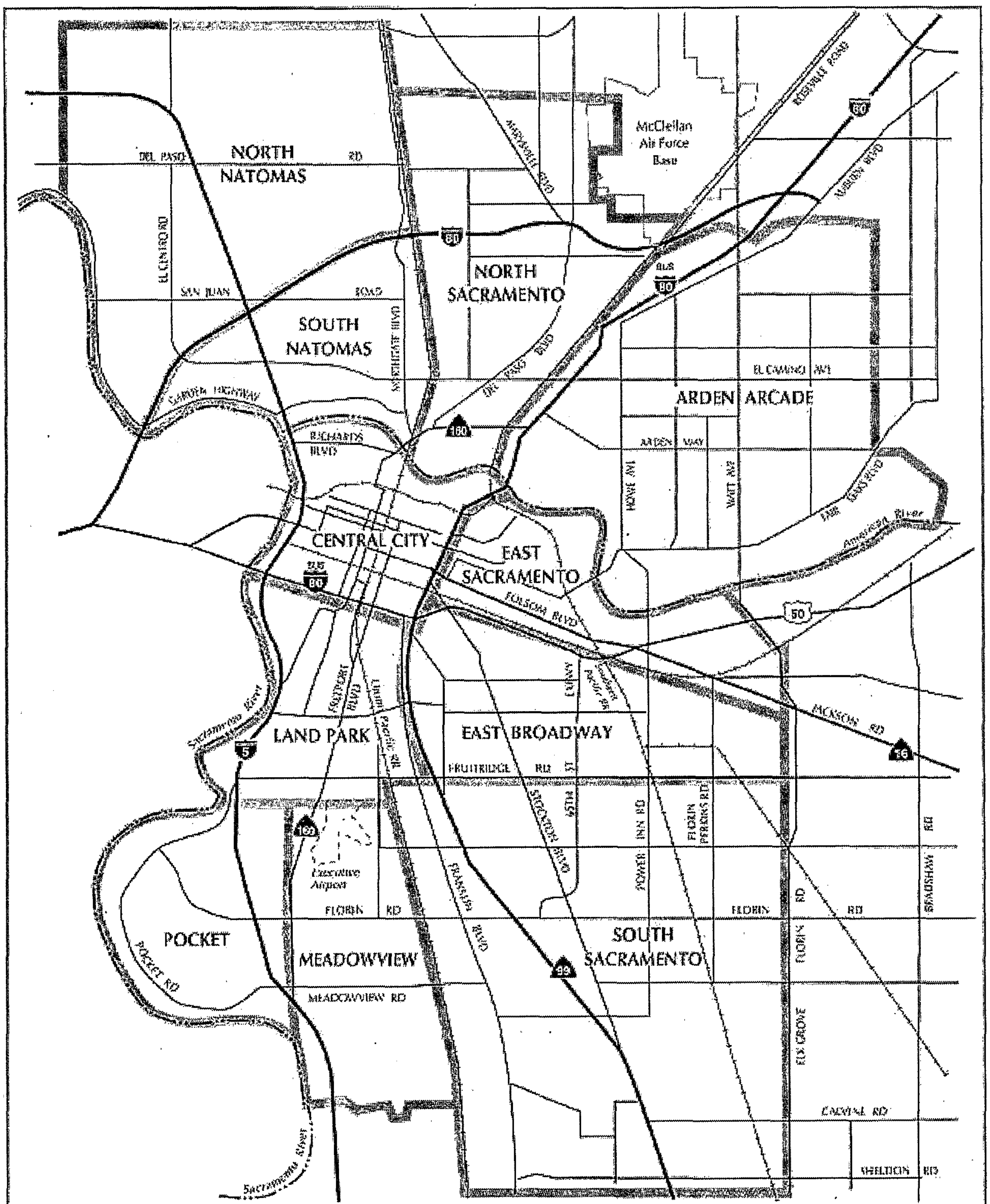

LEGEND

Community Plan Boundary

Source: City of Sacramento General Plan, 1988.

City of Sacramento Community Plan Boundaries

EXHIBIT 4.10-1

WATER FORUM PROPOSAL EIR

0 400 800 FEET NORTH

EDAW

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For the latest General Plan update in 1993, the city inventory of existing land uses included the following: approximately 12,084 acres (79.7%) of undeveloped and water area; 2,193 acres (14.5%) of single family residential; 124 acres (0.8%) of multi-family residential; 268 acres (1.8%) of commercial; 140 acres (0.9%) of industrial; 139 acres (0.9%) of office park; 129 acres (0.8%) of park; and 83 acres (0.5%) of schools.

City of Galt

The most recent land use inventory for the City of Galt (dated 1988, as reported in the Galt General Plan, adopted May 15, 1990) indicated a total incorporated area of 2,578 acres, with an additional 3,974 acres within the City's Sphere of Influence. The city is developed principally on the west side of State Route 99, in the south-central portion of the County of Sacramento. The 1988 inventory included the following land uses within the incorporated city limits: 1,580 acres of agriculture (61.3%); 521 acres of residential (20.2%); 136 acres of community uses (5.3%); 53 acres of industrial (2.1%); 23 acres of commercial/office (0.9%); and 265 acres of other uses (10.3%). Since the 1988 study, the city annexed the 58-acre Fairway Oaks residential property, and a 10-acre church site. In addition, the 2,218-acre Galt East Area Specific Plan was added to the City's Sphere of Influence. The Specific Plan and EIR for that property are under preparation (Calarco, pers. comm., 1997).

The city is organized with a commercial core and civic center surrounded with residential uses. The commercial center and civic center are near the historic district in the vicinity of the railroad. These uses are connected to State Route 99 via C Street. The residential uses are situated around retail uses within newer residential subdivisions found in the western and southern portions of town. Other retail uses are found along major streets, particularly Lincoln Avenue and North Lincoln. The few large industrial areas are located adjacent to the railroad on the west side of State Route 99 and north of the commercial and civic center. These areas are accessed from the highway by the Elm Avenue/Simmerhorn Road ramp system. Crystalite Block and Consolidated Fabricators are also large industrial users and are located east of State Route 99.

City of Citrus Heights

After initiation of the Water Forum process, the City of Citrus Heights in northeastern Sacramento County became incorporated. As a new city, it has not yet developed a detailed inventory of existing uses or adopted its own general plan. It continues to use the county's plan, and its land uses are included in the county's inventory. The city is mostly built out Land uses consist primarily of a mix of retail commercial, office commercial, and residential development. The City of Citrus Heights is served by the Citrus Heights Water District, which is a stakeholder in the Water Forum process.

Western El Dorado County

The El Dorado Irrigation District (EID) sphere of influence encompasses approximately 193,897 gross acres of land, of which 118,865 are currently within the district boundaries. The sphere of influence includes lands that, should they need public water in the future, would be expected to annex into EID (the sphere of influence identifies the expected future limits of the service district boundary). A total of 75,032 acres of land are within the EID sphere of influence, but outside the district, and consist largely of forest land, vacant rural residential, timber preserve, and similar uses. Of the 118,865 acres of land within EID, 67,457 acres are in developed residential (56.8%); 36,074 acres are vacant (30.3%); 7,665 acres are in agricultural preserve (6.4%); 2,112 acres are in developed commercial (1.8%); 1,966 acres are in timber preserve (1.7%); 1,514 acres are developed miscellaneous and "unassigned" (1.3%); 1,062 acres are in developed industrial (0.9%); and 1,015 acres are developed manufacturing uses (0.9%).

The Georgetown Divide Public Utility District (GDPUD) sphere of influence includes a total of 123,747 gross acres of land, of which 54,567 are located within the district boundaries; the remaining 69,180 acres are within the sphere of influence but outside the existing district boundaries. Of the 54,567 acres of land within the GDPUD, 27,651 acres are in developed residential (50.7%); 22,136 acres are in a variety of vacant uses (40.6%); 1,979 acres are in agricultural preserve (3.6%); 229 acres are in developed commercial (0.4%); 2,297 acres are in timber preserve (4.2%); 11 acres are developed miscellaneous (0.02%); 88 acres are in developed industrial (0.2%); 156 acres are developed manufacturing uses (0.2%); and 20 acres in mineral rights (0.03%).

The land use pattern in western El Dorado County generally concentrates urban uses in the vicinity of the U.S. Highway 50 corridor in the portion of the county west of Placerville. Rural residential and agricultural uses are located throughout the non-urbanized western portion of the county. The City of Placerville is the only incorporated city in western El Dorado County. Many smaller unincorporated communities are located throughout the rural areas of the County providing a range of commercial services and residential densities. The majority of the population within western El Dorado County is located in the unincorporated areas outside of Placerville.

Lands considered suitable for agricultural production are found predominantly in the western half of the county. According to the county's General Plan (1994), a total of approximately 115,796 acres (within the county) were classified by the Important Farmland Series maps as being suitable for agricultural production. Of these, approximately 80% of agricultural land were classified as either Unique Farmland or Farmland of Local Importance, approximately 11% were classified as Farmland of Statewide Importance and approximately 9% were classified as Prime Farmland. Historically, cattle grazing and animal husbandry have been the primary agricultural activities, accounting for approximately 44% of the county's total agricultural value in 1988. However, recent trends indicate an increase in fruit and nut production, accounting for approximately 45% of the county's agricultural value in 1993.

The majority of El Dorado County lands under Williamson Act Contracts are located within the western portion of the county. As of February 1994, there were 159 Williamson Act Contracts in effect in the county, comprising approximately 48,084 acres (El Dorado County, 1994).

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South Placer County

South Placer County contains the incorporated cities of Roseville, Rocklin, Lincoln, and Auburn, the Town of Loomis; and the unincorporated communities of Sheridan, Granite Bay, Penryn, Newcastle, and Ophir. Most of the county ' s new housing, commercial and industrial development is located within South Placer County. According to 1990 population estimates, a majority of the county ' s populàbn is located within the urbanized areas of the county (U.S. Bureau of the Census, 1990).

Domestic and agricultural water supply in Placer County is provided by either community systems or individual systems (Placer County General Plan FEIR, page 5-1, 1994). In general, community systems primarily serve urbanized areas, whereas, individual systems predominantly service rural and agricultural demands. Based on 1990 estimates, nearly 83% of all residential units within the county were serviced by community systems (public and private) and approximately 17% were serviced by individual systems (U.S. Census, 1990). Exclusive of the City of Roseville, the South Placer and Auburn-Foothills portions of Placer County roughly correspond to the service areas of Placer County Water Agency (PCWA) Zone 1, and San Juan Water District (Placer County portion). In 1990, the water demand estimates for the South Placer and Auburn-Foothills region were approximately 315,000 acre-feet (AF) per year (Placer County, 1994).

Approximately 15% of Placer County ' s total land area is devoted to agricultural use (U.S Bureau of the Census, 1996). The bulk of the county ' s agricultural activities are located within the South Placer County area, including over 86,000 acres of land enrolled in California Land Conservation Act (Williamson Act) contracts. A majority of the county ' s prime farmlandsi located in the areas west and east of the City of Lincoln. Land located in the foothill regions, between the elevations of 300 and 2,000 feet, are predominantly used for grazing. Livestock and poultry are the most valuable agricultural products of the county (Placer County, 1994).

City of Roseville

The City of Roseville extends over approximately 19,789 gross acres of land, with an additional 4,630 acres within the City ' s Sphere of Influence. Of the gross acreage, 4,207 acres include road and highway rights-of-way, easements, and other undevelopable acreage, leaving 15,582 net acres that could support development within the city.

The city is located northeast of the City of Sacramento, in western Placer County, and is accessed primarily by I-80, with the recently developed State Route 65 to the west. The city has the largest active rail yard (Southern Pacific) in the western states. The rail yard is a notable physical element that separates portions of the city. In a 1990 land use inventory, existing land uses in the city included the following: 3,272 acres of residential (21%), 898 acres of industrial (5.8%), 429 acres of commercial (2.8%), 175 acres of office (1.1%), 1,872 acres of urban reserve (12%), and 8,936 acres of other/undeveloped lands.

Planned Land Uses Within the Water Service Study Area

Descriptions of the planned land uses for jurisdictions within the water service study area are discussed below, based on general plans for jurisdictions in the area.

Unincorporated Sacramento County

The most recent update to the County of Sacramento General Plan was adopted on December 15, 1993 and is intended to guide the growth and development of the county through the year 2010. The unincorporated area of Sacramento County contains approximately 555,000 acres of land. Although the County ' s General Plan does not identify projected buildout acreage by land use type, these data were compiled for the CCOMWP water demand study (Boyle Engineering Corporation, 1995a). Planned land uses for the unincorporated county area include the following : 111,000 acres of Delta area (20%) which largely includes agriculture, waterway, and rural residential land uses; 220,000 acres (40%) of agriculture; 105,000 acres (19%) of residential; 23,000 acres (4%) of right-of-way; 23,000 acres (4%) of vacant; 22,000 acres (4%) of industrial; 18,000 acres (3%) of urban study area; 14,000 acres (2%) of public, quasi-public, cemeteries, and miscellaneous; 10,000 acres (2%) of public recreation; 7,000 acres (1%) of commercial and office, and high-rise regional office; and 2,000 acres (<1%) of mixed land use,

Since preparation of the County ' s General Plan, an updated Community Plan has bee approved by the Sacramento County Board of Supervisors for the Rio Linda and Elverta area. The Community Plan area consists of 12,433 acres in the northern portion of Sacramento County. The new Community Plan accommodates approximately 16,000 dwelling units, an includes the following approximate land use designations: 5,545 acres of agicultural-residential; 150 acres of commercial; 355 acres of industrial; and 2,420 acres of open space and agriculture.

City of Sacramento

The most recent update to the City of Sacramento General Plan was adopted on January 19, 1988. The City ' s General Plan is intended to guide thephysical growth and development of the city through the year 2006. The General Plan indicates the following mix of planned land uses: 34,465 acres of residential (54.6%); 8,770 acres of industrial (13.9%) 5,515 acres of public recreation (8.7%); 5,118 acres public, quasi-public, cemeteries and miscellaneous (8.1%); 3,693 acres of commercial and industrial (5.9%); 3,443 acres of right-of-way (5.5%); 1,624 acres of high-rise regional office (2.6%); 295 acres of unknown, non-agriculture (0.5%); and 190 acres of vacant (0.3%).

City of Folsom

The current City of Folsom General Plan was adopted on October 31, 1988 with amendments through March 1993. The Folsom General Plan is intended to guide the physical growth and development of the county through the year 2010. The population planned for in the City ' s General Plan is 69,333 (Faegans, pers. comm. 1997). The General Plan Land Use map identifies the following planned land uses: 6,132 acres of residential (40.4%); 3,030 acres of open space (20%); 1,531 acres of industrial (10.1%); 1,410 acres of undeveloped and water (9.3%); 1,329 acres of commercial (8.8%); 848 acres of Folsom Prison (5.6%); 580 acres of schools (3.8%); and 300 acres of parks (2%). The city has submitted an application for expansion of its sphere of influence which, if approved, could result in the urbanization of up to 3,584 acres presently outside the city limits.

City of Galt

The City of Galt General Plan was adopted on May 15, 1990 and is intended to guide the physical growth and development of the city through the year 2005. The General Plan anticipates that growth will occur at a fairly rapid rate to a year 2005 population of 23,500 (City of Galt, page 139, 1989). The General Plan identifies the following future land uses as necessary to support the projected population and appropriate jobs/housing balance: 1,096 acres of residential; 314 acres of community uses; 251 acres of other uses; 167 acres of commercial; and 108 acres of industrial. However, the Galt General Plan also includes the following land uses for the entire planning area: 4,739 acres residential (including agricultural-residential) (71.3%); 922 acres of open space (13.9%); 343 acres of public/quasi public (5.2%); 321 acres of industrial (4.8%); 183 acres of commercial (2.8%); and 137 acres of commercial/office (2.1%). As noted above, the 2,218-acre Galt East Area Specific Plan has been added to the City's Sphere of Influence, but land uses within that area are not yet approved. The Specific Plan and EIR are under preparation.

City of Citrus Heights

When the City of Citrus Heights, located in northeastern Sacramento County, became incorporated as the newest city in the County, it adopted the Sacramento County General Plan as its interim guide to future growth. The general plan land use designations in the County General Plan are therefore still applicable within the incorporated limits of Citrus Heights, and were included in the discussion of county planned land uses. The City will adopt its own General Plan at some time in the future.

Western El Dorado County

The most recent update to the El Dorado County General Plan was adopted on August 17, 1995. The County's General Plan is intended to guide the physical growth and development of the county through the year 2015 (El Dorado County, 1994). According to the 1995 General Plan EIR, it is unlikely that buildout of the land uses, as proposed by the General Plan, would be fully realized within the 20-year time frame of the plan. However, it is anticipated that buildout of the plan area could theoretically be achieved by the year 2031 (El Dorado County, 1994).

The El Dorado County General Plan EIR is the subject of pending litigation. However, the adopted General Plan remains in effect as the County's guide with respect to future growth and development, and is presumed valid pending a final determination of the litigation.

At buildout of the General Plan, areas located in western El Dorado County are projected to reach a population of approximately 298,000 with an estimated potential of 159,426 additional residential units. Areas of El Dorado Hills, Cameron Park, Shingle Springs, Diamond Springs, El Dorado, and Placerville are anticipated to experience the greatest increase in residential growth with a projected total population of 195,000 and approximately 65,000 residential units at buildout. The Pollock Pines, Camino, and Pleasant Valley community areas are anticipated to reach a total population of approximately 36,000 with approximately 9,900 additional residential units. Additional areas of anticipated growth include the communities of Latrobe, Somerset and Fairplay (total projected population: 16,000; additional residential units: 4,969), as well as the American River Canyon and the communities of Forest and Mosquito (total projected population: 11,000; additional residential units: 3,057) (El Dorado County, 1994).

On March 8, 1994, the El Dorado County Board of Supervisors adopted Ordinance No. 4325, called the "El Dorado County Public Water Planning Ordinance" (Water Planning Ordinance). The Water Planning Ordinance requires, among other things, the periodic collection, public review, and acceptance of water supply and demand data from certain public water purveyors, an inventory of existing and proposed unserved parcels, estimates of potential public water needs, and water availability assessments. Consistent with the Water Planning Ordinance, El Dorado County prepared an annual "Parcel and Project 1996 Year End Inventory" (Year End Inventory).

According to the Year End Inventory (1996), the El Dorado Irrigation District (EID) serves 6,087 approved residential parcels, 400 of which are in the City of Placerville. Applications are pending for an additional 897 units. In addition, outside of the existing EID boundaries, there are 1,358 approved parcels, and pending applications for an additional 908 units. The majority of the 2,266 existing or pending parcels outside the EID boundaries are within the Carson Creek Specific Plan area in western El Dorado County, south of the U.S. Highway 50. It is contemplated that EID would provide water to the Carson Creek project and others.

In the Georgetown Divide Public Utility District (GDPUD), there are currently 127 approved parcels, and applications pending for an additional 1,115 parcels. This number of new applications is largely due to the Pilot Hill Ranch project, which was not reflected in the last annual report of the Parcel and Project Year-End Inventory prepared by El Dorado County.

South Placer County

Placer County's General Plan update was completed in August 1994. The County's General Plan Update is intended to guide the physical growth and development of the county through the year 2010 and provides growth and demand projections for the years 2010 and 2040, respectively.

According to the General Plan FEIR, nearly 65% of the county's total projected growth through the year 2040 is anticipated to occur within the cities of Lincoln, Rocklin, and Roseville. The unincorporated areas of South Placer County account for approximately 16% of the total projected growth (Placer County, page I-13, 1994). In addition, projected population growth within the South Placer County area through the year 2010 would require the development of approximately 17,600 additional residential units. Approximately 29,800 residential units would be required to accommodate the growth anticipated through the year 2040 (Placer County, 1994).

City of Roseville

The most recent update to the City of Roseville General Plan was adopted on June 1, 1992. The City's General Plan Update is intended to guide the physical growth and development of the city through the year 2010. The General Plan indicates the following mix of planned land uses: 5,337 acres of residential (34.3%); 1,094 acres of commercial (7%); 935 acres of office (6%); 2,256 acres of industrial (14.5%); 3,454 acres of urban reserve (22.2%); and 2,506 acres of public/miscellaneous (16.1%). Assuming a 2010 housing stock of 35,700 units and 2.54 persons per household, the General Plan buildout population would be approximately 90,700. However, recently updated population projections prepared by the Sacramento Area Council of Governments (SACOG) estimate buildout of the General Plan to be approximately 96,000 by the year 2012.

Applicable General Plan Policies

Table 4.10-4, General Plan Policies Consistency Analysis, found at the end of this section, lists applicable General Plan policies organized by jurisdiction within the water service study area. The jurisdictions presented are: Sacramento County; the cities of Sacramento, Folsom, Galt, and Roseville; El Dorado County; and Placer County. Applicable policies include those related to the provision of adequate water supply, use of surface and groundwater, water conservation, and the protection of river habitats among other issues. These policies are discussed further under Section 4.10.3 (Water Forum Proposal Impacts).

4.10.2 THRESHOLDS OF SIGNIFICANCE

Appendix G, the Environmental Checklist of the State CEQA Guidelines, provides general guidance in the identification of circumstances that may result in a significant effect on the environment related to land use (item IX). For purposes of this analysis, land use impacts may be considered significant if implementation of the WFP would:

- Induce substantial growth or concentration of population;
- Convert agricultural land to non-agricultural use or impair the agricultural productivity of existing agricultural land; or
- Conflict with adopted environmental plans and goals of local jurisdictions, as stated in their general plans and community plans. Agricultural land use and water supply and conservation policies in the general plan are relevant to the WFP.

4.10.3 WATER FORUM PROPOSAL IMPACTS

Direct and Indirect Effect Study Areas

Impact 4.10-1

Land Use Impacts on Direct and Indirect Effect Study Areas *(i.e., in-stream and adjacent areas of Folsom Reservoir, Lake Natoma, the Lower American River, and water bodies on the CVP and SWP systems). The WFP does not define specific projects (e.g., diversion or conveyance structures, treatment facilities) that would affect land uses in the direct or indirect effect study areas. It does identify a list of projects (some of which are conceptual) required to implement the WFP, and these projects will be subject to independent project and environmental review. The WFP would not grant land use authority, nor does the Water Forum possess any power over land use decisions. Therefore, adoption of the WFP would result in* ***less-than-significant*** *land use impacts within the direct and indirect effect study areas.*

The WFP does not delineate individual water diversion or facility improvement "projects" (e.g., diversion or conveyance structures, treatment facilities) in the direct or indirect effect study areas and would not, therefore, alter existing land uses in those areas. The primary physical effect of the proposed WFP on these areas would be alteration of river flows and reservoir levels resulting from proposed diversions (see Section 4.3, Water Supply and Section 4.5, Fisheries Resources and Aquatic Habitat).

The WFP recognizes, however, projects required to implement provisions of the proposal that would be subject to independent project and environmental review; these projects are listed in the Water Forum Proposal under "Major Water Supply Projects That Will Receive Wate Forum Support Upon Signing the Water Forum Agreement." Some of these projects includ changes in existing water agreements between various purveyors and local jurisdictions or the USBR, and activation/use of existing water entitlements. These changes in agreements may or may not be considered "projects" under CEQA, but they may have indirect effects on WFP diversions and, consequently, the direct and indirect effect study areas. Again, these "projects" would be proposed by purveyors over time and would be subject to independent project and environmental review by affected agencies and governments.

Given the above considerations, the implementation of the WFP would result in less-than-significant impacts to land uses within the direct and indirect effect study areas.

Water Service Study Area

Impact 4.10-2

Land Use and Growth-Inducing Impact in the Water Service Study Area. *Implementation of the WFP would not directly alter land uses in the water service study area. The WFP is intended to provide a safe and reliable water supply for the region's economic health and planned development through the year 2030. Land use decisions would continue to be made by city and county government decision-makers with guidance provided by adopted General Plans. The WFP would accommodate substantial development, however, as it would remove this obstacle to growth. Therefore, the WFP is considered to be growth-inducing, as defined by CEQA, and the resulting land use and growth impacts would be* ***significant.***

An EIR is required to identify the growth-inducing impacts of a proposed project (Pub. Res Code §21100[b][5]). As defined in the State CEQA Guidelines §15126(f), this means the EIR must "[d]iscuss the ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment." The EIR must disclose whether a prposal "would remove obstacles to population growth (a major expansion of a waste water treatment plant, might, for example, allow for more construction in service areas)." Moreover, "it must not be assumed that growth in any area is necessarily beneficial, detrimental, or of little significance to the environment."

One of the coequal objectives of the project is to provide a reliable and safe water supply to the region through year 2030, while preserving the fishery, recreation, and aesthetic values of the Lower American River. Under the WFP, water would be provided to purveyors which serve jurisdictions in the water service study area. With sufficient water, jurisdictions can make decisions about how much and what type of development to approve, in accordance with planned land uses, recognizing that water supply is not a constraint.

The jurisdictions within the water service study area designate their current/future development pattern and land use intensity in their General Plans. While the State of California requires the preparation of General Plans for all cities and counties in the State, it does not dictate the period of time that each plan must address. The State, in fact, recognizes that effective planning period differs for individual issues. The housing element, for instance has been required to be amended every five years, while the policies for geologic hazards may remain relatively constant. The "horizon" year for each General Plan, then, is selected by each jurisdiction and is intended to set a context within which to develop goals and policies to be used for shorter term decisions.

Each of the General Plans within the water service study area was comprehensively updated at different points in time, and each has a different horizon year. The projected years of ful buildout of General Plan land uses also vary, and are generally well beyond the Plans' horizon years. Jurisdictions typically expect to update and refine their General Plans multiple times before reaching full buildout.

Land use designations established in the most recent General Plans for the jurisdictions in the water service study area represent the maximum long-term level of growth approved by city and county decision-makers. Because the WFP addresses the region's water demands through the year 2030, and the buildout years of the General Plans are not able to be precisely predicted, the reliable water supply provided by the WFP to each purveyor may fall short of, just accommodate, or exceed water demand at buildout. The diversions provided for in the WFP are intended to accommodate each agency's projected surface water need in 2030 considering such factors as projected growth rate, water rights, conservation levels, availability of alternative water supplies (e.g. other surface water or groundwater), environmental considerations, and other factors. The WFP does not propose to approve or adopt any particular level of growth or location of land use development. The WFP would not confer land use authority on the Water Forum Successor Effort or on individual signatories that do not already possess such power; land use decisions will continue to be made by the cities and counties, as guided by their local general plans and other land use regulations and determinations.

In the context of providing a reliable and safe water supply for the region's economic health and planned development, this EIR addresses growth in two respects:

- Will the WFP facilitate levels of growth contemplated in adopted general plans of the cities and counties whose purveyors are participating in the Water Forum, by reducing the constraint of water shortages and providing improved certainty with respect to future water supplies?
- In the long term, by endeavoring to provide water to satisfy projected demands to the year 2030, could the WFP foster substantial growth beyond the projected buildouts of adopted general plans?

The environmental impacts of planned growth and development are assessed in the General Plan EIRs which have been certified and approved by each jurisdiction. In accordance with CEQA, significant impacts of growth and development identified during the General Plan EIR process were either mitigated or considered and overridden. As an EIR on a long-term water plan, it is not the role of the WFP EIR to assess the specific physical impacts of growth accommodated by the water supply envisioned in the WFP in each individual city and county. Rather, the analysis that follows will identify, by jurisdiction, the amount of potential growth accommodated by eliminating water supply as an obstacle to growth.

Water Demand Projections in the Sacramento Countywide Area: The Boyle Study and Its Relationship to General Plans

The water demand assumptions that provided a starting point for the Water Forum negotiations were developed by Boyle Engineering Corporation, under contract to the City-County Office of Metropolitan Water Planning (CCOMWP). The Boyle report, entitled *Estimate of Annual Water Demand Within the Sacramento County-wide Area* (Boyle Engineering Corporation, 1995a) is incorporated herein by reference and available for review at the offices of CCOMWP and Sacramento County Department of Environmental Review and Assessment (DERA). The Boyle study used current, documented and projected land uses, along with the level of water demand per acre projected for each category of land use, to develop future projections of water demand. The study covered all incorporated and unincorporated areas of Sacramento County, except the Delta area (west of I-5 and south of Freeport). The resulting projections are shown in Table 4.10-1.

The Boyle report calculated actual water use for the year 1990 by land use category, and developed per-acre water demand factors for 15 land use categories (including agriculture, industrial, commercial and office, and four categories of residential). Current land uses were identified based on 1990 Sacramento County Assessor's parcel data. Future land uses were projected based on the land use designations in the general plans of the County of Sacramento and the cities of Folsom and Galt; City of Sacramento projections were based directly on a separate Boyle Engineering report conducted for the city in 1991, *Estimate of Ultimate Annual Water Use* (Boyle Engineering Corporation, 1991). This report is also incorporated by reference and available for review at CCOMWP and DERA.

Table 4.10-1 Initial Estimates of Annual Water Demand for the Sacramento Countywide Area [1]			
	Urban (AF/yr)	Agriculture (AF/yr)	Total (AF/yr)
1990	394,600	361,600	756,200
General Plan Buildout [2]	667,600	289,400	957,000
Ultimate Buildout [3]	765,300	262,900	1,028,200

1 Omits Delta area
2 Assumes a water conservation rate of 8%.
3 Assumes a water conservation rate of 12%.

Source: Boyle Engineering Corporation, 1995a.

Based on the projected future land uses, the Boyle report projected water use and water demand for general plan "buildout," then for "ultimate buildout," assuming water conservation rates of 8% and 12%, respectively. "Buildout" represents the geographic distribution and densities of land uses consistent with current general plan land use designations. "Ultimate buildout" is based on the Sacramento County General Plan's identification of possible urban growth areas (identified in the general plan as the "urban service area") beyond the current planning period, and the likely land use changes in these identified future growth areas as a result of future conversions of land from non-urban to urban uses. The Boyle report itself did not lead to approval of any growth; rather, it attempted to predict the type and location of future growth in the county for planning purposes.

The projected water demand numbers were then compared with water demand projections previously developed by the California Department of Water Resources (DWR) using a different methodology. DWR projections are based on population growth projections, supplied by the Department of Finance (DOF), urban per capita water demand, self-supplied industrial projections, and predictions of irrigated crop acreage and applied water per projected crop. The projections were generally consistent. The DOF population projections for the area of Sacramento County studied are shown in the box at the right.

year	population
2000	1,323,000
2010	1,573,000
2020	1,833,000
2030	2,092,000

These population projections were then used to refine the initial Boyle projections, and to derive a second set. This set of projections used a predicted year 2030 urban water conservation rate of 25.6%, which assumed the implementation of the sixteen water conservation Best Management Practices (BMPs), listed in Appendix D of this EIR. The final estimates, which were used for the Water Forum negotiations, derived a projected water demand in the year 2030 by interpolating from the buildout and ultimate buildout projections. Revised projections by demand type are shown in Table 4.10-2, and by jurisdiction in Table 4.10-3.

Table 4.10-2 Revised Projections: Population and Water Demand by Demand Type for the Sacramento Countywide Area [1]				
	Population	Urban Demand (AF/yr)	Agricultural Demand (AF/yr)	Total Demand (AF/yr)
General Plan Buildout	1,939,000	549,100	289,400	838,500
Year 2030	2,092,000 (DWR)	571,100	283,900	855,000
Ultimate Buildout	2,678,000	655,200	262,900	918,100

[1] Assumes conservation rate of 25.6% and omits Delta area.

Source: CCOMWP, 1998.

Table 4.10-3 Revised Water Demand Projections by Jurisdiction (AF) [1]				
Jurisdiction	1990 Usage	General Plan Buildout	Year 2030	Ultimate Buildout
Unincorporated Sacramento [2]	607,100	648,300	662,800	718,200
City of Sacramento	127,300	151,200	152,600	158,100
City of Folsom	17,900	31,800	32,400	34,400
City of Galt	3,900	7,200	7,200	7,300
Total Countywide	756,200	838,500	855,000	918,000

[1] Assumes conservation rate of 25.6%.
[2] Omits Delta area.

Source: CCOMWP, 1998.

As indicated in Table 4.10-2, the projected demand of 855,000 AF for the year 2030 (which was used as the basis for Water Forum negotiations) was slightly higher than the projected demand at general plan buildout for the county-wide area. In other words, buildout is projected to occur before 2030. The level of development projected at "buildout" of the general plans (for Sacramento County and the cities of Sacramento, Folsom, and Galt) corresponds to the population for that area expected to occur in approximately 2024, based on extrapolation from the DOF and DWR population projections. This estimate as to the timing of buildout is different from the general plans' various stated horizon dates. The Boyle and CCOMWP projections estimate when the land use changes that have been planned for in the general plans will occur, based on historic regional factors, as well as correlation with the DOF population projections.

Based on the information currently available and given the assumptions made in the Boyle study, it appears that the WFP, to the extent it provides a level of water supply consistent with projected year 2030 demands, eventually would result in a water supply slightly in excess of what would be required for buildout of the existing general plans in Sacramento County. (The difference between the "buildout" demand [838,500 AF/yr] and the 2030 demand [855,000 AF/yr] is 16,500 AF per year, or approximately 2%.) During the course of implementation of the WFP, it is anticipated that the general plans in the region will be updated and revised. These amendments are expected to plan for land uses after current general plan buildouts. Most of the growth beyond general plan buildout is anticipated to occur in areas presently in the unincorporated county, given that areas within incorporated cities are more built out.

The Boyle analysis calculated individual water demand projections for each water purveyor within the Sacramento County area, which served as a basis for negotiating individual diversions under the proposed WFP. These demand projections were based on land uses as governed by the applicable general plan(s) within each purveyor's service area. For purpose of this EIR the regional projections by city and total unincorporated county area are used, as they are considered more meaningful at this level of review. Future development will continue to be governed by the cities' and county's general plans.

Sacramento County

The Sacramento County General Plan Draft EIR identifies the need for over 800,000 AF of water annually to accommodate planned land uses (including Sacramento, Folsom, Citrus Heieghts[1] and Galt) through year 2010. Although this number cannot be directly compared to values determined by Boyle Engineering because of different methodologies and time horizons, this volume correlates generally with the baseline 1990 volume of 756,000 AF, the Boyle study projections for General Plan buildout (assumed to occur in 2024), and year 2030 demands estimated by CCOMWP based on the Boyle study.

Under the WFP, maximum surface water diversions to unincorporated Sacramento County entities during wet/average years would be approximately 304,500 AF. Total surface water diversions in Sacramento County, including the cities of Folsom and Sacramento, would be approximately 469,100 AF. Remaining demand would be met by groundwater. The City of Galt is supplied entirely by groundwater (refer to Table 3-1).

The total supply of surface water allocated through the WFP would fall far short of projected water demands for year 2030, and it is assumed that remaining demand would be met by groundwater supplies. The WFP would not support the growth that would substantially exceed General Plan projections for Sacramento County.

[1] The City of Citrus Heights was not incorporated at the time of the Sacramento County General Plan Draft EIR. Water demand for the city was included in the demand volume for unincorporated Sacramento County.

The Sacramento County General Plan Draft EIR identified the demand for 800,000 AF of water as a significant water supply impact (County of Sacramento, 1992). The Draft EIR Impact 4.3-6 states: "Existing surface water rights held by water purveyors within the unincorporated areas of Sacramento County are inadequate to meet future needs of projected growth without relying on use of groundwater in areas identified as having groundwater overdraft. This is considered to be a *significant impact* for the General Plan Update."

The County's General Plan Draft EIR identifies several General Plan policies that, collectively, would reduce the significant water supply impact identified for General Plan level growth to a less-than-significant level. These policies would remain in effect until amended by Sacramento County and, therefore, are applicable to land uses in the county that generate the demand for water today and into the future. In fact, the WFP would implement a number of the County's General Plan policies. These policies are indicated in Table 4.10-4 at the end of this section.

City of Sacramento

According to the City of Sacramento General Plan EIR (1987), buildout of approved land uses would result in a water demand of nearly 217,000 AF. At the time of publication of the General Plan EIR, that level of development was projected to occur in 2016.

Studies prepared by Boyle Engineering (1995a, 1995b) determined the year 2030 water demand for the city to be 152,622 AF, 22,000 AF of which is available from groundwater. Under the WFP the city has agreed to additional conservation measures to effect this demand and would divert up to 130,600 AF of surface water in 2030, for a total 2030 supply of 152,600 AF.

Due to differences in methods of calculation, horizon years, and estimated levels of conservation, water demands projected in the General Plan EIR cannot be directly compared to those of the WFP in terms of the level of development that can be supported. However, 152,600 AF is substantially less than the annual demand of 217,000 AF projected in the General Plan, so although surface water diversions contemplated in the WFP are expected to support planned development in the city to the year 2030, this level of development is not expected to exceed levels already contemplated by the City of Sacramento in the adopted General Plan.

City of Folsom

According to the City of Folsom General Plan EIR (1988), buildout of the general plan would result in an annual water demand of 45,738 AF. Based on studies prepared by Boyle Engineering (1995a, 1995b), and assuming 25.6% conservation, the CCOMWP determined the year 2030 water demand for the city to be 32,365 AF. Folsom's current projected demand for water at increased conservation, is 39,364 AF. (Sacramento LAFCO DEIR on City of Folsom Sphere of Influence Amendment, Appendix E, January 1998.)

Under the WFP the city would divert 34,000 AF of surface water in 2030. The city does not have sufficient groundwater resources to supplement its surface water supplies. Due to differences in methods of calculation, horizon years, and estimated levels of conservation, water demands projected in the General Plan EIR cannot be directly compared to those of the WFP in terms of the level of development that can be supported. However, 34,000 AF is substantially less than the annual demand of 45,738 AF projected in the General Plan, and also less than the City ' s current estimated demand for general plan buildout. Therefore, although surface water diversions contemplated in the WFP are expected to support development in the city to the year 2030, this level of development is not expected to exceed levels already approved by the City of Folsom in the adopted General Plan. WFP diversions will not provide sufficient water to meet the projected demands due to expansion of the city ' s sphere of influence.

City of Galt

According to the Galt General Plan EIR, buildout of approved land uses would result in a water demand of 7 mgd, or 7,800 AF per year. Based on studies prepared by Boyle Engineering (1995a, 1995b) the CCOMWP determined the year 2030 water demand for the city to be 7,233 AF. Although the estimated demand is expected to be sufficient to support the city's growth to the year 2030, this level of development is not expected to exceed levels already approved by the City of Galt in the adopted General Plan. The City of Galt currently relies on groundwater for its municipal water supplies and would continue to do so under the WFP.

Water Demand Estimates for the Foothill Water Interests

After initiation of the Water Forum discussions, the Foothill water interests joined the negotiations. These additional purveyors, which were not included in the Boyle study, are: El Dorado Irrigation District (EID), Georgetown Divide Public Utility District (GDPUD), Placer County Water Agency (PCWA), and City of Roseville.

As described in Section 3, Project Description, the WFP includes those agreements among stakeholder organizations that could be entered into as of the effective date of the initial agreement. However, some stakeholder organizations, including El Dorado Irrigation District and Georgetown Divide Public Utility District, have remaining issues that could not be resolved by the time of the EIR preparation. These purveyors are expected to enter into Procedural Agreements with signatories to the Water Forum Agreement, and all parties agree to work in good faith to negotiate mutually acceptable agreements to resolve remaining issues. Once resolved, the Agreement would be amended to include them.

Western El Dorado County

The water demand projections used for western El Dorado County are derived in part from studies prepared in support of the American River Water Resources Investigation (ARWRI) process being undertaken by the Bureau of Reclamation and Sacramento Metropolitan Water Authority (SMWA/USBR, 1996). The ARWRI study evaluates projected water demands based on generalized water demand rates of residential, commercial, industrial and agricultural land uses through the year 2030. The urban water demand predictions were based on the DOF population projections (using a per capita water usage), while demands for manufacturing industrial, and agricultural uses were derived from prior DWR bulletins. Agricultural use was calculated based on crop patterns and water demand for each crop type, with irrigation rates and efficiencies considered. The DWR assumed a 5 percent decrease in net irrigated crop acreage by 2030. Adjustments were made for the existence of ponds and ditch systems, which result in infiltration and evaporation losses. Calculations were aggregated by Detailed Analysis Unit (DAU) and then summed to the larger Planning Study Areas and Hydrologic Study Areas.

According to the ARWRI study, the projected year 2030 water demand for the western El Dorado County would be approximately 85,300 AF—65,300 AF for municipal, industrial, and other water demands, and 20,000 AF for agricultural uses. The ARWRI water demands were based on a projected year 2030 irrigated land area of 7,800 acres and a projected year 2030 study area population of 266,520. According to the El Dorado County General Plan EIR, a countywide population of approximately 250,000 is projected for the year 2015, with an approved General Plan buildout population of 323,000, approximately 300,000 of which would reside in the water service study area. Because the current El Dorado County General Plan is being challenged in litigation, less reliance was placed on that plan in validating demand projections.

As described in Chapter 3, Project Description, El Dorado County water purveyors had remaining issues that could not be resolved by the time of EIR preparation. These purveyors are expected to enter into Procedural Agreements with Water Forum signatories to continue to negotiate in good faith to resolve remaining issues. It is expected that upon resolution, the Agreement would be amended to include these agencies. As such, negotiated surface water diversions for El Dorado County purveyors were included in the modeling analysis of the WFP. Modeling assumes that during wet/average years, up to 67,100 AF of surface water would be used in western El Dorado County (48,400 AF by EID and 18,700 AF by GDPUD). For GDPUD, this projected demand is in addition to an assumed safe yield of 10,400 AF from the Stumpy Meadows Project; neither GDPUD nor EID have any groundwater sources. This volume of 67,100 AF represents about 79% of the ARWRI-projected year 2030 demand and less than 73% of the County's General Plan buildout demand. Therefore, if EID and GDPUD are added to the WFP, implementation of the project would not support development within western El Dorado County that would exceed buildout of the adopted General Plan or exceed population-based water demand projected by ARWRI.

South Placer County

Projected growth in South Placer County through the year 2010, according to the General Plan EIR, would result in an increased water demand of approximately 104,000 AF per year (AF/yr) over the 1990 baseline (315,400 AF/yr) for a total of 419,400 AF or an equivalent increase of nearly 33%. Projected growth anticipated through the year 2040 would result in an increased water demand of approximately 170,000 AF/yr for a total of 485,400 AF or an approximate 53% increase. According to the County General Plan FEIR, water is available to meet domestic demands resulting from development under the County's General Plan, but the western portion of the county is lacking the required facilities to adequately meet projected agricultural use demands and would require additional provisions of reliable surface water supplies. (Placer County, 1994).

The Water Forum used Placer County's west slope projections of constant 3.2% annual population growth to derive a total 2030 demand for PCWA and San Juan Water District of 70,500 AF and 25,000 AF, respectively for a total demand of 95,500 AF in wet/average years. This growth rate of 3.2% per year was within historic growth rates of 3.1 to 4% in the county since 1950, and consistent with a cumulative growth rate since 1930 of 3.4% annually.

According to the ARWRI study, year 2030 water demand for South Placer County (including cities) is projected at approximately 393,300 AF, representing a net increase of approximately 48,100 AF over 1990 demand levels. Municipal, industrial, and other demand is projected to increase by 67,800 AF (nearly 68%) from 99,300 AF to approximately 167,100 AF, while projected agricultural water demand is expected to decrease by 19,700 AF (about 8%) from approximately 245,900 AF in 1990 to approximately 226,200 AF in 2030. Projected increases in municipal and industrial water demand is the result of population growth expected in the southern portion of the county, primarily the cities of Roseville and Rocklin. Projected 2030 population for the Placer County portion of the ARWRI study area is 369,100, based on DOF information and an assumed growth rate (SMWA/USBR, 1997).

The City of Roseville, located in Placer County, is itself a stakeholder in the Water Forum process. Roseville's demand for 2030, based in part on the urban services boundary of its General Plan, was projected at 54,900 annual AF (see specific Roseville discussion, below). Assuming 2.54 persons per household and 1 AF of water per household per year, this amount of water would provide for a population of approximately 140,000; the population at buildout of the general plan is currently projected to be approximately 91,000 (City of Roseville, 1992). However, recently updated population projections prepared by SACOG estimate buildout of the general plan to be approximately 96,000 by the year 2012. In addition, the City of Roseville is considering various plans for the future annexation and rezoning of its urban reserve areas. If implemented, these plans would result in approximately 36,000 additional residents for a total projected buildout of approximately 132,000 residents (SACOG, 1995).

According to SACOG projections, the remaining incorporated communities of Auburn, Colfax, Lincoln, Loomis, and Rocklin would result in a total population of approximately 119,000 in the year 2015 (SACOG, 1995). Based on buildout of the various Placer County community plans (projected to occur prior to 2015), the remaining unincorporated areas within South Placer County would result in a population of approximately 171,000.

With a projected buildout population of 96,000 for the City of Roseville (estimated to occur in 2012), 119,000 residents in the remaining incorporated communities of Placer County, and 171,000 residents within the unincorporated areas, South Placer County would reach a population of approximately 381,000 by the year 2015. This figure is substantially greater than the ARWRI-projected population of 369,100 for the year 2030. Assuming future development of Roseville's urban reserve areas (an additional 36,000) and a continued growth rate of 3.2% per year for the remaining areas of the County, western Placer County could reach a population of approximately 490,000 residents by the year 2030.

The WFP would provide for a total surface water allocation of approximately 150,400 AF for South Placer County including PCWA, San Juan Water District, and the City of Roseville. This volume represents 112,100 AF more than the combined baseline amounts of 38,300 AF for these purveyors. Assuming the generation factor of 2.54 persons per household and 1 AF of water per household per year, these allocations would provide for a population of approximately 382,000. These year 2030 allocations for South Placer County closely correlate to SACOG's projected buildout population of 381,000 in approximately 2015. These calculations indicate that the WFP would support growth through approximately the levels projected for 2015 and therefore would not support development that would exceed buildout of the adopted General Plan.

City of Roseville

The City of Roseville receives surface water for its municipal water supplies through contracts with USBR and PCWA, and would continue to receive water from these sources under the WFP. Groundwater wells are used only for emergency backup, and would be used as an alternative supply in drier years under the WFP.

According to the Roseville General Plan EIR, buildout of approved land uses (projected to occur in 2010) would result in a water demand of 30,000 to 36,000 AF per year, with a corresponding population of approximately 91,000. However, as described above, updated population projections by SACOG estimate a population of 96,000 by 2012, and assuming annexation and rezone of its urban reserve areas, a population of 132,000 at buildout. Under the WFP, Roseville would receive up to 54,900 AF of surface water in wet/average years. Assuming an average water demand of one acre-foot per household per year, and an average household size of 2.54 persons (City of Roseville, 1992), a 2030 water supply of 54,900 AF would support a population of approximately 140,000.

The level of development in 2030 is likely to exceed the amount currently indicated by the city for the 2010 horizon year of the General Plan (as supported by the SACOG study) and additional water supplies are expected to be required. In addition, although the estimated population of 140,000 that could be supported by the water supply contemplated by the WFP exceeds the 132,000 projected by SACOG, the difference is not considered substantial given the uncertainties in water use generation factors and the long-term planning horizon. In accordance with State law, the City of Roseville will periodically update its General Plan, revising projected land uses and guiding policies, as necessary to reflect the city's vision. The city will need to consider available water supplies, appropriate levels of conservation, and environmental protection policies in its approval of future land uses.

Summary of Growth-Inducing Effects in the Water Service Study Area

The water demand projections for 2030 are estimates, based on a variety of factors, many of which cannot be determined with certainty. In all long-term water demand and population predictions some degree of uncertainty is involved. Further, approval of the WFP would not in itself guarantee the negotiated water supply to each purveyor, given that numerous interim implementation steps must occur, including approval and construction of water projects, and regulatory approvals.

Similar to water and population projections, long-range projections as to the land use and growth impacts of future water supply are inherently imprecise. Depending on the land use decisions of the cities and counties between now and 2030, more or less development could be planned and approved, or a different mix of industrial, commercial, agricultural and residential uses could occur than has been projected by Boyle, DWR, DOF and ARWRI. Constraints other than water supply could limit growth (e.g., transportation constraints; limited sewage treatment facilities; and regulatory, political, and economic factors).

The growth that will take place in the region in the next 30 years will be governed by local government decision-makers and the locally adopted general plans and other land use regulations. The WFP would have no direct influence on the land use decisions that are made, although it helps resolve one potential obstacle to growth in its planned provision of a safe and reliable water supply. It is reasonably foreseeable that, if the WFP is adopted and implemented, the approximately projected levels of growth for the year 2030 used in the Water Forum negotiations would occur.

In the context of CEQA analysis, the implementation of the WFP would facilitate growth, in that it would remove a potential future obstacle to regional growth. The safe and reliable water supply under this Proposal is necessary to accommodate growth identified and approved in existing adopted general plans. In addition, it would provide a long-term future water supply, that would in some cases increase the future potential for additional incremental growth beyond adopted general plans (as identified in Sacramento County and Roseville, based on projections). Because the WFP is contemplated to provide water supply for projected regional growth over more than 30 years, and because of the substantial amount of growth anticipated to occur during this time, this aspect of the WFP is considered to be growth-inducing.

It can be anticipated that the general impacts of the projected long-term levels of growth in the region would include: increased burdens on infrastructure including roadways, transit, schools, and other public services; increased air pollution and noise from increased traffic; overall land use changes including a reduction in land cultivated in agriculture; loss of habitat as land is developed; and loss of open space opportunities.

Implementation of the WFP could also result in secondary or indirect impacts to water quality in Folsom Reservoir, Lake Natoma, Lower American River, Sacramento River, and the Delta by accommodating planned development within the watershed. Additional urban developments could potentially increase future nutrient, pathogen, TDS, TOC, sediment, and/or priority pollutant loading from increased urban runoff and/or urban stormwater discharges. This may be particularly true during periods of the year when increased surface water diversions under the WFP result in lower storage in Folsom Reservoir and reduced river flows in the American and Sacramento River, thereby decreasing the dilution capacity in these waterbodies for a given level of constituent loading. The degree to which water quality in these waterbodies would be affected under the WFP in 2030 is believed to be primarily dependent upon: 1) future urban land-use practices; and 2) the water quality mitigation measures that would be implemented as part of new residential and industrial developments to prevent/minimize future increases in constituent loading rates. As discussed under Impact 4.4-1, in Section 4.4, seasonal reductions in dilution capacity anticipated to occur in these water bodies would not, by themselves, be expected to result in significant adverse impacts to water quality.

The degree to which increased constituent loading to the river will occur is largely dependent upon future urban land-use practices and the project-specific water quality mitigation measures implemented to prevent approved developments from increasing constituent loading to the river. Each city and county is responsible for implementing water quality management procedures in response to the requirements of the National Pollution Discharge Elimination System (NPDES). For instance, the Sacramento Stormwater Management Program (SCWA *et al.*, 1995) is being implemented by Sacramento County, and the cities of Sacramento, Folsom, Citrus Heights, and Galt to monitor and evaluate all water quality Best Management Practices required by their applicable NPDES permits. Such programs reduce the pollutant loads reaching the region's waterbodies.

Detailed project-level analysis of water quality impacts potentially resulting from future approved development within the watershed would be conducted as part of the environmental documentation prepared for specific development projects. These assessments will identify other relevant mitigation measures necessary to avoid such potential water quality impacts.

Increased diversions of surface water under the WFP would be used, in part, to supply planned residential and industrial developments with a water supply. A portion of the additional future municipal and industrial water use under the WFP would be returned to the Sacramento River system as treated effluent discharged from one of several wastewater treatment plants within the region (i.e., SRWWTP, El Dorado Irrigation District's Deer Creek WWTP, City of Roseville's WWTP, City of Auburn's WWTP, and/or the City of Lincoln's proposed WWTP). The effects that increased effluent discharge could have on Sacramento River water quality is of concern regarding potential adverse impacts to human health (from use of river water as a raw drinking water supply) and to aquatic life in the Sacramento River and Delta.

A Master Plan to expand the capacity of the SRWWTP to accommodate regional growth is currently underway. Although precise volumes are not known at this time, expansion of the SRWWTP would account for the majority of additional effluent discharge to the Sacramento River system in 2030. Potential water quality impacts of any such expansion would be evaluated in project-specific environmental documentation, and considered by County decision-makers prior to approval.

This EIR cannot analyze the precise impacts of the regional growth that may be facilitated by the WFP because of the many variables involved. With respect to land use designations already approved in adopted general plans, environmental analysis has already been completed in the general plan EIRs. For future development projects, more project-specific environmental review and analysis of impacts and mitigation measures will be required before such projects are approved.

With respect to mitigation, the measures incorporated into the WFP and measures expected to be implemented as a result of the WFP CEQA process will help to assure that a safe and reliable supply of additional water for planned growth is accomplished in an environmentally balanced manner, taking into account the fishery, recreational, and aesthetic effects of increased diversions. However, in terms of mitigating the secondary effects of long-term growth, because the Water Forum has no land use authority, its options for minimizing the adverse environmental impacts of growth are limited and no feasible mitigation measures within the Water Forum's jurisdiction are available.

General Plan Policy Consistency Analysis

Impact 4.10-3

Consistency with General Plans. *The WFP would not result in the reduction or forfeiture of existing surface water entitlements, the reduction or diminution of any existing groundwater rights, nor would it provide water purveyors, the Water Forum, or the Water Forum Successor Effort with any land use authority. Water Forum Proposal would not alter (i.e., reduce) agricultural lands within the jurisdictions of the water service study area and, consequently, would result in a* **less-than-significant** *impact to agriculture.*

The WFP states that "nothing in the Proposal is intendd to call for the reduction or forfeiture of existing surface water entitlements." Therefore, surface water entitlements that provid irrigation to agricultural lands within the water service study area would not be modified through the Proposal.

Similar to surface water, the WFP states that nothing in the WFP is intended to result in "... the reduction or diminution of any existing groundwater rights." The existing groundwate rights are not proposed for modification with the WFP. Those users with groundwater rights would maintain their ability to use groundwater for agricultural production or irrigation. The WFP would create a structure by which groundwater can be monitored and governed in the Sacramento County area, as set forth in the Groundwater Management Element. The concept for groundwater management is to establish a local Groundwater Management or other management arrangement in each of three areas within Sacramento County. (Note: the North Area Groundwater Management Authority has been successfully established.) The three areas would include the following entities:

- **North Area**: Arcade Water District, Arden Cordova Water Service (Arden area), Carmichael Water District, Citizens Utilities Company of California (portion), City of Citrus Heights, Citrus Heights Water District, City of Sacramento, Del Paso Manor Water District, Fair Oaks Water District, McClellan Air Force Base, Sacramento International Airport, Northridge Water District, Orange Vale Water Company, Rio Linda Elverta Community Water District, Sacramento County WMD (portion).

- **South Area:** Arden Cordova Water Service (Cordova area), Citizens Utilities Company of California (portion), City of Sacramento, Elk Grove Water Works, Florin County Water District, Fruitridge Vista Water Company, Mather Air Force

Base, Omochumne-Hartnell Water District (portion), Sacramento County WMD (portion), Tokay Park Water Company, Sacramento County Water Agency, Zone 40.

- **Galt Area:** City of Galt, Clay Water District, Galt Irrigation District, Omochumne-Hartnell Water District (portion).

The management entities would consist of representatives of water purveyors, agricultural uses, and self-supplied industrial groundwater pumpers. The entities would have the authority necessary to manage the groundwater in the area of the basin under their jurisdiction by:

- maintaining the long term sustainable yield;
- facilitating implementation of conjunctive use programs; and
- coordinating efforts to safeguard groundwater quality.

The WFP also states that "the authority to make land use decisions is vested in county boards of supervisors and city councils. "The Water Forum recognizes that fact ad assumed that these entities will continue to exercise this authority." The WFP provides a structure for several of the participating water purveyors to identify future growth assumptions and the necessay agreements to which they must commit to provide a safe and reliable water source for uses to the year 2030.

Impact 4.10-4

Consistency with General Plan Water Supply and Conservation Policies. *The Water Forum Proposal would not conflict with adopted environmental plans and goals of local jurisdictions, as stated in their general plans and community plans. Rather, the WFP implements many of the General Plan policies directed at the provision of water within the water service study area jurisdictions. Consequently, the WFP would result in* **less-than-significant** *impacts to adopted environmental plans and goals of local jurisdictions.*

The policies of the General Plans for the jurisdictions within the water service study area that are relevant to the proposed project are listed in Table 4.10-4, found at the end of this section. The table also presents a conclusion of "Consistency" for each policy, followed by statements supporting the conclusion. Please refer to individual policies, their conclusions and supporting statements. The conclusion of Impact 4.10-4 is based on a comprehensive review of the analysis presented in Table 4.10-4.

4.10.4 MITIGATION MEASURES

No mitigation measures are necessary for the following less-than-significant impacts:

4.10-1: Land Use Impacts on Direct and Indirect Study Areas
4.10-3: Consistency with General Plan Agricultural Land Use Policies
4.10-4: Consistency with General Plan Water Supply and Conservation Policies

The following discussion of mitigation is provided for significant and potentially significant impacts.

impact
4.10-2
mitigation

Land Use and Growth-Inducing Impact in the Water Service Study Areas

General Plan Policies for Environmental Protection. *The water supply included in the WFP has been determined considering the planned growth for each jurisdiction within the water service study area; as such, the WFP is consistent with the growth parameters described each city and county General Plan. The General Plan of each jurisdiction includes policies and programs for the protection of the environment and, to the extent feasible, the avoidance or mitigation of significant effects on the environment from planned growth and development. During the normal course of each jurisdiction's implementation of its General Plan policies, feasible mitigation of significant impacts from planned growth and development would occur. Because mitigation of growth-related environmental impacts is in the purview of each city and county, through their existing land use authority, and because the Water Forum itself has no such authority, the WFP cannot feasibly provide for additional mitigation of growth-related land use and development environmental impacts.*

4.10.5 LEVEL OF SIGNIFICANCE AFTER MITIGATION

Since the adoption and implementation of land use and development-related mitigation measures is the responsibility of the cities and counties, the Water Forum cannot assure that growth-related environmental impacts can be reduced to less-than-significant levels. Consequently, to fulfill the disclosure requirements of CEQA, this EIR must indicate that growth and land use impacts are considered significant and unavoidable.

4.11 AESTHETICS

The following section addresses the existing visual conditions and visual quality issues related to the implementation of the WFP. The existing visual environment is described first, followed by a discussion of the environmental effects of the project, and the mitigation measures necessary to alleviate any identified significant adverse impacts.

4.11.1 EXISTING CONDITIONS

LOWER AMERICAN RIVER

The Lower American River has been designated a "Recreational River" in the National and State Wild and Scenic Rivers systems. All rivers designated as wild, scenic, or recreational by the federal government and the State of California are considered to exhibit high scenic quality. In contrast to the surrounding urban development, the overall visual character of the Lower American River consists of steep bluffs, terraces, islands, backwater areas, and riparian vegetation.

Based on visual characteristics, the Lower American River has been divided into three distinct visual components (SAFCA/USBR, 1994). The upper visual component extends from Nimbus Dam downstream to the Gristmill Dam Recreation Area, located approximately two miles upstream of the Watt Avenue Bridge. This component contains the most visual variety and is, therefore, considered the most visually sensitive. The visual corridor along this portion of the river includes steep bluffs, terraces, riparian vegetation, and shallow water areas (Exhibit 4.11.1). This area is commonly viewed by travelers crossing the Sunrise Avenue Bridge.

The middle visual component of the Lower American River extends from the Gristmill Dam Recreation Area downstream to just below the Howe Avenue Bridge. This second component has less visual variety than the upper section of the river. The visual corridor along this portion of the river consists primarily of moderately sloped embankments, riparian vegetation, and shallow water areas (Exhibit 4.11.2). This second component of the river is commonly viewed by travelers crossing the Howe Avenue and Watt Avenue bridges.

The lower visual component extends from the area just below the Howe Avenue Bridge downstream to the Sacramento River. Of the three components, this component exhibits the least visual variety. Artificial bank protection developed for flood protection purposes becomes increasingly evident within this area of the river, and the Fairbairn Water Treatment Plant intake facility is a noticeable feature in the otherwise natural setting of the Lower American River. However, the visual corridor along this component of the river is still a complex environment, including areas of gravel banks, riffles, and ponds (Exhibit 4.11.3). This component of the river is commonly viewed from multiple locations including Howe Avenue and the H Street bridges.

LAKE NATOMA

Lake Natoma is the regulating reservoir for releases from Folsom Dam. It is a long, narrow lake. Land surrounding Lake Natoma is largely undeveloped and consists primarily of wooded and undeveloped canyon areas, sheer bluffs, and dredge tailings (cobble piles). The dredge tailings are remains from the gold mining era and are typically unvegetated. Some urban development in Folsom is visible from Lake Natoma. The Lake Natoma bluffs, which rise nearly 150 feet in elevation, offer views overlooking the lake and panoramic views of the Sierra Nevada and the Sacramento Valley. Lake Natoma, its shoreline and bluffs, are considered very scenic (Exhibit 4.11.4) (CDPR, 1978).

FOLSOM RESERVOIR

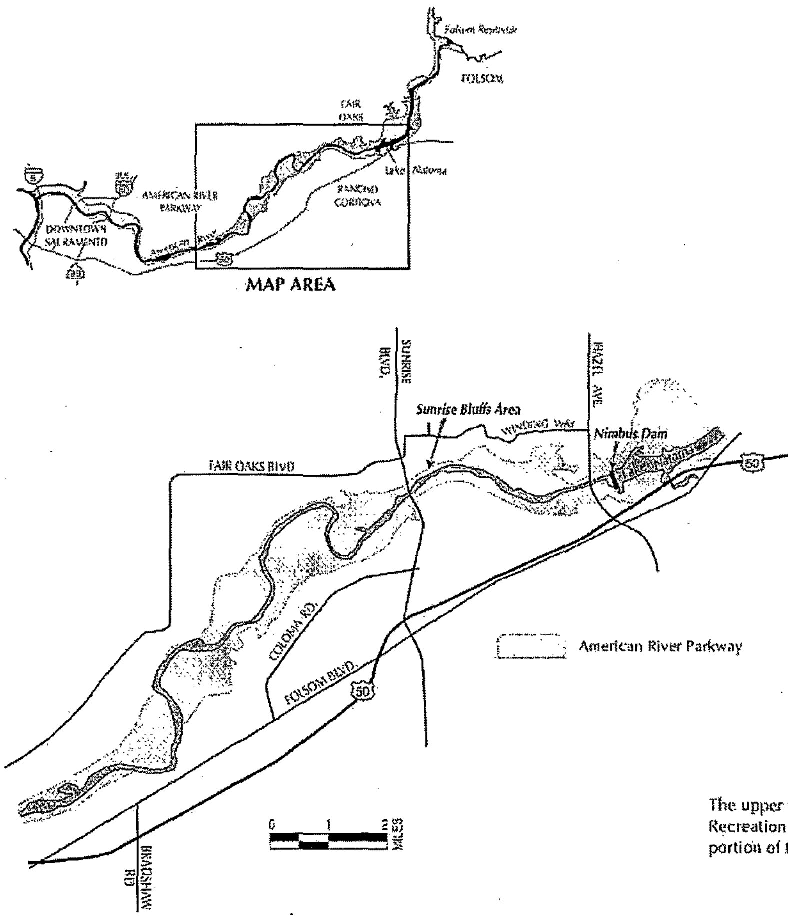
Folsom Reservoir is a man-made reservoir consisting of nearly 75 miles of shoreline surrounded by upland forest communities. In general, the shoreline of the reservoir consists of non-native grasses, steep embankments, and rolling, wooded foothills. During dry years and summer months, the water surface elevation is often low, creating a drawdown zone along the water edge that is largely devoid of vegetation. One of the more popular overlooks of Folsom Reservoir is located immediately south of Folsom Dam (See Exhibit 4.11.5). Views of Folsom Reservoir have become increasingly limited due to restricted access and residential development abutting public lands and recreation areas (SAFCA/USBR, 1994).

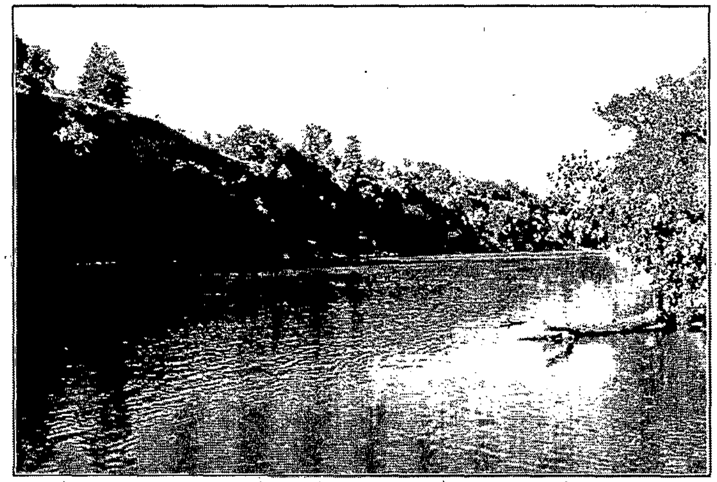
UPPER SACRAMENTO RIVER AND RESERVOIRS

The upper Sacramento River is generally defined as the area of the river extending from Keswick Dam downstream to the confluence with the Lower American River near the City of Sacramento. In general, the visual corridor of the upper Sacramento River can be divided into two distinct components (SAFCA/USBR, 1994). The first component consists of the upper approximately 56 mile stretch of the Sacramento River from Keswick Reservoir downstream near the town of Red Bluff and includes areas of riffles, runs, glides and shallow pools bordered by steep hills and bluffs.

The second component of the upper Sacramento River extends from Red Bluff downstream to the confluence with the American River and is largely confined by levees and rock revetment bank protection. Agricultural land uses abut much of the upper Sacramento River downstream of Red Bluff. As a result, this second component has less visual variety and is considered less pristine in appearance than the upper section of the river.

Shasta, Keswick, Trinity, and Whiskeytown reservoirs are located at the northern end of the upper Sacramento River within the Whiskeytown-Shasta-Trinity National Recreation Area (NRA). As such, Shasta, Trinity, and Whiskeytown reservoirs are recognized under the NRA objective, which protects lands of recreational and scenic value (USBR, 1997). Keswick Reservoir serves as a regulating reservoir for releases from Shasta Lake. Lands adjacent to these





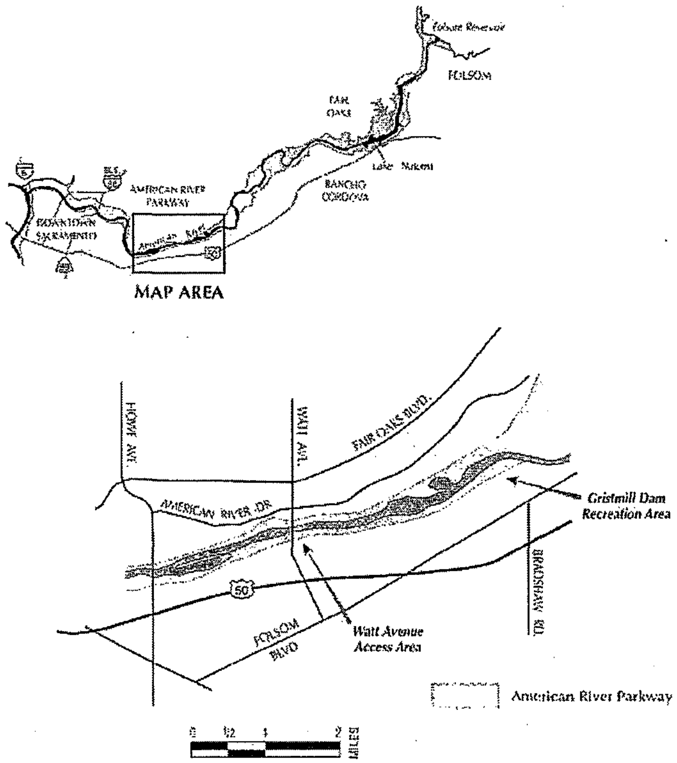
View of Lower American River near Sunrise Bluffs Area. River Flow Rate: 2,250 cfs.

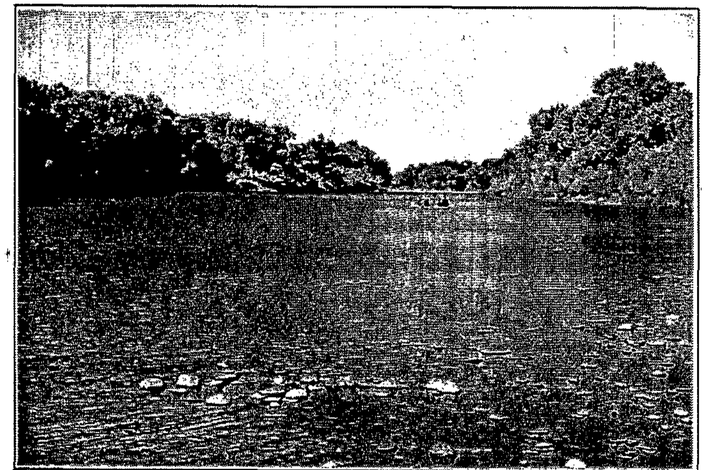
The upper visual component of the Lower American River extends from Nimbus Dam downstream to the Gristmill Recreation Area, located approximately two miles upstream of the Watt Avenue Bridge. The visual corridor along this portion of the river includes steep bluffs, terraces, riparian vegetation, and shallow water areas.

Source: EDAW, 1997.

Lower American River - Upper Visual Component (Nimbus Dam Downstream to Gristmill Dam Recreation Area)

EXHIBIT 4.11-1




View of Lower American River near Watt Avenue Access Area. River Flow Rate: 2,250 cfs.

The middle visual component of the Lower American River extends from the Gristmill Dam Recreation Area downstream to just below the Howe Avenue Bridge. The visual corridor along this portion of the river consists primarily of moderately sloped embankments, riparian vegetation, and shallow water areas.

Source: EDAW, 1997.

Lower American River - Middle Visual Component (Gristmill Dam Recreation Area Downstream to Below Howe Avenue Bridge)

EXHIBIT 4.11-2

NORTH EDAW

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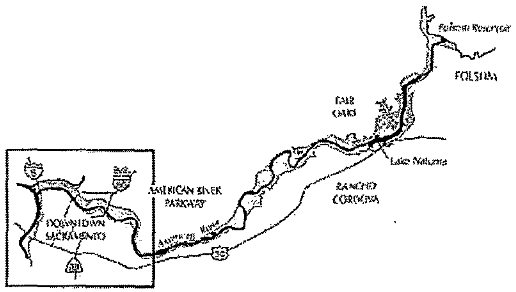
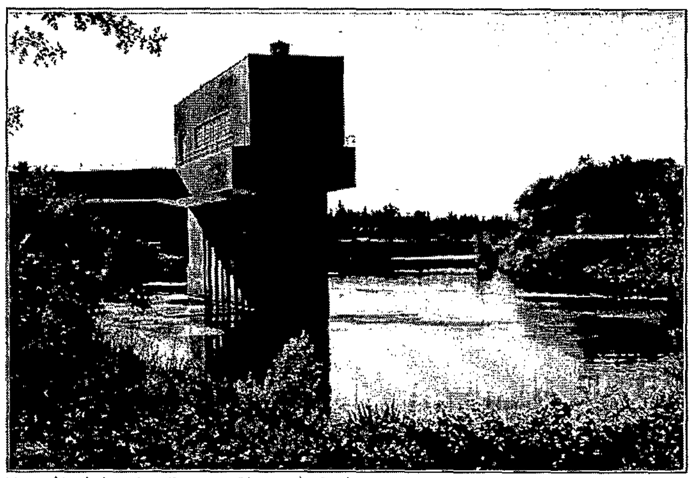
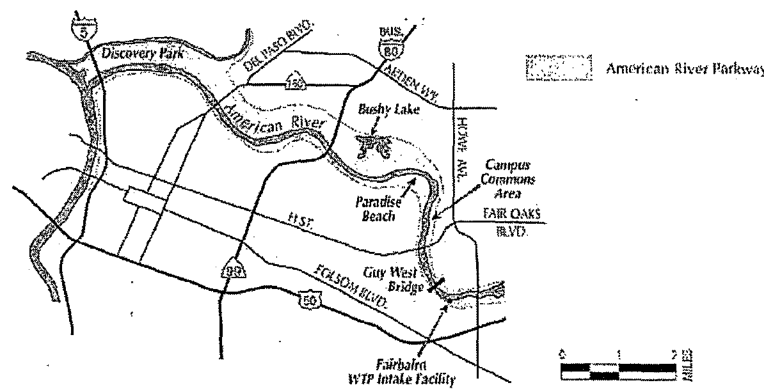


View of Lower American River near Campus Commons Area. River Flow Rate: 2,250 cfs



View of Fairbairn Water Treatment Plant Intake Facility.

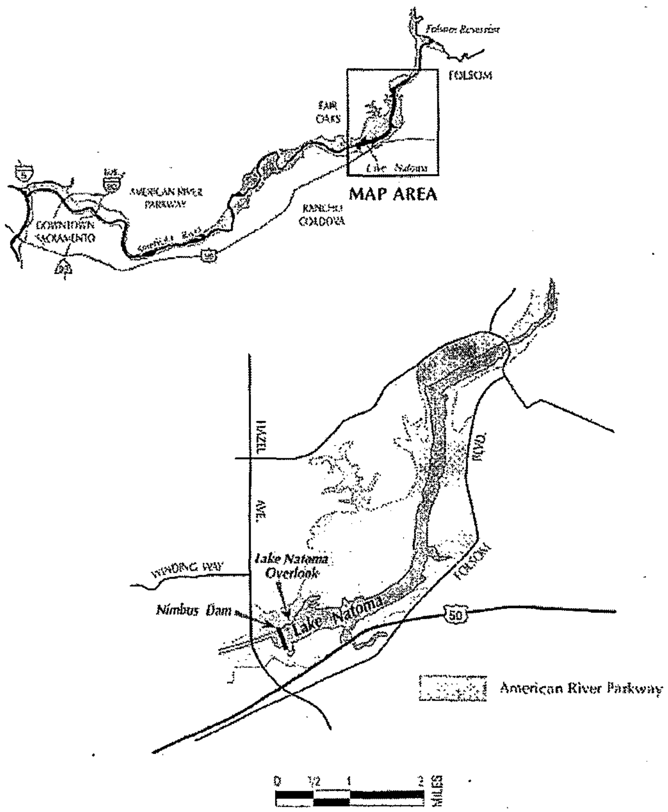


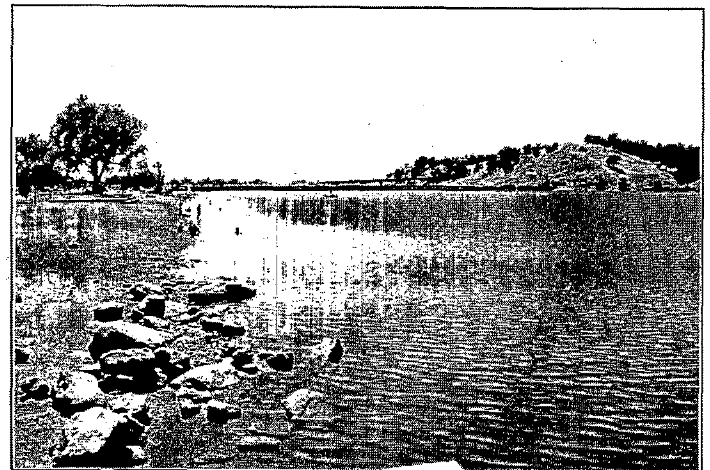
The lower visual component of the Lower American River extends from the area just below the Howe Avenue Bridge downstream to the Sacramento River. Artificial bank protection developed for flood protection purposes becomes increasingly evident within this area of the river. The Fairbairn Water Treatment Plant intake facility is also located within this lower component. However, the visual corridor along this component of the river is still a complex environment, including areas of gravel banks, riffles, and ponds.

Source: EDAW, 1997.

Lower American River - Lower Visual Component (Below Howe Avenue Bridge Downstream to the Sacramento River)

EXHIBIT 4.11-3



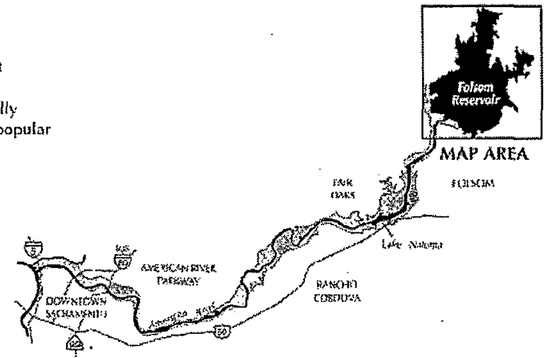


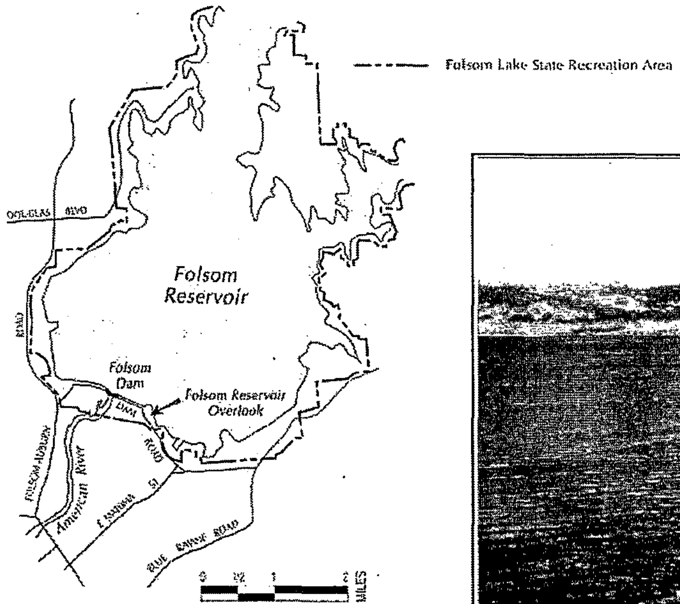
View of Nimbus Flat (area to the left), Nimbus Dam (center), and the lake overlook on the bluff (upper right).

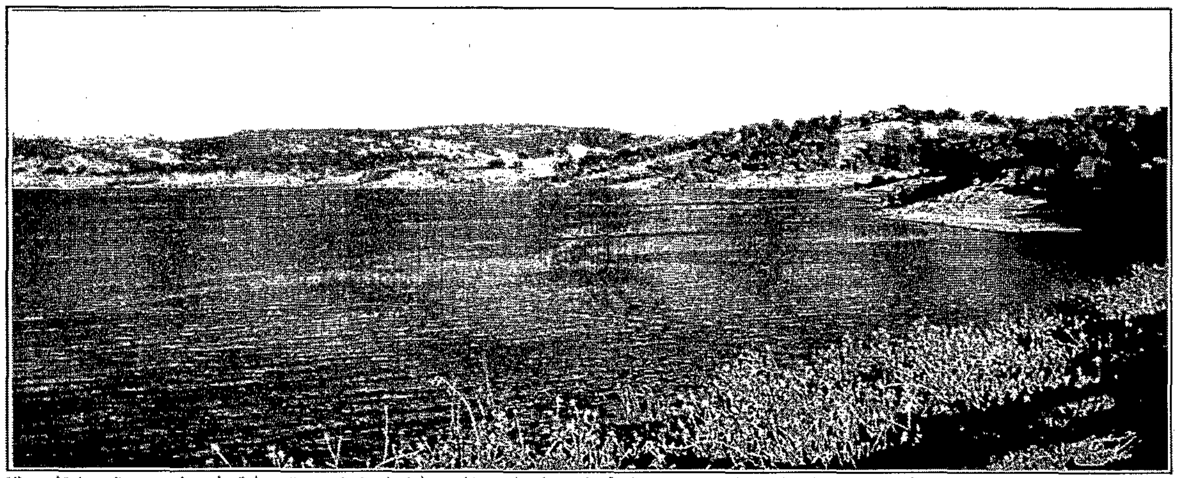
Lake Natoma is a small, narrow lake often described as a "wide spot in the river." Land surrounding Lake Natoma is largely undeveloped and consists primarily of wooded and undeveloped canyon areas, sheer bluffs, and dredger tailings (cobble piles). The Lake Natoma Bluffs, which rise nearly 150 feet in elevation, offer views overlooking the lake and panoramic views of the Sacramento Valley and the Sierra Nevada.

Source: EDAW, 1997.

Folsom Reservoir is a man-made reservoir consisting of nearly 75 miles of shoreline surrounded by upland forest communities. In general, the shoreline of the reservoir consists of non-native grasses, sandy beaches, steep embankments, and rolling, wooded foothills. During dry years and summer months, the reservoir level is typically reduced creating a drawdown zone along the water edge that is largely devoid of vegetation. One of the more popular overlooks of Folsom Reservoir is located immediately south of Folsom Dam.







View of Folsom Reservoir from the Folsom Reservoir Overlook located immediately south of Folsom Dam. Surface water elevation: 427 feet.

Source: EDAW, 1997.

Folsom Reservoir

WATER FORUM PROPOSAL EIR

EXHIBIT 4.11-5

EDAW

C-090473

reservoirs consist primarily of steep slopes, upland vegetation, and coniferous forests. Shoreline areas are largely undeveloped. The shorelines of these reservoirs vary from steep and rocky banks to coves of wooded flats. In addition, due to fluctuations in water surface elevations, significant drawdown zones are evident along the shorelines of these reservoirs throughout much of the year. Due to changes in water surface elevation and wave action from wind and boats, limited vegetation exists within these drawdown zones (SAFCA/USBR, 1994).

LOWER SACRAMENTO RIVER

The lower Sacramento River is generally defined as the area of the river extending from its confluence with the Lower American River downstream to the Sacramento-San Joaquin Delta. Artificial bank protection (developed for flood protection purposes) is increasingly evident within the lower stretch of the river and has resulted in a substantial loss of native riparian vegetation. Much of the lower Sacramento River is now leveed and bordered by agricultural land (SAFCA/USBR, 1994). As a result, the visual character of the lower Sacramento river is not considered distinctive (USBR, 1997).

SACRAMENTO-SAN JOAQUIN RIVER DELTA

The Sacramento-San Joaquin River Delta spans a vast low-lying flat area at the confluence of the Sacramento and San Joaquin rivers. Lands in the Delta region are frequently characterized as two distinct geographic and visual components commonly referred to as the lowlands, ranging from below sea level to approximately 10 feet above mean sea level (msl); and the upland plain, ranging from approximately 10 to 100 feet msl (DWR/USBR, 1996).

In general, the lowlands consist primarily of relatively flat agricultural land uses interspersed with rivers, levees, and canals. Wetlands and areas of riparian vegetation are present along many of the waterways. Occasional, scattered clusters of trees, as well as rural residential and commercial development also occur within the lowland area of the delta region (DWR/USBR, 1996).

The upland plain provides for a transition from the lowlands to the foothills of the Mount Hamilton, Altamont, and Diablo ranges. In contrast to the lowlands, increased diversity in vegetation, landforms, waterforms, and development patterns occur within the upland plain areas. A substantial increase in agricultural, residential, and commercial land uses is evident within this component, which has resulted in a significant alteration of natural vegetation. Typical vegetation occurring within undeveloped areas consists of grasslands, scattered oaks, and riparian vegetation. Waterforms within this component include rivers, streams, agricultural ponds, and drainage/irrigation canals, but are less abundant than in the lowlands. Larger communities of rural to low-density residential development are also present within the upland plain (DWR/USBR, 1996).

4.11.2 THRESHOLDS OF SIGNIFICANCE

Appendix G, the Environmental Checklist of the State CEQA Guidelines, provides general guidance in the identification of circumstances that may result in a significant effect on the environment related to aesthetics. For purposes of this analysis, and in accordance with the State CEQA Guidelines, visual impacts may represent a significant impact if implementation of the WFP would:

- have a substantial adverse effect on a scenic vista;
- substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway;
- substantially degrade the existing visual character or quality of the site and its surroundings; or
- create a new source of substantial light or glare that would adversely affect day or nighttime views in the area.

Certain uses are considered more sensitive to visual change than others. The analysis of visual impacts is considered generally subjective, as sensitivity to change in the visual environment varies and individuals respond differently to these changes.

RIVER FLOWS

Discernible aesthetic impacts along river corridors are primarily associated with adverse impacts to localized vegetation. Significant reductions in river flow can result in a reduced expanse of the water area, which can result in the thinning of the riparian corridor, loss of valuable border zone vegetation, and subsequent degradation of wildlife habitat (Sands *et al*, 1985). As a result, significant aesthetic effects would be based primarily on the thresholds identified for vegetation and wildlife habitat. In addition, refer to Section 4.8, Vegetation and Wildlife.

SURFACE WATER ELEVATIONS OF RESERVOIRS

In general, it is assumed that reductions in surface water elevations of greater than 10 feet are discernible by the general public and reduction of 15 feet or more are demonstrably negative, when they occur with sufficient frequency to be noticed. Other environmental studies have used similar thresholds (SAFCA/USBR, 1994). As a result, significant aesthetic effects would be based primarily on the frequency in which surface water elevation of reservoirs would be reduced more than 10 feet, in comparison to base conditions.

4.11.3 WATER FORUM PROPOSAL IMPACTS

WFP impacts are described below for the direct effect study area (i.e., Lower American River, Folsom Reservoir, and Lake Natoma) and the indirect effect study area (i.e., upper and lower Sacramento River; Shasta, Trinity, Keswick, and Whiskeytown reservoirs; and Sacramento-San Joaquin River Delta).

This section does not address the aesthetic impacts resulting from development served by WFP diversions. The WFP is intended to serve planned growth and development within the water service study area. Aesthetic impacts associated with such development is addressed in the General Plans of each jurisdiction within the water service study area. It is recognized that the

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WFP addresses water demands through the year 2030, and that General Plans that apply to the water service study area have horizon years that occur sooner (e.g., 2006 for the City of Sacramento, 2010 for Sacramento and Placer counties and the City of Folsom). However, in most cases, the General Plans project a total buildout level of growth that substantially exceeds the amount anticipated by the General Plan horizon years. Refer to Section 4.10, Land Use; and Chapter 5, Growth-Inducing Impacts, for a discussion of development related impacts.

Direct and Indirect Effect Study Areas

Lower American River

Impact 4.11-1

Aesthetic Value of the Lower American River. *Compared to existing conditions, diversions accommodated by the WFP would not result in substantially reduced flows such that adverse visual impacts would occur. Nor would flows be reduced below that necessary to support riparian vegetation and wildlife habitat within the Lower American River corridor. Because WFP conditions would not result in the thinning of the riparian corridor, or the loss of valuable border zone vegetation and habitat, the aesthetic effects of WFP conditions on the Lower American River are considered* ***less than significant.***

One of the coequal objectives of the WFP is to "preserve the fishery, wildlife, recreational, and aesthetic values of the Lower American River." In general, implementation of the WFP would result in an increase in water diversions, which would result in changes in river flow patterns. Because diversions from the Lower American River are based on maintaining adequate instream flows for fishery, wildlife, recreational, and aesthetic values (based on the Hodge standard) and because fluctuations in river flows are a common occurrence along the Lower American River, changes in river flow patterns would not be considered a significant aesthetic effect.

Urban riparian areas are considered to be of great aesthetic value, especially within California's Central Valley area where riparian corridors provide for a variety of recreational and interpretive activities and act as buffers between heavily urbanized areas and adjacent rivers. Likewise, the aesthetic value of the Lower American River corridor is directly related to the presence of a wide expanse of river supporting dense stands of diverse riparian vegetation, and the sights and sounds of wildlife. Significant reductions in river flow rates would result in a reduced expanse of the river, which can result in the thinning of the riparian corridor, loss of valuable border zone vegetation, and subsequent degradation of wildlife habitat (Sands, 1985).

As discussed in Section 4.8, cottonwoods are considered a key indicator species for overall health of the riparian vegetation within the Lower American River corridor. As a result, the representative growth season for riparian vegetation is during the months of March through October with the peak growth season occurring during the months of April through July.

During the growing season, implementation of the WFP would result in a mean monthly flows staying above the minimum and within the optimal flow ranges less often than under base conditions. The effect of the WFP conditions is most evident during the later months of the growing season (June - October) resulting in 3 to 10 fewer years of the 70-year record in which flows would be above the minimum requirement necessary for the maintenance of riparian vegetation. However, as discussed in Section 4.8, Vegetation and Wildlife, Lower American River flows during the critical months of the growing season (March - July) would not vary substantially from existing conditions. As a result, the Lower American River under WFP conditions would retain sufficient flows necessary for the maintenance of riparian vegetation. Furthermore, the higher flows needed for seed dispersal would occur with sufficient frequency to maintain the riparian forest community. Because WFP conditions would not result in the thinning of the riparian corridor, or the loss of valuable border zone vegetation and habitat, the aesthetic effects of WFP conditions on the Lower American River are considered less than significant.

Upper and Lower Sacramento River and Sacramento-San Joaquin River Delta

Impact 4.11-2

Aesthetic Value of the Upper Sacramento River, Lower Sacramento River, and Sacramento-San Joaquin Delta. *Compared to existing conditions, additional diversions under the WFP would not result in a substantial reductions in water flows such that adverse visual impacts would occur. Nor would flows be reduced below that necessary to support riparian vegetation and wildlife habitat within the upper and lower Sacramento River and the Sacramento-San Joaquin River Delta. For example, reductions in Sacramento River flows, under WFP conditions, would vary from base conditions by approximately 3% or less during the growing season months (March - October). Consequently, this impact is considered* ***less than significant.***

As discussed in Section 4.8, Vegetation and Wildlife, the primary growing season for riparian vegetation within this region occurs during the months of March through October.

Under WFP conditions, reductions in mean monthly flows on the Sacramento River would vary from base conditions by approximately 3% or less during the months of the growing season As a result, changes in river flows would not be of sufficient magnitude or frequency to result in the thinning of the riparian corridor, loss of valuable border zone vegetation, or subsequent degradation of wildlife habitat. Because fluctuations in river flow patterns are a common occurrence along the Sacramento River, and because reduced flows resulting from implementation of the WFP would not significantly alter existing riparian vegetation, the aesthetic effects of WFP conditions along the Sacramento River and the Sacramento-San Joaquin River Delta are considered less than significant.

Lake Natoma, Whiskeytown and Keswick Reservoirs

Impact 4.11-3

Aesthetic Value of Lake Natoma, Whiskeytown, and Keswick Reservoirs. *Compared to existing conditions, implementation of the WFP would not result in substantial changes in the frequency or magnitude of surface water elevation changes at these reservoirs. Consequently, the aesthetic quality of these reservoirs would not be expected to change substantially, relative to existing conditions. This impact is considered* ***less than significant.***

Lake Natoma and Keswick Reservoir serve as regulating reservoirs for releases from Folsom and Shasta dams, respectively. Whiskeytown Reservoir releases to the Upper Sacramento River via Keswick Reservoir, and functions as a regulating reservoir for diversions from the Trinity Lewiston Unit.

Under WFP conditions, although diversions and release schedules would change, they would not alter the function of Lake Natoma, Keswick, and Whiskeytown reservoirs as regulating reservoirs. As a result, even though water release patterns would be different than base conditions, the normal operations of these reservoirs is not expected to change substantially and surface water elevations at these lakes are expected to operate within the same range as the base condition. Therefore, aesthetic impacts to these regulating reservoirs are considered less than significant.

Folsom, Trinity, and Shasta Reservoirs

Impact 4.11-4

Aesthetic Value of Folsom Reservoir. *Compared to existing conditions, implementation of the WFP would result in mean monthly surface water elevation decreases of greater than 10 feet at Folsom Reservoir. However, because the frequency of such reductions would be minimal (less than 3 percent during a seventy year hydrologic cycle), the aesthetic effect of the WFP's reduction in surface water elevations at Folsom Reservoir is considered* ***less than significant.***

In general, fluctuations in surface water elevations are considered an accepted feature of these reservoirs. However, significant decreases in surface water elevations can result in an increase in the drawdown zone around the rim of the reservoir. Because drawdown zones are typically unvegetated, decreases of greater than 10 feet are generally considered to be visually significant.

For this reason, the analysis of aesthetic impacts was based on a comparison of base conditions and WFP modeling results (over a 70-year hydrologic record) for the determination of the magnitude of reductions in surface water elevations at these reservoirs.

Table 4.11.1 presents the number of years of the 70-year hydrologic period of record in which implementation of the WFP would result in reductions of mean surface water elevations of greater than 10 feet, within specified ranges. As shown, a majority of the decreases in surface water elevations would range from 10 to 15 feet at Folsom Reservoir. However, because the frequency of such reductions would be minimal (less than 3 percent), the aesthetic effect of the WFP ' sreduction in surface water elevations at Folsom Reservoir is considered less than significant.

Impact 4.11-5

Aesthetic Value of Trinity and Shasta Reservoirs. *Compared to existing conditions, implementation of the WFP would result in mean monthly surface water elevation decreases of less than 10 feet at Trinity and Shasta reservoirs. For example, during the 70-year hydrologic period of record, surface water elevation reductions would range from 3.3 to 4.8 feet at Trinity Reservoir and from 2.6 to 4.6 feet Shasta Reservoir. Because reduction in surface water elevations at Trinity and Shasta Reservoirs would be less than 10 feet, this impact is considered* ***less than significant.***

Table 4.11-1
Impacts on the Aesthetic Value of Folsom Reservoir

Month	Reductions in Mean Monthly Surface Water Elevations[1]			
	≥10 <15 ft	≥15 <20 ft	≥20 ft	TOTAL
January	2	2	0	4
February	1	1	0	2
March	2	0	0	2
April	2	0	0	2
May	0	1	0	1
June	1	0	0	1
July	1	0	0	1
August	1	0	0	1
September	2	0	0	2
October	2	0	0	2
November	2	0	0	2
December	4	0	0	4
Totals	20	4	0	24
Percent[2]	2	<1	0	<3

1 Number of years, based on a 70-year hydrologic record, when reservoir surface water elevations with implementation of the WFP would be lower, by the specified range, than base conditions.
2 Percentage of increased occurrences based on a 12- month, 70-year hydrologic record.

Source: EDAW, 1998; SWRI, 1998.

Although fluctuations in surface water elevations are considered an accepted feature of these reservoirs, decreases of greater than 10 feet are generally considered to be visually significant. For this reason, the analysis of aesthetic impacts was based on a comparison of base conditions and WFP modeling results for the determination of the magnitude of reductions in surface water elevations at these reservoirs.

WFP conditions would result in surface water elevation reductions ranging from 3.3 to 4.8 feet at Trinity Reservoir and from 2.6 to 4.6 feet Shasta Reservoir. Compared to existing conditions, implementation of the WFP would result in mean monthly surface water elevation decreases of less than 10 feet at Trinity and Shasta reservoirs. Consequently, the aesthetic effect of the WFP ' s reduction in surface water elevations at these reservoirs is considered less than significant.

4.11.4 MITIGATION MEASURES

No mitigation measures are necessary for the following less-than-significant impacts:

4.11-1:	Aesthetic Value of the Lower American River
4.11-2:	Aesthetic Value of the Upper Sacramento River, Lower Sacramento River, and Sacramento-San Joaquin Delta
4.11-3:	Aesthetic Value of Lake Natoma, Whiskeytown, and Keswick Reservoirs
4.11-4:	Aesthetic Value of Folsom Reservoir
4.11-5:	Aesthetic Value of Trinity and Shasta Reservoirs

4.12 CULTURAL RESOURCES

The cultural resources study discussed in this section is based on a large-scale record search of documents at the North Central Information Center (CSUS) and the Northwest Information Center (Sonoma State University) of the California Historical Resources Information System. This record search updated a previous search conducted in 1995 for a separate project.

The results of the record search are used in this section to document the relative numbers and types of archaeological and historical resources already recorded in the study area (defined below), to identify those areas not already surveyed for cultural resources, and to assess the likelihood that these unsurveyed areas will prove to contain additional sites and features. All of this information is summarized under the heading of Existing Conditions. Next, PROSIM hydrological modeling data is interpreted to estimate the impacts on important cultural resources from predicted changes in reservoir levels and river flows; this is included under WFP Impacts (Section 4.12.4). The final sections provide recommended measures for mitigating those impacts (Mitigation Measures and Level of Significance after Mitigation).

Several of the facilities involved in the project have been studied or are being studied under existing or pending environmental documents. For those facilities, this study was designed to include only a review of the cultural resources element of those documents, to confirm that they adequately address the issue of important cultural resources and compliance with CEQA.

CULTURAL RESOURCES STUDY AREA

The project area is located primarily within Sacramento County, with adjacent portions in western Placer and El Dorado counties. This cultural resources study considers potential impacts on specific water courses and reservoirs from increased water diversions, and to locations of proposed or existing pipelines, diversion points, and water treatment facilities These are listed below and conform to the direct effect study area (see Exhibit 3-2):

Water Courses and Reservoirs

- The Lower Sacramento River from the Sacramento/Sutter County line to the town of Freeport;
- The Lower American River from Folsom Reservoir to the confluence of the American and the Sacramento rivers;
- Folsom Reservoir; and
- The North Fork of the American River from Folsom Reservoir upstream to near the town of Auburn.

Proposed and Existing Facilities

- Fairbairn WTP (existing, possible expansion);
- An expanded SRWTP (existing) or new diversion facility at Interstate 5/ American River (proposed);
- A new diversion facility and water treatment facility on Sacramento River north of American River confluence (proposed);
- Folsom South Canal (existing);
- A South Fork American River diversion facility east of Folsom Reservoir (proposed);
- A new re-aligned Natoma Pipeline (proposed); and
- A new permanent pumping station on North Fork American River near Auburn (proposed).

Determining impacts to cultural resources within the service areas would be speculative at this time and are deferred to future project specific environmental documentation.

4.12.1 EXISTING CONDITIONS

This section provides (1) a summary of the prehistoric, ethnographic, and historic background of the Area of Potential Effect (APE); and (2) a description of the previous cultural resources studies and known sites within the APE. For this EIR, the APE is the direct effect study area and indirect effect study area. This information comes primarily from two offices of the California Historical Resources Information System: one at CSUS, Department of Anthropology; and the other at Sonoma State University, Rohnert Park, Department of Anthropology. Maps and reports on file at the Far Western offices in Davis, California, also were consulted, especially for information on Folsom Reservoir.

PREHISTORY

Human occupation of northern California may have begun shortly after 8,000 years Before Present (B.P.) (Basgall and Hildebrandt, 1989; Clewett and Sundahl, 1983; Fredrickson, 1973), with what Wallace (1954), True *et al.* (1979) and others have termed the early Milling Stone Horizon, perhaps representing a subsistence pattern based largely on wild seeds and other plant foods. Kowta (1988) speculated that this wide-spread tradition represented Hokan groups, who may have been the earliest permanent inhabitants of California. Rare finds of fluted point fragments provide evidence of occupation of the Placer County region approximately 8,000 years ago.

The archaeological record points to a dramatic intensification of land use beginning around 4,000-5,000 years ago, possibly linked to the onset of warmer, drier conditions and corresponding changes in the distribution of vegetation communities (Elston *et al.*, 1977; Moratto *et al.*, 1978; West, 1993), or to the appearance in the Central Valley of an early, riverine-adapted Penutian population (Kowta, 1975). In the lower Sacramento Valley, this marks the approximate beginning of the Early period, sometimes referred to as *Windmiller* (Ragir, 1972). Radiocarbon dates from Early-period components, which have been identified primarily in the Sacramento-San Joaquin Delta region, range from about 4,500 to about 2,500 years B.P. Surviving Early-period sites are rare in the Central Valley, and most studies of them have concentrated on burials and associated artifacts, especially charmstones and shell beads and ornaments. Within Placer County west of the Sierran Crest (the foothill region of the Central Valley), nothing of the early period is known.

A cultural transition seems to have occurred in the region at about 2,500 years ago, marked by changes in burial practices (increased evidence of cremation and of flexed burials), tool types (e.g., increasing use of mortars and of bone tools), and ceremonial items (changing styles of shell beads and ornaments and charmstones). Archaeologists refer to this as the Middle Period (sometimes the Middle Horizon), and some feel that the transition may reflect the eastward spread of Miwok people from the Bay Area (Bennyhoff and Fredrickson, 1969; Moratto, 1984). Small, semi-permanent settlements and bedrock mortars found in the Lake Tahoe area of Placer County denote habitation during this time period.

The Late Period in the Central Valley and its foothill regions began sometime around 1,500 years ago, as reflected by changes in archaeological assemblages throughout the region. Late-period sites reflect dense populations with highly developed social organizations, trade networks, food storage and redistribution systems, ceremonial/funerary complexes, and a strong sense of territoriality (Fredrickson, 1973; Moratto, 1984). Shifts in the subsistence pattern are manifested in the total dominance in most areas of mortars and pestles over milling slabs (believed to reflect large-scale adoption of the acorn as a staple food), and in the increase in fishing implements and riverine fauna (e.g., fish and shelfish remains). Two major phenomena may have triggered these changes: the onset of an intense warm/dry interval at 1,500 B.P. (Moratto *et al.*, 1978) that would have altered vegetation and hydrologic patterns; and the entry into central California of the ancestral Wintun (Whistler, 1977). Both events would have caused a disruption in the subsistence and settlement patterns of the valley and adjacent areas; moreover, the arrival of the riverine-adapted Wintun would have increased regional population (and thus population pressure) and forced the intensified use of land and resources. This resource intensification may be reflected in the increased use of fish and shellfish, considered by some to be lower-ranked resources, at late-period sites in the northern valley (Broughton 1988; Eugster, 1990). By the Proto-historic and Historic periods, fishing had become a primary subsistence activity for the Central Valley tribes (see above), who by that time had come to occupy relatively stable and well-defined territories centered on the major rivers (Barrett and Gifford, 1933; Goldschmidt, 1978; Kroeber, 1925; Johnson, 1978).

ETHNOGRAPHY

This section provides a brief discussion of the Native groups who inhabited the area at the time of Euro-American contact, with emphasis on those aspects of a culture that might be expected to survive within the archaeological record. Information on the Valley Nisenan is excerpted from McCarthy (1994); information on the Miwok is from various sources, as cited below.

Nisenan People

The project lies mostly within the ethnographic territory of the Valley Nisenan (a subdivision of the southern Maidu), who held lands along the Sacramento River from just below the confluence with the American River, upstream to just beyond Yuba City/Marysville, and eastward along the American River into eastern Placer and El Dorado counties (Kroeber, 1925; Merriam and Talbot, 1974). The Valley Nisenan reportedly lived in large settlements along the American and Sacramento rivers: Kroeber (1929) lists 12 villages, apparently all Valley Nisenan, along the American River between its confluence with the Sacramento River and Folsom, and many more upstream on the Sacramento. The largest Nisenan villages may have had 500 to 1000 occupants (Cook, 1976; Kroeber, 1925; Wilson and Towne, 1978).

The Valley Nisenan had access to diverse resources throughout their territory, and they scheduled their subsistence activities according to the seasonal availability of particular foods. Acorn was primary among these, as were fish (especially salmon and lamprey eels), large and small game animals, and many varieties of birds (Beals, 1933; Kroeber, 1925; Voegelin, 1942). These animals not only provided essential foods throughout the year, but their hides, feathers, bones, and sinew supplied necessary materials for clothing, blankets, and tools (Beals, 1933; Kroeber, 1925, 1929; Voegelin, 1942; Wilson and Towne, 1978). These resources were augmented through trade with neighboring groups. The east/west trade routes generally followed the major streams, and major trails in Nisenan territory approximated the routes of Highway 50 and old Highway 40 (now partially re-routed Interstate 80) (Davis, 1974). Consequently, the vicinity where major streams converged in the Sacramento and Folsom areas may have been important trade centers.

The Nisenan also occupied areas within the foothills of Placer and El Dorado counties, west of the Sierra Nevada crest. The Hill Nisenan were hunter-gatherers, with a territory that was capable of supporting large, semi-permanent villages. Upland and foothill areas were occupied throughout the year, but within the more mountainous eastern areas occupants were more mobile, spending winter below the snow line, moving eastward to areas above the snow line during spring and summer.

Rituals for the dead were a prominent component of Nisenan religious expression. A funeral was performed upon the death of a community member. All of the deceased's property was burned with the body. When the ashes cooled, they were gathered together in a basket and buried in the cemetery, which was separate from the burning ground. Each settlement had its own burning ground but not its own cemetery; apparently there were centralized cemeteries that were shared by several communities (Beals, 1933). In the Pre-contact period, these cemeteries were on high knolls, but when grave robbing became a problem after contact, the Nisenan moved the cemeteries closer to their villages so they could protect them more effectively (Beals, 1933). Several months to a year after the funeral, the Nisenan held a mourning ceremony or 'cry' for the deceased, at which clothing, baskets and beads were burned in honor of the dead, while the participants mourned. Historic-period 'cry' sites are sometimes marked by the presence of burnt and melted glass trade beads.

The indigenous patterns of Nisenan society were irrevocably changed with the arrival of Euro-Americans in California. By the 1830s, many non-Indians were coming to California, principally trappers who operated throughout the Central Valley. These expeditions also brought diseases, and in 1833 the Indian population was decimated by a pandemic thought to have been malaria (Cook, 1955). Also by this time the Mexican government was granting enormous tracts of land to its citizens and to a small number of other nationals, who used the local Indians as a labor force. Circumstances worsened for the Nisenan when gold was discovered at Sutter's sawmill in Coloma, on the South Fork of the American River, in 1848. A year later, 100,000 miners poured into the Sierran Foothills, many of them through the Sacramento-Folsom area, disrupting Nisenan (and other Indian) life and often destroying villages and homes. The riverbeds were a major focus of mining activities; consequently, Nisenan residents of the area would have borne a major brunt of the Gold Rush. It may be assumed that the Nisenan abandoned the Sacramento and Folsom area by the early 1850s to seek refuge in more remote locations, possibly in the foothills.

Miwok People

The southern portion of the project area, including the town of Freeport and about a ten-mile stretch of the Sacramento River north of Freeport, lies within the ethnographic territory of the Plains Miwok, who held this part of the Valley from just below Sacramento to just above Stockton (Levy, 1978). The Plains Miwok are affiliated with the Sierran Miwok to the east and the Lake, Bay and Coast Miwok to the west, on the basis of their related languages; all of these groups spoke languages of the Utian family of the hypothetical Pen-Utian or Penutian Stock. The Utian speakers may have arrived in central California relatively early and displaced the even earlier Hokan speakers, who, at the time of European contact, occupied the outer fringes of the state (Levy, 1978; Moratto, 1984; Whistler, 1977).

The Plains Miwok occupied much of the Sacramento River Delta and adjacent plains, including the lower reaches of the Cosumnes and Mokelumne rivers and Dry Creek, a major tributary. This territory encompassed a wide range of micro-environments, including delta wetlands and marshes, lakes and sloughs, riparian forest, prairie grassland, and oak woodland/savanna Travel, or trade with neighboring groups, would have provided the Plains Miwok with coastal, foothill and mountain resources, as well.

Kroeber (1976) reports that cremation was "usual but probably not universal" among the ethnographic Miwok, who apparently held an annual mourning ceremony similar to that of the Nisenan, with wailing and burning of the deceased's property. Archaeological studies in the

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Cosumnes River region, however, have shown that the interment of unburned human remains took place among the Miwok, at least in prehistoric times (e.g., Bouey and Waechter, 1992).

Like the Nisenan, the Plains Miwok were overrun by zealous missionaries and later by eager gold-seekers and the diseases they brought. By about 1880, they were considered "culturally extinct" (Bennyhoff, 1977), although they are by no means physically so. Primary information on traditional Plains Miwok culture, subsistence, and settlement patterns is limited and often conflicting. Most of what is known comes from mission records, early explorers' journals, and the recollections of aged and displaced Indian informants, often members of neighboring tribes; some archaeological data are also available. The material summarized here, much of which was gathered for neighboring groups, has been taken from Kroeber (1925), Barrett and Gifford (1933), Bennyhoff (1977) and Levy (1978).

Euro-American History

Euro-American settlement of the Sacramento Valley essentially began in 1839 with the establishment of a fort near the confluence of the American and Sacramento rivers by Swiss immigrant Johann Sutter. The only permanent settlers before that time were the Native Californians (see below), and Mexican citizens who had been granted large tracts of land, or *ranchos*, by their government. The Central Valley ranchos, which followed the Sacramento River northward from Sutter's fort, were held primarily by Euro-Americans who had become Mexican citizens in order to own land.

The most pivotal event in the history of the Sacramento Valley and adjacent Sierran foothills was the discovery in January 1848 of gold at Sutter's sawmill in Coloma, on the South Fork of the American River roughly 20 miles above its confluence with the Middle Fork. A second gold discovery was made in May of 1848 in the Auburn Ravine. These discoveries caused a rush of gold seekers and settlers into the area, largely by way of the ports of Yerba Buena (San Francisco) and New Helvetia (Sacramento). A large proportion of these immigrants were Euro-Americans, who rebelled against Mexican rule and helped to claim California for annexation by the United States.

Many towns along the American and Sacramento rivers developed as supply depots for the mines with later economic development based on mining of coal, granite, iron, copper, quartz and clay. The American River was considered the richest placer mining area in the state. The town of Folsom (originally called Granite City) was established on the river in 1855-56, as were smaller mining communities (e.g., Mormon Island, Negro Hill, Rattlesnake Bar, Salmon Falls) that now are inundated by Folsom Reservoir; these short-lived settlements are marked today by mine tailings, mine tunnels, and associated remains (Waechter and Mikesell, 1994).

Meanwhile, Sacramento grew in a few short years from a miner's tent city into a bustling port centered along the Sacramento River waterfront, where the American River joined the Sacramento. As the city grew, it became necessary to protect it from the frequent flooding of the two rivers, by constructing levees and eventually by raising the level of the town itself. Sometime before 1869, as part of these early flood-control efforts, the mouth of the American

River, where it enters the Sacramento River, was re-channeled to a point about 700-800 m (roughly ½ mile) north of its original location (Lagomarsino (1969). Before that time, the river mouth was at a point approximate with where E Street would be if it were extended west all the way to the Sacramento River. This is also evident from a circa-1870 map of the town published in Schulz et al. (1980).

Timber and agriculture grew in stature, fed by mining industry needs. By 1853, it had become clear to many people that producing and supplying food, lumber and alcohol for the miners was more profitable than mining itself, and many of the farmers who had come to California to seek gold now turned back to agriculture. Large areas of the Sacramento and foothill area were soon planted in fruit, grain, and wine grapes. Timber mills sprung up, in 1869 in Placer County alone, 15 mills produced 17 million board feet of lumber. The development of the timber and agriculture industries in northern California was aided greatly by the construction of railroad freight lines connecting Sacramento with other areas, and many farm towns sprang up along these lines. One of the largest impediments to agriculture in the region was the frequent and catastrophic flooding of the broad lowlands along the rivers. With the development of large-scale land reclamation projects between 1890 and 1930, however, the Sacramento area developed into one of the richest agricultural regions in the world.

KNOWN RESOURCES WITHIN THE AREA OF POTENTIAL EFFECT

The following is a summary of documented cultural resources studies and recorded sites within the APE, as well as a general assessment of the archaeological sensitivity of specific areas.

Lower Sacramento River (Sacramento/Sutter County Line to Freeport)

At least 31 cultural resources studies have been conducted for this segment of the Sacramento River. The record searches carried out at the North Central and Northwestern Information Centers revealed 27 recorded sites (24 prehistoric and 3 historic) and at least 42 historic structures along this segment of the river. Three of the prehistoric sites, all burial mounds, are considered eligible for the National Register of Historic Places (NRHP): CA-SAC-16, CA-SAC-43, and CA-SAC-164. Burials were noted at two other prehistoric mound sites, but their status is unknown at this time. A 1990 survey of prehistoric site CA-SAC-268, originally recorded by Riddell in 1960, revealed no cultural material, and no further work was recommended (Bouey, 1990). The remaining 17 prehistoric sites, recorded in the 1930s and 1950s, were not relocated during more recent surveys/augering, and are believed to have been destroyed during levee construction.

The Natomas Main Drainage Canal (CA-SAC-430H) meets the Sacramento River on its northern bank, roughly 3/4 mile west of its confluence with the American. To our knowledge, this historic feature has not been evaluated. Two segments of the levee system at the confluence have been recorded as historical features (LAR-16 and LAR-18); the first has been determined eligible and the other is unevaluated (Nilsson *et al.*, 1995). In addition to these features, the tiny river town of Freeport, founded in the 1860s as an early tidewater railroad terminal (Thompson, 1957), has the potential to be determined an important historical resource.

Other eligible or potentially eligible historic resources along the lower Sacramento include a rural historic landscape district (Reclamation District-1000), Washington Water Company Water Tower, Sacramento Weir and Yolo Bypass, St. Josephs Church and Rectory, Leonidis Taylor Monument, and 37 houses built between 1855 and 1900. Fifteen of these houses are part of the historic Lisbon District (YOL-HRI-9/287-301), a community settled by Portuguese immigrants during the 1850s. This district, which is characterized by early pioneer-style houses, became the largest Portuguese community in the area by 1900 (K. Les, 1986). Of the 37 houses along this stretch of the river that are listed in the Historic Property Data File for Yolo County (State Historic Preservation Office [SHPO]), only one (John White House) was not recommended for the National Register; the other 36 are listed as "appears eligible" or "may become eligible," either as separate properties or as contributors to a National Register district. All of these properties are on South River Road, adjacent to the river, but the distance of each from the river bank cannot be determined at this time. It is safe to assume that they are located outside the river levees.

The banks of the lower Sacramento River are considered highly sensitive for archaeological and historical resources.

Lower American River (Folsom Reservoir to confluence of American and Sacramento River)

A record search revealed 36 recorded sites (22 prehistoric, 13 historic, 1 multi-component) on the American River between Folsom Dam and the Sacramento River. Four prehistoric sites are eligible for the National Register, 3 are ineligible, and 15 are unevaluated. These sites include 'village mounds' and 'village middens' small camps, bedrock mortar stations, and flaked stone scatters. Several ethnographic Maidu settlements were located along the river, especially on the north bank (Wilson and Towne, 1978); at least some of the recorded "villages" undoubtedly represent these settlements.

Historic sites recorded on the American River consist of dredge tailings (see below), segments of the Western and Transcontinental railroads, bridge abutments, a pump house, features associated with the Folsom hydroelectric power system (CA-SAC-429H), stone foundations, a cemetery (CA-SAC-192/H), and segments of the historic levee system (LAR-16, LAR-18). Segment LAR-16 has been recommended as eligible to the National Register; segment LAR-18 remains unevaluated (Nilsson *et al.*, 1995).

Lake Natoma, just downstream from Folsom Dam, lies entirely within the boundaries of the historic Folsom/American River Mining District (Clark, 1979). The district is primarily a dredge field some 10 miles long and 7 miles wide (though growing smaller with modern development of the Folsom area) dating from the 1890s to the 1960s. It is marked by vast areas of dredge tailings running south and west from the town of Folsom, and it also includes historic mining features like ground sluice systems, ditches, bedrock tunnels, shafts, adits, prospect pits, rock retaining walls, tailings, and refuse dumps. This was one of the largest dredging fields in California and produced an estimated $125 million in gold. Many small studies have been done within the district, along the American River, for various types of development; several portions of the district have been recorded as CA-SAC-308H. As of this writing, a group of local archaeologists and historians were working with the Army Corps of Engineers and the Bureau of Reclamation on a programmatic approach for dealing with this huge resource, all or parts of which are likely to be determined important (D. McGowan, pers. comm., 1995, 1996, 1997). Portions of the District have been recorded as the Alder Creek Corridor Placer Mining District, the Prairie Diggings Placer Mining District, the Natomas—Intel Dredge Field, and the Natoma Ground Sluice Diggings. Of these, only the Alder Creek CPMD and part of the Prairie Diggings PMD remain intact; the other areas have been partially or completely destroyed by modern development. Both of the surviving districts have been determined eligible to the National Register by Caltrans Archaeologist Judy Tordoff.

The Lower American River is considered highly sensitive for archaeological and historical resources, especially historic mining remains.

North Fork of the American River (Folsom Reservoir Upstream to Auburn)

Seven cultural resources reports are available for this stretch of the river, six of them resulting from studies done between the 1960s and the 1980s for the proposed Auburn Dam, which has yet to be constructed as of October 1998. Together these reports encompass the entire North Fork drainage between Folsom Reservoir (where it ends in the southern part of Section 23, T12N/R8E) and the town of Auburn.

At least 13 sites have been recorded within the APE along the North Fork of the American River, some immediately adjacent to the river and others slightly up slope. The five prehistoric sites consist primarily of bedrock mortar milling features; any midden deposit that may have accompanied these features appears to have been washed or eroded away (True, n.d.). Such features, usually without midden, are common along the river canyon, where the side slopes are dotted with suitable bedrock outcrops (e.g., Waechter, 1993). Many of these prehistoric sites have been impacted in the past by scouring (from floodwaters) and erosion. Their status relative to CEQA and the State and National registers are not known, as most of them have not been formally evaluated. The eight historic sites recorded during the various Auburn Dam surveys are features related to historic mining. A few of these 13 sites have been evaluated as part of the Auburn and Folsom reservoir studies, but most have not. Some are Gold Rush-era and may qualify as important sites under CEQA.

In addition to these recorded resources, two historic features are shown on the Pilot Hill and Auburn USGS quadrangles as running along the western slope above the river. These are the North Fork Ditch (1850s), portions of which have been recorded about three miles to the south as CA-PLA-520H; and an "old railroad grade" that crosses the river in the northwest corner of Section 12 (T12N/R8E), immediately downstream from where the North and Middle forks join. The present status of these features is unknown, but both have the potential to be important historic resources under CEQA. The Auburn quadrangle seems to indicate that the North Fork Ditch ends at the diversion dam, where the North Fork of the river is artificially divided from Folsom Reservoir, but to our knowledge this has not been confirmed in the field. In 1954, the ownership of the North Fork Ditch Company passed to the San Juan Water District (Plimpton, n.d.).

As noted earlier, many other sites have been recorded within and adjacent to the bed of Folsom Reservoir, including the North Fork Ditch immediately downstream from this project segment (see below). These sites also could be impacted by the proposed Georgetown Divide/Placer County diversion near Auburn.

The North Fork of the American River is considered sensitive for archaeological and historical resources.

Folsom Reservoir

Many studies have been carried out in and adjacent to the Folsom Reservoir basin, beginning with the Smithsonian Institution Basin River Surveys (Drucker, 1948) and continuing into the 1990s (e.g., Waechter, 1992, 1993). These studies, and the sites recorded for them, are summarized in Scott, 1995, and Waechter and Mikesell, 1994. The consensus among these researchers was that the nature and extent of the effects were dependent on several factors, most notably the location of a cultural property within the reservoir basin. Sites within the zone of seasonal fluctuation or drawdown suffered the greatest impacts, primarily in the form of erosion/scouring, deflation, hydrologic sorting, and artifact displacement, caused by waves and currents. Sites located lower in the reservoir, within the deep pool (including those adjacent to old river flood plains), were more likely to be covered with silt, which sometimes formed a protective cap. Sites at or near the high water line, and sites exposed during drawdown, suffered both erosion and vandalism. The various reservoir studies also indicated, however, that even sites that have been inundated for a few decades may still contain viable research data (Waechter and Mikesell 1994).

One hundred and eighty-five (185) sites have been recorded at the reservoir, and many more undoubtedly lie beneath the waterline. Among these are 126 prehistoric sites or components, some with remnant patches of midden (Waechter and Mikesell, 1994). Human burials are noted on a few of the early (1940s-1950s) site records, but the present status of these burials is unknown. The 59 historic-period sites recorded at the reservoir are mostly related to Gold Rush-era mining, settlement, and transportation. Many of the sites show signs of adverse effects from wave action, inundation, and/or recreation use at the reservoir (Waechter, 1992, 1993; Waechter and Mikesell, 1994). Any changes in water levels caused by increased or decreased diversions from the reservoir, or from points upstream (see above), have the potential to impact many important or unevaluated cultural resources within the reservoir basin. It is also the case, however, that many—though not all—of the cultural deposits in the upper part of the reservoir, where water-level fluctuation is greatest, have been scoured down to bare granitic sand. For this reason, additional impacts from the WFP may be less significant—that is, may result in less data loss—in the upper zone than elsewhere within the reservoir. This may mean that mitigation for impacts within this zone can be less extensive (and thus less costly) than for other areas. Conversely, sites below this zone have suffered much less from seasonal water-level fluctuations, and new impacts to these sites probably will be more significant in terms of data loss.

Fairbairn Water Treatment Plant

The Fairbairn WTP is not a historic structure. In addition, the North Central Information Center has noted that the area of the plant has very low archaeological sensitivity, and that survey of the location was not necessary (Quad Consultants, 1989). A recent study for another project confirmed that the Fairbairn WTP does not meet National Register criteria on the basis of its age alone, and therefore, there is no need to record the facility as a historic property (Far Western and JRP 1998). Based on this information, alterations to the WTP should have no significant impacts on important cultural resources.

Diversion Point: South Fork of the American River (immediately upstream from Folsom Reservoir)

No sites have been recorded at that location where the South Fork flows into Folsom Reservoir, but many sites have been recorded within and adjacent to the bed of Folsom Reservoir, immediately downstream from this project segment (see below); these sites could be impacted by changes in reservoir levels caused by this proposed diversion.

Natoma Pipeline

The proposed re-alignment of the existing Natoma Pipeline was surveyed for cultural resources in April of 1997. No sites or features were found along the pipeline route, which runs through the grounds of the new Folsom State Prison. An evaluation by JRP Historical Consulting Services determined that the City of Folsom Water Treatment Plant the endpoint of the pipeline is not a historic structure (JRP 1997). The Natoma Pipeline survey report (Waechter 1997) notes that a short segment of the alignment near its southern end was not marked in the field during the time of the survey, and that the final alignment, once chosen, should be checked against the survey corridor to make sure they match. If the two corridors are found to be the same, then the installation of the Natoma Pipeline will have no significant impacts to important cultural resources. If the two do not match, limited additional survey may be necessary.

Expansion of SRWTP

The SRWTP (also referred to as the City Water Filtration Plant) is a historic resource. At the time of its construction in 1921, the plant was considered the most modern of its kind in the United Sates. It was dedicated by Mrs. Calvin Coolidge, First Lady, who threw the switch that started the pumps. The classical revival structures still stand at 101 Bercut Drive, and have been recommended eligible to the National Register of Historic Places. As of this writing, the historic evaluation of the property is on file at the City of Sacramento's Planning Department (Boghosian, pers. comm., 1998).

Mouth of the American River

There are at least four archaeological sites or features at the mouth of the American River: the two levees mentioned earlier (LAR-16 and LAR-18), a portion of the Natomas East Main Drainage Canal (CA-SAC-463H), and prehistoric mound CA-SAC-26. The Natomas East Main

Drainage Canal, constructed in 1912, also is considered to be of significant historical value (Nilsson *et al.*, 1995). CA-SAC-26 represents a Middle and Late Prehistoric site and the ethnographic Nisenan village of *Pushune* or *Pujune* (Kroeber 1925, cited in Nilsson *et al.*, 1995). This site is listed on the National Register of Historic Places. As of Nilsson *et al.*'s 1995 visit and re-recordation, most of the cultural deposit at this very important site appeared to have survived. Any impacts on these four sites or features probably would be considered significant.

<u>Permanent Pumping Station on American River near Auburn (proposed)</u>

See discussion of *North Fork of the American River (Folsom Reservoir upstream to Auburn)*, above.

<u>New Diversion and Water Treatment Facilities on Sacramento River North of the American River Confluence (proposed)</u>

See discussion of *Lower Sacramento River (Sacramento/Sutter County line to Freeport)*, above.

KNOWN RESOURCES WITHIN WATER SUPPLY SERVICE AREA

<u>Sacramento County</u>

No systematic archaeological survey has been conducted for Sacramento County. Instead, there have been many small, project-specific studies, including surveys, test excavations, and site evaluations, as required under state and/or federal regulations. These studies have identified hundreds of historic and archaeological resources within Sacramento County. Many of these have been determined eligible for the National Register, and some have been formally listed. Many others have been determined not eligible, and the rest remain unevaluated. This section provides a very brief summary of known resources in *portions* of the county. Most of this information derives from large-scale record searches carried out for an earlier project at the North Central Information Center (NCIC) at CSUS.

The following discussion is by USGS 7.5' quadrangle, beginning in the eastern part of the project area (Clarksville quad) and working west and south.

<u>Clarksville 7.5' Quadrangle</u> - Reports in the NCIC backlog file indicate the presence of a great many historic sites or features (mostly associated with mining and homesteading) and prehistoric sites, many of which have not yet been assigned state trinomials. The unsurveyed portions of this quad include lands of high archaeological sensitivity, as they include flats and knolls adjacent to streams and are crossed by known historic features (e.g., Natomas Ditch [CA-SAC-434H], Folsom dredge tailings [partially recorded as CA-SAC-308H]). It is very likely, therefore, that additional sites, both historic and prehistoric, are present within this quad.

<u>Folsom 7.5' Quadrangle</u> - A large portion of this quadrangle lies within the historic Folsom/American River gold mining district (Clark 1979; also see above discussion of Lower American River). The town of Folsom (formerly Granite City) contains a great many important historic resources, some of which are listed on or determined eligible for the National Register (e.g., the Historic Folsom Depot Grounds, the Folsom Turntable). Surveys within the basin of

Folsom Reservoir have recorded over 100 sites; another 52 sites have been recorded along the Lower American River below the dam (Scott 1995; see also discussion under *Folsom Reservoir and Lake Natoma*, above). Recent evaluations have been done of two Chinese cemeteries in the town of Folsom (Baker and Maniery, 1995); one of these has been designated as a California Point of Historical Interest, and the other has been determined by the State Historic Resources Commission and the Office of Historic Preservation to be eligible for listing on the National Register of Historic Places. An evaluation also has been done for the early mining settlement of Negro Bar, on the American River, which has been designated a Point of Historical Interest and listed on the State Register. Recently, the Sacramento firm of PAR Environmental Services carried out data recovery excavations in the historic Chinese section of Folsom, for the new American River bridge; no report is available yet on these excavations.

The western portion of the quadrangle, within the San Juan Water District, is less sensitive for historic resources than the area around Folsom. Very little of this area has been surveyed, and so the potential for prehistoric resources is unknown, although much of the area is already developed and so it is likely that many sites have already been impacted.

Citrus Heights 7.5' Quadrangle - A number of sites have been recorded on this quad, including at least four (CA-SAC-199, 205, 206, 320) along the American River. Because the area is so heavily developed, it is unlikely that many surface cultural remains will be found; however, there is still the potential for intact subsurface deposits in some areas.

Carmichael 7.5' Quadrangle - Large portions of this quad have been surveyed for cultural resources, mostly in and around Mather AFB, where no sites have been recorded (McIvers 1985). This apparent lack of sites may be due to the high degree of development on the base, especially over its western half; it is possible that subsurface deposits exist that are no longer visible on the surface. This quad also contains a portion of the mine tailings of the historic Folsom/American River gold mining district, which has the potential to be determined a significant historical resource (see discussion of *Lower American River*, above).

Sacramento East 7.5' Quadrangle - The most sensitive portion of this quad is that area of downtown Sacramento bounded by the Sacramento and American rivers on the north and west, and Interstate Business 80 on the east and south. Numerous archaeological studies have been carried out in downtown Sacramento, mostly as part of planned development. Several of these were excavations of buried historic features associated with businesses and residences from the second half of the Nineteenth Century (e.g., Costello 1994; Peak & Assoc. 1983; Praetzellis 1991; Praetzellis and Praetzellis 1982, 1990a, 1990b, 1990c, 1992, 1993). Because of frequent and large-scale flooding of the downtown area in the 1850s and 1860s, truckloads of fill were used to raise the city streets from 4 to 16 feet above the original levels. Many intact features remain buried under this fill and under flood silts.

Also of historic importance are the Southern Pacific Railyards and the Richards Boulevard area. The Railyards are built on the site of Sutter Slough, a marshy lake that was filled in about 100 years ago, but around which once existed businesses, private residences (including those of early Chinese settlers) and railyard facilities. The Southern Pacific Railroad, formerly the Central

Pacific portion of the first Transcontinental Railroad, is a registered State Historic Landmark (No. 780). According to Praetzellis and Praetzellis (1990), the Southern Pacific railyards are "very likely to contain legally significant archaeological resources." Likewise, Lindström (1991) concluded that there is a substantial likelihood that the Richards Boulevard area contains both prehistoric and historic archaeological resources "which meet the criteria for legal significance."

Sacramento West 7.5' Quadrangle - This quad is discussed above under *Lower Sacramento River.*

Clarksburg 7.5' Quadrangle - This quadrangle is discussed above under *Lower Sacramento River.*

The Sacramento County General Plan Update EIR (dated February 1992) includes an analysis of impacts on cultural resources from future development. It concludes that "as growth and development occurs [sic], the potential for destruction of archaeological resources would be increased. Excavation, trenching for foundations, pipe and cable installation, landscaping, and other earth disturbing activities associated with development could result in adverse impacts on archaeological resources" (Chapter 4.9-1). The EIR goes on to state that increased development in either the existing urban/suburban area, the eastern (Sunrise/Douglas) or northern (North Natomas) portions of the county, or the composite area of Elliott Ranch; Laguna/Franklin; Sunrise/Douglas; and Elverta, all "would be considered to have a ***significant impact*** on cultural resources" (4.9-1).

Western Placer County

The following excerpts are taken from the Placer County General Plan, Draft Background Report of 1995, and the Placer County Department of Museums' Cultral Resources Inventory. Additional information can be obtained from "Historical, Architectural and Archaeological Resources of Placer County, the Report of the Placer County Resources Inventory, Volumes I, II and III," December 1992.

A comprehensive cultural resources overview has been completed by the Placer County Department of Museums to document the archaeological and historical heritage of the unincorporated county. In addition, the cities of Auburn, Lincoln, Loomis, and Foresthill have conducted cultural resource studies within their boundaries.

Little is currently known about large expanses of Placer County, although important archaeological sites have been recorded in the proposed Auburn Dam project area (noted earlier). Minor excavations have been conducted at a number of sites in the Christian Valley and upper Auburn Ravine and Ophir areas. Known prehistoric sites in Placer County include many bedrock milling features and fewer habitation sites. Prehistoric remains found in the county may date to as early as 5000 years B.P., or perhaps earlier. Historically, there are few early Gold Rush-era buildings left in Placer County, largely because early miners and immigrants generally lived outside or in cloth tents. A number of buildings, structures, and features are left from the later mining era, however; some of these include Griffith's granite quarry and office in Penryn (now a State Landmark), the clay pits northwest of Lincoln, an abandoned kiln in the middle of the Black Oak Golf Course, the Sisley mine industrial mill outside of Penryn, the Big

Ben Mine building on Virginiatown Road, a few abandoned mines like the Hathaway Mine in the Ophir District, and the Whiskey Diggings Ditch that still carries water through the foothills of western Placer County.

Many other buildings, artifacts, and properties are associated with later phases of mining activity, including mine workers' and owners' residences, warehouses, old mining buildings, gold camp sites, stamp mills, mining structures, mining ditches, and miles of streambank dredge tailings. Two earth berms associated with an early railroad are evident in the Fruitvale District.

Structures associated with early lumber mills include old railroad trestles, tunnels, water flumes, and wooden bridges. Several buildings from this period on the Cal Ida Lumber Company property are considered locally significant. Numerous small, Depression-era concrete bridges built by laborers from the Work Projects Administration (WPA) are located throughout the county. Other historical resources include early school houses, nineteenth- and early twentieth-century residences, commercial buildings and districts, community halls, churches and cemeteries.

Any proposed project-level land development under Placer County jurisdiction must undergo design review before construction activities can begin. Placer County has in place Historic Design Guidelines, the provisions of which are applied and reviewed during the design review process. Provisions include: consultation with the NCIC for any project that could have an impact on cultural resources, and requirements that modifications or new construction in historic areas be done in a manner consistent with the style of the existing building and surrounding buildings/structures.

Western El Dorado County

The following information is summarized from the El Dorado County General Plan, Volume I: Background Information. Sources used to gather data on archaeological resources for the background report include: the El Dorado County Planning Department, the NCIC, the El Dorado County Historical Society, the El Dorado County Heritage Association, and the State Office of Historic Preservation. All references cited below are taken from these sources.

Cultural resources currently identified within El Dorado County include archaeological, historical, and historic architectural resources. Although many of these have been evaluated under federal and state criteria and have been formally designated as important resources, many others remain unevaluated. Moreover, a substantial portion of the land under El Dorado County jurisdiction has not yet been surveyed for cultural resources.

As of 1997, there were approximately 850 prehistoric and historic archaeological sites assigned State trinomial designations in El Dorado County, and over 300 additional site records that have not been processed (Russo, NCIC, 1993). In addition to the recorded historic archaeological sites, there are 27 State Historic Landmarks (over half are located in the western part of the county), 14 properties listed on the National Register (10 of these are located in the western portion of the county), 9 properties declared eligible for inclusion in the National

Register, and 25 named gold mining districts. In addition to these sites, Crawford Ditch is currently being considered for inclusion in the National Register (Peabody, 1990). This ditch represents only one of many miles of ditches located throughout El Dorado County that conveyed water to and from the mining areas. Since the decrease in mining activities, these ditches have been important for agricultural and other uses.

El Dorado County is traversed by many historic trails dating from the Gold Rush era and earlier, the most well-known being the Mormon-Carson Trail and the PonyExpress Trail. Some of the historic trails incorporate portions of earlier trails established by Native American groups that lived in the area. Other historic areas include the Coloma and Marshall Gold Discovery area, the Main Streets of Georgetown, Greenwood, the Wakamatsu Tea and Silk Farm Colony, and the Placerville Historic District.

El Dorado County also keeps an inventory of county resources not included on state or federal lists. Over 90 sites are on this list, a majority of these sites occur in the western county. Resources in the county inventory include Wells Fargo Express offices, stage coach stops, the site of the first county court house, pioneer cemeteries, historic homes, jail houses, and wineries (El Dorado County, 1995).

4.12.2 THRESHOLDS OF SIGNIFICANCE

Impacts under the WFP are considered significant if the magnitude and frequency of change in river stage or reservoir elevation would do any of the following:

- *Expose previously submerged resources, increasing their vulnerability to* vandalism and other factors;
- Inundate previously exposed resources; or
- Expose resources to increased cycles of inundation and drawdown.

Many of the recorded cultural resources within the WFP APE have been inundated by earlier projects; a large number of these lie submerged under Folsom Reservoir. Studies of reservoir impacts to cultural sites have shown that the greatest impacts are from wave action, which erodes the deposit and moves artifacts, and from cycles of inundation and drawdown, which also causes erosion and movement, in addition to repeated wetting and drying of the deposit (Foster *et al.* 1977; Foster and Bingham 1978; Henn and Sundahl 1986; Lenihan *et al.* 1981; Stoddard and Fredrickson 1978; Ware 1989). These same studies suggest that sites that lie permanently submerged, for example within the deep pool of a reservoir, suffer much less damage than those within the drawdown zone. For sites that already are submerged, continued submergence does not constitute an effect. However, inundation to sites that lie above the present waterline (and that have not been subject to inundation before) would be an adverse effect.

CEQA requires that *important* cultural resources must be protected. The CEQA Guidelines define an important resource as one listed on, or eligible for listing on, the California Register of Historical Resources (PRC Section 5024). Resources that are found to be eligible for the

Register "are to be protected from substantial adverse change." Such change is defined in Section 5020.1 as demolition, destruction, relocation, or alteration activities that would impair historical significance; one example would be "remodeling a historic structure in such a way that its distinctive nature is altered" (OPR, 1994).

An eligible resource will meet one or more of the following criteria:

- It is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;
- It is associated with the lives of persons important in the state's past;
- It embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possess high artistic value; or
- It has yielded, or may be likely to yield, information important in prehistory or history.

In addition to CEQA compliance, any project that involves federal funds or permits must also comply with Section 106 of the National Historic Preservation Act (NHPA); this act defines important (*"significant"*) resources as those listed on, or eligible for listing on, the National Register of Historic Places. National Register criteria are very similar to those for the California Register, defining an important cultural resource as one that is associated with important persons or events, or that embodies high artistic or architectural values, or that has scientific value (36 CFR 60.6). State Historic Landmarks, and any cultural resource that has been determined eligible to the National Register, automatically qualify for the California Register. Where a cultural resource has not been evaluated for its importance, it is treated as potentially important until an evaluation can be done.

4.12.3 IMPACTS ASSESSMENT METHODOLOGY

This section presents an analysis of the potential for significant impacts from the WFP on important cultural resources for each of the water bodies and facilities that constitute the Project APE. First, results of hydrologic modeling simulations are used to estimate potential impacts on important cultural resources at Folsom Reservoir and along the banks of the Lower Sacramento and Lower American rivers as a result of changes in water surface elevations and river flows. Second, those diversion points and other facilities covered under pending or existing environmental documents are identified and discussed briefly.

APPLICATION AND INTERPRETATION OF HYDROLOGIC MODELING

In the following section, hydrologic modeling data are used to compare the existing or Base Condition with expected changes in reservoir elevations and river flows within the APE from implementation of the WFP.

4.12.4 WATER FORUM PROPOSAL IMPACTS

FOLSOM RESERVOIR

To evaluate potential impacts to cultural resources in and around Folsom Reservoir, the maximum increase and decrease in mean monthly Folsom Reservoir water surface elevations were compared between the Base Condition and the WFP. If water surface elevations were to be raised above the present high-water line (466 ft msl), this could result in the inundation of previously exposed cultural resources located near the shoreline; conversely, lower elevations could expose cultural resources that were previously submerged. Additionally, and perhaps more significantly, if, under the WFP, a shift in the zone of fluctuation would occur, cultural resources located within the zone could also be potentially affected through increased exposure to erosion, hydrologic sorting caused by wave action, and breakdown of organic matter through repeated wetting and drying.

Impact 4.12-1

Effect of Varying Water Levels on Cultural Resources in Folsom Reservoir.
Implementation of the WFP would result in some variation in Folsom Reservoir elevations as compared to the Base Condition. This variation would not result in increased reservoir levels of sufficient magnitude to cause either inundation of previously exposed areas, or exposure of previously inundated sites, beyond that which is occurring under the Base Condition. However, implementation of the WFP would result in significantly more cycles of inundation and drawdown in the area between 360 and 395 ft msl; this increase would constitute a ***significant*** *impact to sites within that zone.*

Table 4.12-1 presents data for Folsom Reservoir showing the maximum, minimum, and average mean monthly water surface elevations for the Base Condition and the WFP. For all months of the year, the average mean monthly elevation under the WFP is slightly lower than under the Base Condition, but the difference is insignificant (0.4% to 0.8%). In no month does the maximum mean monthly elevation under WFP exceed that of the Base Condition, and so there would be no inundation of previously exposed areas (that is, those areas above the present high-water line of 466 ft msl). Moreover, the lowest mean monthly reservoir elevation under the WFP (348.6 ft msl, in October) would be identical to that under the Base Condition (348.6 ft, in February); this means that no new areas of the reservoir would be exposed, beyond those areas already subject to drawdown. Thus, impacts from higher or lower mean monthly water levels under the WFP would be less than significant.

Table 4.12-2 compares the numbers of water-level fluctuations across various elevations in the reservoir for the Base Condition (over the 70-year period of record) and the WFP. While the total number of fluctuations is not significantly different from one to the other (1,453 versus 1,511, or 4.0%), for some months the difference is quite large (up to 120%). The greatest increase in number of cycles under the WFP would occur in the zone between 360 and 395 ft msl (and especially from 360 to 370 ft msl). Because sites within this zone have been somewhat protected in the past by being lower in the reservoir pool, such increases could have significant new adverse impacts to these sites over time.

Table 4.12-1
Comparison of mean monthly Folsom Reservoir water surface elevations for Base Condition and Water Forum Proposal[1]

Month	Maximum Mean Monthly Elevation (ft msl)			Minimum Mean Monthly Elevation (ft msl)			70-Year Mean Monthly Average Elevation (ft msl)		
	Base Condition	WFP		Base Condition	WFP		Base Condition	WFP	
January	421.3	421.3	(0.0)	354.2	360.9	(1.9)	402.1	399.7	(-0.6)
February	421.3	421.3	(0.0)	348.6	357.2	(2.4)	405.7	403.7	(-0.5)
March	432.0	432.0	(0.0)	363.2	359.0	(-1.2)	416.0	414.3	(-0.4)
April	444.5	444.5	(0.0)	363.6	361.2	(-0.7)	429.7	428.1	(-0.4)
May	460.7	460.7	(0.0)	365.4	364.2	(-0.3)	439.9	437.9	(-0.5)
June	460.7	460.7	(0.0)	361.3	362.0	(0.2)	435.1	432.6	(-0.6)
July	459.0	458.4	(-0.1)	353.5	356.5	(0.8)	426.1	424.4	(-0.4)
August	447.2	444.5	(-0.6)	347.8	352.7	(1.4)	417.6	415.8	(-0.4)
September	434.3	429.5	(-1.1)	344.5	349.7	(1.5)	411.0	408.6	(-0.6)
October	429.4	429.4	(0.0)	345.9	348.6	(0.8)	405.5	402.4	(-0.8)
November	421.3	421.3	(0.0)	350.7	351.2	(0.1)	402.3	399.4	(-0.7)
December	421.3	421.3	(0.0)	363.1	365.2	(0.6)	402.3	399.7	(-0.7)

1 Pre-1956 reservoir elevations extrapolated from hydrologic modeling data.
( ) = relative difference from Base Condition, expressed as a percentage.

Source: Far Western Anthropological Research Group, Inc. 1998.

Table 4.12-2
Number of Water-level Fluctuations Events in Folsom Reservoir for the Base condition and the Water Forum Proposal for the 70-year Period of Record

Elevation (ft msl)	Base Condition #	WFP	
		#	% Difference
465	0	0	0.0
460	52	38	-26.9
455	60	58	-3.3
450	75	72	-4.0
445	84	80	-4.76
440	88	86	-2.27
435	90	90	0.0
430	96	92	-4.17
425	105	99	-5.71
420	131	125	-4.58
415	104	116	11.54
410	105	103	-1.90
405	97	104	7.22
400	101	106	4.95
395	75	87	16.00
390	62	79	27.42
385	41	55	34.15
380	31	44	41.94
375	26	35	34.62
370	10	22	120.00
365	6	8	33.33
360	4	8	100.00
355	4	2	-50.00
350	4	2	-50.00
345	2	0	-100.00
340	0	0	0.00
335	0	0	0.00
330	0	0	0.00

[1] Pre-1956 reservoir elevations extrapolated from hydrologic modeling data.
% = relative difference

Source: Far Western Anthropological Research Group, Inc. 1998.

LOWER AMERICAN RIVER

For the Lower American River, the maximum and minimum mean monthly flows, as well as the relative change in average mean monthly flows over the 70-year hydrologic period of record were compared between the Base Condition and the WFP. In order to estimate the magnitude and frequency of bank exposure and bank inundation along the Lower American River, two locations were assessed: Nimbus Dam, and the river mouth (confluence with the Sacramento River).

A definitive stage/discharge relationship has never been developed for the entire range of flows occurring in the Lower American River, though limited information does exist for very high (e.g., flood) flows. For this reason, it is difficult to quantify precisely the potential for exposure or inundation of cultural resources along the banks of the Lower American River. Generally, however, it is accepted that higher water surface elevations occur under higher flows and lower water elevations occur under lower flows. A comparison of flows under the Base Condition and WFP provide an estimate of the relative changes in river stage that could result from the implementation of the WFP.

NIMBUS DAM RELEASES

Impact
4.12-2

Effect of Varying Flows/River Stage on Cultural Resources Along the Lower American River Bank Near Nimbus Dam. *Implementation of the WFP would result in American River flows downstream of Nimbus Dam that differ somewhat from those under the Base Condition. For nearly all months of the year, mean monthly river flows under the WFP would be lower than under the Base Condition, meaning that no new areas of the riverbank would be inundated. Because no significant sites are expected to have survived within the riverbed itself, these lower flows would not expose previously submerged (and intact) cultural resources. Therefore, changes in river flows from the WFP would have a* ***less-than-significant*** *impact to cultural resources along the river near Nimbus Dam.*

As Table 4.12-3 demonstrates, mean monthly river flows under the WFP would be lower than has been the case historically, for all months except January; the slightly higher January minimum mean flows (516 versus 511 cfs) would still be significantly lower than the maximum mean monthly flows under the Base Condition, meaning that no new areas would be inundated. In addition, the 70-year hydrologic record confirms that the minimum mean monthly flows shown in the table are uncommon, usually occurring only in severe drought years; therefore these occurrences may not be truly representative of the impacts of the WFP.

The riverbanks and small islands in the river below Nimbus Dam have high potential to contain cultural resources, particularly Native American settlements and resources related to historic-era gold mining (especially within the historic Folsom/American River Mining District). However, these resources would not be affected by lower water levels. Few, if any, cultural sites are expected to lie within the riverbed itself, and any that once did (e.g., mining remains or temporary sites used during times of very low water) probably would not have survived the historic effects of scouring and erosion by the river at high stage. Therefore, lower river flows resulting from implementation of the WFP should have a less-than-significant impact to cultural resources along this stretch of the river.

Table 4.12-3
Comparison of Lower American River Flows Below Nimbus Dam for Base Condition and Water Forum Proposal

Month	Maximum Mean Monthly Flows (cfs)		Minimum Mean Monthly Flows (cfs)		70-Year Mean Monthly Average Flows (cfs)	
	Base Condition	WFP	Base Condition	WFP	Base Condition	WFP [1]
January	21000	20840 (-7.6)	511	516 (1.0)	4337	4211 (-4.2)
February	33196	33123 (-0.2)	500	500 (0.0)	4883	4719 (-4.5)
March	16237	16107 (-0.8)	400	400 (0.0)	3991	3849 (-3.6)
April	14374	14181 (-1.3)	336	321 (-4.5)	3595	3413 (-5.8)
May	11377	11032 (-3.0)	338	330 (-2.4)	4028	3819 (-5.8)
June	14730	14275 (-3.1)	378	375 (-0.8)	4101	3817 (-8.4)
July	6414	6044 (-5.8)	401	390 (-2.7)	3201	2685 (-16.4)
August	4920	4805 (-2.3)	390	385 (-1.3)	2817	2460 (-11.4)
September	4921	4827 (-1.9)	454	444 (-2.2)	2479	2223 (-8.9)
October	3546	3173 (-10.5)	521	517 (-0.8)	2139	2040 (-5.0)
November	16969	16084 (-5.2)	500	500 (0.0)	2713	2566 (-5.9)
December	19334	19049 (-1.5)	575	541 (-5.9)	3665	3521 (-5.6)

[1] Change under the Water Forum Proposal, relative to Base Condition. Values reported in parentheses represent the average change (%) for the 70 years modeled, rather than the difference (%) between the 70-year average flow values for each month under the two scenarios.

Source: Far Western Anthropological Research Group, Inc. 1998.

FLOWS AT THE CONFLUENCE (AMERICAN AND SACRAMENTO RIVERS)

Impact 4.12-3

Effect of Varying Flows/River Stage on Cultural Resources Along the Lower American River Near the Mouth. *Implementation of the WFP would result in American River flows at the mouth that differ somewhat from those under the Base Condition. For nearly all months of the year, mean monthly river flows under the WFP would be the same as or lower than under the Base Condition, meaning that no new areas of the riverbank would be submerged. Because no significant sites are expected to have survived historically within the riverbed itself, these lower flows would not expose previously submerged (and intact) cultural resources. Therefore, changes in river flows from the WFP would have a* ***less-than-significant*** *impact to cultural resources along the river near the mouth.*

As shown in Table 4.12-4, the maximum and minimum mean monthly flows at the river mouth under the WFP would always be the same as, or lower than the Base Condition, with two exceptions: minimum mean monthly flows under the WFP would be higher than under the Base Condition in January (by 0.5%) and March (by 13.3%). However, the 70-year hydrologic record confirms that such low flow is uncommon, usually occurring only in severe drought years and, therefore, these occurrences may not be truly representative of the impacts of the WFP. In any case, because the river stage under the WFP would never be higher than the maximum stage that is already occurring, no new areas would be inundated.

Table 4.12-4
Comparison of Lower American River Flows at Mouth for Base Condition and Water Forum Proposal

Month	Maximum Mean Monthly Flows (cfs)			Minimum Mean Monthly Flows (cfs)			70-Year Mean Monthly Average Flows (cfs)		
	Base Condition	WFP		Base Condition	WFP		Base Condition	WFP [1]	
January	20940	20786	(-0.7)	389	391	(0.5)	4255	4127	(-3.1)
February	33241	33161	(-0.2)	385	365	(-5.2)	4809	4629	(-3.7)
March	16257	16121	(-0.8)	278	315	(13.3)	3892	3740	(-3.9)
April	14296	14063	(-1.6)	188	188	(0.0)	3467	3242	(-6.5)
May	11190	10774	(-3.7)	188	188	(0.0)	3860	3591	(-7.0)
June	14543	14000	(-3.7)	188	188	(0.0)	3906	3543	(-9.3)
July	6222	5749	(-7.6)	188	188	(0.0)	2992	2392	(-20.1)
August	4733	4519	(-4.5)	188	188	(0.0)	2612	2176	(-16.7)
September	4764	4585	(-3.8)	281	281	(0.0)	2303	1989	(-13.6)
October	3412	3032	(-11.1)	375	375	(0.0)	2006	1858	(-7.4)
November	16873	15970	(-5.4)	375	375	(0.0)	2606	2434	(-6.6)
December	19281	18994	(-1.5)	500	500	(0.0)	3575	3426	(-4.2)

[1] Change under the Water Forum Proposal, relative to the Base Condition. Values reported in parentheses represent the average change (%) for the 70 years modeled, rather than the difference (%) between the 70-year average flow values for each month under the two scenarios.

Source: Far Western Anthropological Research Group, Inc. 1998.

It is possible that historic-era (post-1869) shipwrecks lie beneath the silty river bottom near the confluence, and that very low river flows could expose these resources. However, the magnitude of the changes predicted under the WFP are so minor that this is highly unlikely. Known resources along the riverbank (two historic levees, a portion of the Natomas East Main Drainage Canal [CA-SAC-463H], and prehistoric mound CA-SAC-26) lie outside the present river channel, and decreases in river flows should have no effect to these resources.

LOWER SACRAMENTO RIVER

For the Lower Sacramento River, the 70-year maximum and minimum mean monthly flows at Freeport were assessed between the Base Condition and the WFP. The Lower Sacramento River is influenced in large part by tides: the relationship between river stage and discharge is affected by the diurnal influence of these tides.

Impact
4.12-4

Effect of Varying Flows/River Stage on Cultural Resources Along the Lower Sacramento River Bank Near Freeport. *Implementation of the WFP would result in Sacramento River flows at Freeport that differ slightly from those under the Base Condition. However, these variations are not of sufficient frequency or magnitude to cause either significant exposure or inundation of cultural resources and thus represent a* ***less-than-significant*** *impact to cultural resources.*

Table 4.12-5 shows that river flows under the WFP would almost always be lower than those under the Base Condition; the only exception would be a slight increase (2.3%) in February. The changes would be quite small, ranging from 0.1% to 9.4%. This increment is unlikely to result in a noticeable change in river stage and therefore would be unlikely to affect cultural resources. Moreover, the lower Sacramento River is bordered by levees that act to stabilize the riverbank during both low and high flows; this means that changes in river flows of the magnitude expected would not affect the adjacent riverbanks, where cultural sites might occur. Therefore, impacts to cultural resources on this stretch of the Sacramento River under the WFP are expected to be less-than-significant.

Proposed and Existing Facilities

Several of the facilities or diversions described below are associated with, but not part of, the WFP. They are being covered under pending or existing environmental documents or will be addressed at a future date when those projects are proposed. As noted earlier, most of these documents were not yet available for review during preparation of this report. Consequently, this report assumes that the various lead agencies and the SHPO will concur with the conclusions and recommendations in those documents regarding cultural resources. If this assumption is correct, then any potential impacts on important cultural properties will be mitigated as part of these other studies, and so there will be no effect under the WFP.

Table 4.12-5
Comparison of Sacramento River Flows at Freeport
For Base Condition and Water Forum Proposal

Month	Maximum Mean Monthly Flows (cfs)			Minimum Mean Monthly Flows (cfs)			70-Year Mean Monthly Average Flows (cfs)		
	Base Condition	WFP		Base Condition	WFP		Base Condition	WFP [1]	
January	72098	72029	(-0.1)	11508	11339	(-1.5)	31682	31546	(-0.4)
February	83987	83933	(-0.1)	10481	10717	(2.3)	37837	37681	(-0.5)
March	69067	68948	(-0.2)	10353	10312	(-0.4)	33418	33258	(-0.5)
April	70938	70806	(-0.2)	5940	5883	(-1.0)	23643	23468	(-1.1)
May	53526	53170	(-0.7)	7008	6954	(-0.8)	19243	19029	(-1.3)
June	52566	52084	(-0.9)	7917	7877	(-0.5)	17950	17632	(-1.8)
July	26474	26055	(-1.6)	7372	7325	(-0.6)	14517	14025	(-3.4)
August	23140	22984	(-0.7)	6582	6305	(-4.2)	15220	14911	(-2.2)
September	26751	26636	(-0.4)	6439	6378	(-0.9)	14336	14080	(-1.8)
October	32725	31338	(-4.2)	6223	5635	(-9.4)	11981	11840	(-1.2)
November	55950	56013	(0.1)	6228	6182	(-0.7)	15776	15541	(-1.3)
December	71521	71398	(-0.2)	9243	8700	(-5.9)	25015	24845	(-0.8)

[1] Change under the Water Forum Proposal, relative to the Base Condition. Values reported in parentheses represent the average change (%) for the 70 years modeled, rather than the difference (%) between the 70-year average flow values for each month under the two scenarios.

Source: Far Western Anthropological Research Group, Inc. 1998.

Fairbairn Water Treatment Plant, Sacramento Regional Wastewater Treatment Plant

The Arcade Water District and the Carmichael Water District propose increased water diversion at the Fairbairn WTP. The City of Sacramento proposes increased water diversion through the expansion of the Fairbairn WTP or the SRWTP. As noted earlier, the Fairbairn WTP is not a historical resource. The SRWTP is, however, and its classical revival structures have been evaluated by an architectural historian and recommended as eligible for listing on the National Register of Historic Places, for their architecture (Criterion C) and for their contribution to state and local development (Criterion A). Any modifications to this important historic facility may require mitigation.

New Diversion Facility and Water Treatment Facility on Sacramento River North of American River Confluence

The City and County of Sacramento and EBMUD propose to increase water diversion through either the expanded Sacramento WTP (see above) or a new diversion facility at the Interstate 5 crossing with the American River. The new facility is covered under a pending EIS/EIR by EBMUD.

Folsom Reservoir Direct Diversion (Existing Facilities; Cooperative Transmission Pipeline)

The Northridge Water District, City of Roseville, Placer County Water Agency, and San Juan Water District propose to increase diversion via existing facilities; proposed modifications to these facilities are covered under pending and/or completed environmental documents.

The City of Folsom will increase water diversion via a new, 1.4-mile pipeline to be installed within the existing (1950s) pipeline corridor (Natoma Pipeline). An archaeological survey of the route was conducted by Far Western in April of 1997. No cultural resources were found within the corridor, and so (pending SHPO concurrence) the new pipeline will have no impact to important cultural properties.

New Permanent Pumping Station on North Fork American River near Auburn

The Placer County Water Agency proposes to construct a permanent pumping station for water diversion; this new station is already covered under a pending environmental document.

New diversion facility on the South Fork of the American River, east of Folsom Reservoir

No survey has been done of the point where the South Fork flows into Folsom Reservoir, and so, no sites have been recorded at this location. Once the exact location has been chosen, it may be necessary to conduct a survey for cultural resources. Without this survey, impacts to cultural resources at the diversion point cannot be assessed.

4.12.5 MITIGATION MEASURES

No mitigation measures are necessary for the following less-than-significant impacts:

- 4.12-2: Effect of varying flows/river stage on cultural resources along the lower American River below Nimbus Dam
- 4.12-3: Effect of Varying Flows/River Stage on Cultural Resources Along the Lower American River Bank Near the Mouth
- 4.12-4: Effect of Varying Flows/River Stage on Cultural Resources Along the Lower American River Near Freeport

The following mitigation measures are provided for significant and potentially significant impacts:

The WFP may affect important cultural sites at Folsom Reservoir.

impact **4.12-1** mitigation

Effect of Varying Water Levels on Cultural Resources Around Folsom Reservoir

Cultural Resources Survey of Sites Within Folsom Reservoir

The WFP hydrologic modeling data indicates that the project would have a significant impact on cultural sites and features within the reservoir pool, especially those located between the 360 ft msl and 395 ft msl elevations. Significant impacts would include the potential exposure of previously submerged sites to increased vandalism, recreation use, wave action, and the effects of repeated inundation and drawdown. Many prehistoric and historic sites have been recorded within the reservoir basin, most of which remain unevaluated. Only about half of the reservoir has been surveyed, and many other sites undoubtedly exist in the unsurveyed areas.

In 1994, Far Western and JRP Historical Consultants prepared a Research Design as part of SAFCA's Folsom Re-operation Study. That document included all of the reservoir basin between the 390-foot and the 466-foot contours. The Research Design provides, among other components, summaries of the known cultural resources within the study area; research issues applicable to those resources; and recommendations for evaluating the sites, protecting them from further damage, and mitigating unavoidable impacts. Checklists are included for evaluation of various types of sites. All unevaluated sites within the reservoir that fall within the direct impact zone of the WFP could be given additional study, using this Research Design as a guideline. Also, unsurveyed portions of the direct impact zone could be surveyed for cultural resources, as water levels permit; any additional sites and features also may require evaluation and mitigation. The appropriate agencies (i.e., Bureau of Reclamation, US Army Corp of Engineers, and the State Office of Historic Preservation) could decide that evaluation and mitigation of a *representative sample* of the sites is sufficient, although this cannot be determined without comprehensive consultation with those agencies. Recent conversations with archaeologists at the Bureau of Reclamation's Sacramento office suggest that such sampling would be acceptable to that agency.

4.12.6 LEVELS OF SIGNIFICANCE AFTER MITIGATION

Mitigation of significant impacts to important cultural resources, as recommended above (and assuming concurrence by the SHPO), would result in a less-than-significant impact to such resources. However, because the WFP adoption and implementation will involve a complex process with multiple participants, it is not feasible to fully assure that sufficient mitigation can be implemented to reduce impacts to less-than-significant levels. Consequently, to fulfill the disclosure requirements of CEQA, this EIR must indicate that cultural resource impacts at Folsom Reservoir (4.12-1) are considered significant and potentially unavoidable.

4.13 SOILS AND GEOLOGY

4.13.1 EXISTING CONDITIONS

TOPOGRAPHY AND RELIEF

The topography of Sacramento County is represented by three physiographic regions: the Sierra Nevada foothills to the northeast, the lower Sacramento Valley extending through the western and central portions of the county, and the Sacramento-San Joaquin Delta in the southwest. The Sierra Nevada foothills are characterized by undulating to hilly topography ranging in elevation from 140 to 830 ft msl. The lower Sacramento Valley is characterized by predominantly flat to gently rolling topography although some areas further to the east are gently rolling to hilly. Elevation ranges from sea level in the southwest to about 400 ft msl in the eastern portions of the region (USDA-SCS, 1993).

Accounting for up to 83% of the county, the lower Sacramento Valley physiographic region is the largest and consists of numerous landforms. Nearly level floodplains are found along the Sacramento, American, and Cosumnes rivers and along smaller creeks with basin and terrace remnants common along the north side of the American River. The most extensive component of this region is the lower Sacramento Valley floor which consists of low terraces, basin rims, and local basins. This area has slopes generally less than 1% (USDA-SCS, 1993).

The youngest geomorphic features in Sacramento County are low floodplains. These landforms include nearly level tidal and freshwater marshes and back swamps in the Delta area, natural levees, floodplain alluvial fans, and floodplains bordering the Sacramento, American, and Cosumnes rivers and many smaller channels. Bar and channel topography is evident on the low floodplains along the American River and in a few small areas along the Cosumnes River. The low floodplains are frequently inundated unless they are protected by levees or upstream dams (USDA-SCS, 1993).

The Sacramento-San Joaquin Delta is made up of numerous islands and land tracts, commonly dish-shaped and having a natural levee on the higher land around the perimeter and a backswamp or reclaimed freshwater marsh in the low central area (USDA-SCS, 1993).

SOILS

Soils in Sacramento County can be characterized by geomorphic provinces and include Valley land soils, Valley basin soils, Terrace land soils, and Upland soils. Valley land soils are alluvial in nature and are found in deep alluvial fans and floodplains. These soils are highly valued for irrigated crops. Valley basin soils include organic, imperfectly drained, and saline/alkali soils and are limited to the Sacramento-San Joaquin Delta. They are characteristically poorly drained, highly organic, and often acidic in nature. Terrace land soils are found along the edges of the Central Valley and include brown neutral and red iron pan soils. Upland soils are characteristic of hilly topography (USBR-SMWA, 1996).

Soils in Sacramento County have been significantly influenced by human activities. Generally, soils used for cultivation and urban development have been altered and in many areas, have undergone considerable modification. Historic gold dredging, hydraulic mining, drainage system development, creation of levees, and cut and fill have all contributed to modifying the original soils (USDA-SCS, 1993). As an example, dredging took place intermittently along the American River until 1962 and altered more than 20,000 acres of natural soils leaving dredge tailings. Large amounts of cobbles and gravel with intermixed fines are characteristic of these dredge tailing or mound sites. Today, some of these dredge tailing sites located in lower lying areas support cottonwoods, berry vines, and annual grasses (USDA-SCS, 1993).

GEOLOGY

Sacramento County is located within two geomorphic provinces or areas with similar geologic origin and erosional/depositional history. Most of the county isin the Great Valley geomorphic province and is characterized by a relatively flat alluvial plain comprised of deep sediments (Sacramento County, 1992).

Underlying Sacramento County, the deepest layer of rock is composed of intrusive igneous rocks extending from the Sierra Nevada Mountains. Overlying this Mesozoic aged stratum are siltstone, claystone and sandstone sedimentary rocks of marine origin (Sacramento County, 1992). Near the surface, a layer of fluvially deposited sediments eroded from the Sierra Nevada forming a layer approximately 3,000 feet deep. The two uppermost deposits of these fluvial sediments are the Laguna and Victor formations (Sacramento County, 1992).

Seismicity and Faults

Within Sacramento County, the closest known active fault is the Dunnigan Hills fault, located approximately 19 miles northwest of the City of Sacramento (Sacramento County, 1992). The San Andreas fault is located approximately 80 miles to the southwest with the closest active branches of this fault being the Antioch (42 miles southwest) and the Green Valley and Concord faults (45 miles southwest). The Midland fault, also historically known to be active, is located about 22 miles west of the City of Sacramento. Seismic studies have also been undertaken to identify potentially active faults in the Auburn Dam project area. The Maidu East Lineament of the Bear Mountain fault was discovered as a result of these investigations (Sacramento County, 1996).

Since no active faults are in the immediate vicinity of the major populations of Sacramento County, seismic hazards related to surface ground rupturing are unlikely. However, although earthquake hazards are primarily associated with ground shaking in areas along a fault, ground shaking may affect areas for many miles in the vicinity of the fault. Secondary hazards associated with fault-related seismic episodes may include several types of ground movements including liquefaction, slope failures, landslides, lurch cracking, and differential settlement (Sacramento County, 1996).

Landslides

Landslide is the general term used to describe a falling mass of soil and rock. In Sacramento County, only a narrow corridor along the eastern boundary of the county extending from the Placer County line south to the Consumnes River is considered to hold landslide potential (Sacramento County, 1992).

Liquefaction

Liquefaction is the loss of soil strength due to seismic forces acting on water-saturated granular soils which leads to a "quicksand" condition generating various types of ground failure. There are two areas in Sacramento County which have been identified as being susceptible to liquefaction. These include the downtown core of the City of Sacramento and the Delta area (Sacramento County, 1992).

Subsidence

Subsidence is the gradual settling or sinking of the earth's surface with little or no horizontal motion. Sacramento County is affected by five types of land subsidence. These include: 1) compaction of unconsolidated soils due to earthquakes, 2) compaction by heavy structures, 3) erosion of peat soils, 4) peat oxidation, and 5) groundwater withdrawal (Sacramento County, 1992). Prolonged groundwater pumping and its affect on the regional groundwater aquifer is responsible for the greatest amount of land subsidence within Sacramento County.

Lateral Spreading

Lateral spreading is the horizontal movement or spreading of soil toward an open face such as a stream bank, the open side of a fill embankment, or the sides of levees. In Sacramento County, the areas most prone to lateral spreading are those with artificial fills that have been improperly engineered or have steep, unstable banks or those areas with high groundwater tables.

4.13.2 THRESHOLDS OF SIGNIFICANCE

The following impact significance criteria for soils and geology are derived from the recently amended CEQA Guidelines, Appendices G and I, and from the *Guidelines for Geologic/Seismic Considerations in Environmental Impact Reports* (California Division of Mines and Geology, 1982).

Impacts on geology were considered significant if the WFP would:

- Result in substantial changes in geologic substructures that could affect human safety; or
- Expose people or property to major geologic hazards, including unstable slopes (e.g., landslides), ground failure, subsidence, liquefaction, and lateral spreading.

Impacts to soils were considered significant if the WFP would:

- Increase soil disturbance leading to substantial wind or water erosion of soils; or
- Result in the permanent and substantial loss of soil cover.

4.13.3 WATER FORUM PROPOSAL IMPACTS

Impact 4.13-1

Changes in Geologic Substructures. *While the WFP itself would not require ground disturbing activities, implementation of the WFP over time, has the potential to substantially change geologic substructures through future construction activities associated with new water facilities (i.e., river intakes, water treatment plants, pump stations, well fields and conveyance pipelines). With the construction of these facilities, potential changes to subsurface geology could affect human safety. However, development and planning of future water facilities projects would consider geotechnical studies and implement design recommendations, as appropriate, in order to minimize any hazardous geologic changes to the underlying substrata. Therefore, changes in geologic substructures are considered* ***less than significant.***

The WFP does not involve construction activities requiring earth moving, ground breaking or disturbance of the existing subsurface geologic environment. However, specific water projects may be implemented by the Water Forum stakeholders in the future, consistent with the intent of the WFP, which could result in construction activities that hold the potential to cause various forms of ground disturbance. These future projects may include new water treatment plants, river intake structures, Ranney collectors, infiltration galleries, groundwater wells, pumping/booster stations, and conveyance pipelines. Any of these future projects have the potential to alter the underlying subsurface environment to varying degrees.

As future projects are proposed and specific information relating to their site plans and construction activities become known and developed, detailed site-specific analyses of those physical structures on the underlying geologic substrata would be made. Prior to the installation and operation of future infrastructure, soils/geotechnical investigations would be conducted relating to structural stability and hence, human safety and design recommendations provided for all components of the future infrastructure. These investigations may include seismic considerations and involve subsurface soil studies documenting soil bearing capacity, groundwater presence, and trench and slope stability.

At the time of construction, it is expected that project plans and specifications would consider all recommendations identified in soil/geotechnical investigations conducted for the project to ensure compliance with relevant State and local building codes and construction ordinances. A geotechnical engineer would either be on-site during construction or intermittently observe all excavation activities, providing advice to the grading contractor in the field, as necessary.

Future facilities could expose their operators and maintenance workers to both the direct and indirect effects of ground motion from earthquakes. While the project area (direct and indirect study area and water service study area) is not known to support active faults, ground shaking associated with moderate to large earthquakes along any of the regionally active faults (Dunnigan Hills, Antioch, Green Valley, Concord, or Midland) has the potential to affect these facilities, depending on their magnitude. Based on historical earthquake-induced ground shaking episodes, however, the level of expected disturbance is not anticipated to result in building collapse or major structural failures that would be considered a significant threat to human safety.

Impact 4.13-2

Exposure to Major Geologic Hazards. *While implementation of the WFP would not result in any undue exposure to major geologic hazards, construction of future projects associated with the implementation of the WFP, has the potential to expose people or property to major geologic hazards, including unstable slopes, ground failure, subsidence, liquefaction, and lateral spreading. Given the relative stability of the geologic subsurface environment in the greater Sacramento area, and the necessary geotechnical/soils studies and proper design practices that would be required in all future projects, exposure to geologic hazards is considered to be a* ***less-than-significant*** *impact.*

The WFP does not involve any ground disturbing construction activities that would result in de-stabilization of surface or subsurface unconsolidated material. As discussed for Impact 4.13-1, it is not expected that ground shaking induced by earthquakes would be of sufficient magnitude to cause significant damage to buildings or lead to a significant risk in human safety because of the increased threat of major structural failures (i.e., building collapse). Future projects, when proposed, would be required to fully consider and evaluate specific information relating to the site plans and construction activities associated with those projects. As discussed above, at the time of construction, it is anticipated that all of the recommendations (i.e., mitigation measures) identified in any soils/geotechnical investigations prepared for the project would be followed and applied to the construction activities.

While the topography of the Water Service Study Area can be generally characterized as nearly level (less than 1% slope) with low terraces common, slope instability could be a potential concern with future project infrastructure in highly localized areas. Particularly, where future intake structures and raw water conveyances cross levees, the potential exists for levee slopes to be destabilized. Owing to the importance of flood levees in the Sacramento region, any activities associated with their physical structure are strictly regulated (e.g., Reclamation Board, U.S. Army Corps of Engineers) and all precautions taken to avoid any effects to levee integrity.

Liquefaction and lateral spreading are the result of lowered shear resistance of unconsolidated materials (e.g., soils) caused by increased pore pressure. The addition of water to these materials, as would occur with a rising water table, is a frequent cause of these conditions. Additionally, slope angle acts to promote downslope movement so that such movement is enhanced on steeper slopes. In Sacramento, Placer, and El Dorado counties within the project area, groundwater levels are well below the surface and situated in weathered bedrock (see

Section 4.3.1, Groundwater Resources - Existing Conditions). It is anticipated that the WFP would not contribute to rising water tables anywhere in the project area sufficient to reduce the cohesive nature of the unconsolidated materials to a point where lateral spreading or liquefaction would be induced. In addition, shear stress acting downslope would be minimized due to the generally flat topography of the project area.

As mentioned previously, prior to the approval and implementation of future project-specific actions or their components, soils/geotechnical studies would be conducted as part of the required environmental analysis and permitting compliance for those individual proposed projects. Exposure to major geologic hazards is considered to represent a less-than-significant impact.

Impact 4.13-3

Increased Soil Erosion by Wind or Water. *The WFP itself would not involve any construction activities that would disturb surface soils and thereby induce either wind or water erosion. However, construction activities related to future water projects associated with the implementation of the WFP could lead to short-term soil disturbing activities. With the availability of project-specific siting investigations, soils/geotechnical studies and the implementation of any necessary project-specific mitigation measures, and increased soil erosion is considered to represent a* ***less-than-significant*** *impact.*

The WFP would not involve any construction activities that would be associated with the disturbance of surface soils. As mentioned, prior to the approval and implementation of future project-specific actions or their components, siting/location investigations as well as soils/geotechnical studies would be conducted as part of the required design and environmental analysis for those individual proposed projects. Mitigation measures developed for these projects, where appropriate, would be based upon existing planning and approval processes applicable to those types of projects. As an example, the Sacramento County Land Grading and Erosion Control Ordinance requires any construction activity, capable of displacing 350 cubic yards or more of soil or clearing one acre or more of land, to prepare plans setting out all of the measures to control erosion, sedimentation, dust, construction materials, and pollutant entry into waterways, surrounding areas, or otherwise public rights-of-way. Increased soil erosion or substantial permanent soil cover loss are considered to represent less-than-significant impacts.

Impact 4.13-4

Loss of Soil Cover. *While the WFP itself would not include activities that would promote soil loss, future projects could result in land conversion and subsequent soil loss. Certain project facilities where situated in open terrain, may result in the permanent loss of some soil cover. However, future projects would have to evaluate potential soil loss impacts and mitigate for any identified significant effects. Soil loss associated with the WFP is considered to represent a* ***less-than-significant*** *impact.*

The WFP would not involve any construction activities that would be associated with the disturbance of surface soils. Moreover, as discussed in Section 4.10, Land Use, loss of soil cover results from land conversions (e.g., agricultural to urban). The Sacramento County General

Plan promotes the protection and long-term health and resources value of agricultural soils through its Policy CO-55. Under this policy, the loss of soils categorized as Prime or Statewide Importance would be considered a significant impact under CEQA if losses exceed 50 acres. The WFP itself would not result in soil cover loss.

Future projects, however, would be evaluated in detail for their potential impacts to soil resources. Where individual facilities or their components are proposed and would change the existing land use such that soil cover would be irretrievably lost, such impacts would be identified, described, and mitigated during project specific review and before project completion.

4.13.4 MITIGATION MEASURES

No mitigation measures are necessary for the following less-than-significant impacts:

4.13-1: Changes in Geologic Substructures
4.13-2: Exposure to Major Geologic Hazards
4.13-3: Increased Soil Erosion by Wind or Water
4.13-4: Loss of Soil Cover

4.13.5 LEVEL OF SIGNIFICANCE AFTER MITIGATION

None of the potential impacts identified above would result in significant impacts.

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