Lower American River Flow Management Standard

July 31, 2006

LOWER AMERICAN RIVER
FLOW MANAGEMENT STANDARD

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List of Acronyms

AF	acre-feet
ARG	Lower American River Group
B2IT	(b)(2) Interagency Team
BO	Biological Opinion
CDFG	California Department of Fish and Game
cfs	cubic feet per second
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CWT	coded-wire tags
D-893	State Water Resources Control Board Decision 893
Delta	San Francisco Bay/Sacramento-San Joaquin Delta
FMS	Flow Management Standard
FRI	Four Reservoir Index
INI	Impaired Nimbus Inflow Index
MFR	Minimum Flows Requirement
NMFS	National Marine Fisheries Service
OCAP	Operating Criteria and Plan
Operations Forecast	Annual Operations Forecast
Reclamation	Bureau of Reclamation
RST	rotary screw trap
SRI	Sacramento River Index
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
Temperature Plan	Reclamation May 1 Annual Water Temperature Management Plan
USFWS	U.S. Fish and Wildlife Service
WOMT	Water Operations Management Team

LOWER AMERICAN RIVER
FLOW MANAGEMENT STANDARD

1.0 INTRODUCTION

The American River is the second largest tributary to the Sacramento River, a critical component of the San Francisco Bay/Sacramento-San Joaquin Delta (Delta) system that provides drinking water to two thirds of the state and irrigation water to half of California's agriculture industry. The lower American River (**Figure 1**) is a particularly valuable asset within the Sacramento region, providing important fish and wildlife habitat, a high-quality water source, a critical floodway, and a spectacular regional recreational parkway.

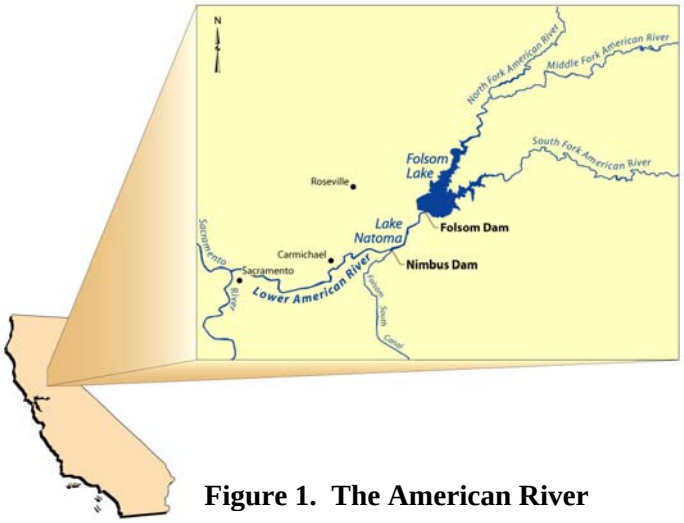

Figure 1. The American River

The Bureau of Reclamation (Reclamation) operates Folsom Dam and Reservoir to provide water for irrigation, municipal and industrial uses, hydroelectric power, recreation, water quality, flood control, and fish protection. Reclamation operates under a state water right permit and fish protection requirements that were adopted in 1958 as State Water Resources Control Board (SWRCB) Decision 893 (D-893). This decision allows flows at the mouth of the American River to fall as low as 250 cubic feet per second (cfs) from January through mid-September, with a minimum of 500 cfs required between September 15 and December 31.

Biological, socioeconomic, legal, and institutional conditions have changed substantially since the SWRCB adopted D-893 in 1958. For example, D-893 does not address requirements of the Central Valley Project Improvement Act (CVPIA), the 1995 Bay Delta Plan, or biological opinions (BO) to protect Central Valley anadromous salmonids. The SWRCB, Reclamation and many diverse stakeholders (e.g., Water Forum[1]) involved in various American River actions have agreed that the conditions specified in D-893 are not sufficiently protective of the fishery resources within the lower American River. In fact, as a result of Reclamation operating the Folsom/Nimbus Dam complex to more recent requirements and habitat management plans, flows in the lower American River have been well in excess of those required by D-893.

[1] In September 1993, the Water Forum, a diverse group of business and agricultural leaders, citizens groups, environmentalists, water managers, and local governments in the Sacramento Region, was formed to evaluate water resources and future water supply needs of the Sacramento metropolitan region.

1.1 PURPOSE OF THE FLOW MANAGEMENT STANDARD

The Flow Management Standard (FMS) is intended to result in improved conditions for fish in the lower American River, particularly fall-run Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead *(O. mykiss).* The primary purpose of the FMS is to maximize the annual production and survival of anadromous salmonids and promote a dynamic, resilient and diverse fish assemblage, within the context of water availability and operational constraints. The improved flow standard will:

- Improve currently required flows and water temperatures
- Formalize a river management process for Folsom Reservoir and lower American River operations
- Coordinate monitoring, evaluation and reporting of the resultant hydrologic and biological conditions

The proposed FMS consists of three separate elements: Minimum Flows Requirement (MFR) and Water Temperature Objectives (Sections 2.0 and 3.0); Lower American River Group (Section 4.0) and Monitoring and Evaluation Program (Section 5.0). In addition, the FMS includes criteria for implementation of the MFR (Section 6.0).

2.0 MINIMUM FLOWS REQUIREMENT

The MFR is the cornerstone of the FMS. As used in the FMS, the term "Minimum Flows Requirement" is meant to describe the minimum required flows and does not preclude Reclamation from making higher releases at Nimbus Dam. The MFR, as measured by the total release at Nimbus Dam, vary throughout the year in response to the hydrology of the Sacramento and American river basins.

The October 1 through December 31 MFR range between 800 and 2,000 cfs. The January 1 through Labor Day MFR range between 800 and 1,750 cfs. The post Labor Day through September MFR range between 800 and 1,500 cfs.

As a general rule, the MFR must equal or exceed 800 cfs year round. Narrowly defined exceptions to this rule allow Nimbus releases to drop below 800 cfs to avoid depletion of water storage in Folsom Reservoir when dry or critical hydrologic conditions are forecasted to occur. These narrowly defined exceptions to the MFR (described below in italics) are an important component of the FMS.

2.1 OCTOBER THROUGH DECEMBER MINIMUM FLOWS REQUIREMENT

- During the October through December period, MFR is based on the Four Reservoir Index (FRI), which is calculated as the combined end-of-September storage in four reservoirs –

French Meadows, Union Valley, Hell Hole, and Folsom. MFR from October through December range between 800 and 2,000 cfs.

- A Chinook salmon spawning flow progression is included that incorporates a water temperature trigger of 60ºF. The flow progression has been developed for efficient use of water supply. In other words, more water is provided when more fish are expected to be spawning. The flow progression also is intended to avoid redd superimposition by gradually stepping up the flows to the prescribed MFR. Thus, the MFR from October through December would be implemented as follows:

If the FRI indicates that MFR is to be less than 1,500 cfs

- Implemented on October 1
- Continue at same level through December 31

If the FRI indicates that MFR is to be 1,500 cfs or higher

- October 1 through November 1: 1,500 cfs
- November 2 through November 8: MFR minus 250 cfs, but no less than 1,500 cfs
- November 9 through December 31: MFR

2.2 JANUARY AND FEBRUARY MINIMUM FLOWS REQUIREMENT

- During January and February, the MFR is based upon the preceding month MFR, adjusted by the Sacramento River Index (SRI), which is an index of water year runoff for the entire Sacramento River Basin that is updated monthly. The MFR in January and February is between 800 and 1,750 cfs.
  - If the SRI predicts an above normal or wet year, then the January MFR is 1,750 cfs.
  - If the SRI predicts a dry or below normal year, then the January MFR remains the same as December, but no greater than 1,750 cfs.
  - If the SRI predicts a critically dry year and the December MFR is equal to or greater than 800 cfs, then the January MFR is 85 percent of the December MFR or 800 cfs, whichever is greater.
  - In February, the calculation is the same as for January, except the January MFR is the basis for the calculation.

  Defined Exception:
  - *If the SRI predicts a critically dry year and the Previous Month MFR is less than 800 cfs, then this condition is an "off-ramp condition" (described below), wherein the January and/or February MFR is 250 cfs, in lieu of the SRI-adjusted MFR.*

- The MFR is subject to potential adjustments based on the end of previous month Folsom Reservoir storage.
  - If the end-of-December Folsom Reservoir storage is less than 300,000 acre-feet (AF), then the January MFR is set at 85 percent of the December MFR or 800 cfs, whichever is greater.
  - If the end-of-January Folsom Reservoir storage is less than 350,000 AF, then the February MFR is 85 percent of the January MFR or 800 cfs, whichever is greater.

- These adjustments only apply if end-of-month storage below the indicated thresholds is not induced by flood control operations. Because MFR during critically dry years are already subject to adjustments based on the SRI, potential adjustments based on the end of previous month Folsom Reservoir storage are not applicable during critically dry years.

2.3 MARCH THROUGH MAY MINIMUM FLOWS REQUIREMENT

- From March through May, the MFR in the lower American River are based on the Impaired Folsom Inflow Index (IFII), which is defined as the forecasted May through September Folsom Reservoir inflow. The MFR from March through May are between 800 and 1,750 cfs.
- Forecasted end-of-May storage at Folsom Reservoir is examined in late February to determine if the IFII-based MFR, or the February MFR, is implemented for the March through May period.
  - If the end-of-May Folsom Reservoir storage is forecasted to be equal to or greater than 700,000 AF, then the IFII-based MFR is implemented.
  - If the end-of-May Folsom Reservoir storage is forecasted to be less than 700,000 AF, then the March through May MFR is either the IFII- based MFR, or the February MFR, whichever is less.

2.4 JUNE THROUGH SEPTEMBER MINIMUM FLOWS REQUIREMENT

- The IFII (described above) used to establish March through MFR, also is the index used to establish the MFR from June through September. The MFR from June through Labor Day are between 800 and 1,750 cfs. The Post Labor Day through September MFR is between 800 and 1,500 cfs.

Defined Exception:

- *Forecasted end-of-September storage is examined[2] in late May to determine if the IFII-based MFR results in the forecasted end-of-September storage being less than 300,000 AF.*
  - *If the forecasted end-of-September storage is less than 300,000 AF, then the MFR would be adjusted to the average release expected to result in an end-of-September storage of 300,000 AF. Flows resulting from this defined exception shall not be less than 250 cfs.*

2.5 WATER CONSERVATION AND FISH PROTECTION ADJUSTMENTS TO MINIMUM FLOWS REQUIREMENT

- For the period of August 15 through Labor Day, potential adjustments to the MFR prescribed by the appropriate index have been developed for the purpose of: (1) water conservation; or (2) fish protection. The upper range of the MFR (i.e., greater than 1,500

[2] This examination involves a calculation taking into account end-of-May Folsom Reservoir storage; forecasted June through September Folsom Reservoir Inflow, diversions, and evaporation; June through September Folsom South Canal diversions; and June through September Nimbus Dam IFII Minimum Flow. The resultant end-of September storage is the forecasted storage referred to for this defined exception.

cfs) for this period is subject to an adjustment of as much as 250 cfs, as long as resultant flows are not lower than 1,500 cfs.

- Water Conservation Adjustments
  - In approximately one-third of the years in the 72-year period of simulation, hydrologic conditions during August 15 through Labor Day suggest a potential for conserving water in Folsom Reservoir.
  - Reclamation will consult and coordinate with other members of the American River Group (California Department of Fish and Game (CDFG), U.S. Fish and Wildlife Service (USFWS), and the National Marine Fisheries Service (NMFS)) prior to water conservation adjustments. Reclamation will document the reasons for water conservation adjustments and the effects, if any, on the fishery, and will provide a revised Annual Operations Forecast (Operations Forecast) for the remainder of the period covered by the forecast.
  - Water conservation adjustments will not cause or exacerbate harmful water temperature-related impacts to: (1) rearing juvenile steelhead; or (2) spawning fall-run Chinook salmon.
- Fish Protection Adjustments
  - Fish protection adjustments will only occur with prior documented unanimous concurrence from USFWS, NMFS and CDFG. Concurrence shall be based on protection of the lower American River fisheries (including conservation of remaining cold water reserves), taking into account effects of the adjustment to the MFR on in-river water temperature and habitat.

- For the period Post Labor Day through October 31, the upper range of the MFR (i.e., greater than 1,250 cfs) is subject to a fish protection adjustment of as much as 250 cfs, as long as resultant flows are not lower than 1,250 cfs. Fish protection adjustments will only occur with prior documented unanimous concurrence from USFWS, NMFS and CDFG. Concurrence shall be based on protection of the lower American River fisheries (including conservation of remaining cold water reserves), taking into account effects of the adjustment to the MFR on in-river water temperature and habitat.

2.6 ANNUAL OPERATIONS FORECAST

The Operations Forecast to be developed by Reclamation by May 1 each year will be based on the most accurate forecast available, and will describe how project operations will be consistent with the MFR indicated by the appropriate FMS indices and the Water Temperature Objectives. Water conservation or fish protection adjustments to MFR prescribed by the FMS from August 15 through October 31 will not be relied on or incorporated into the Annual Operations Forecast. For additional information, please refer to Section 4.0, Lower American River Group.

2.7 YEAR-ROUND DEFINED EXCEPTIONS

- ***Conference years****- when the projected March through November unimpaired inflow to Folsom Reservoir is less than 400,000 AF. Special provisions for conference years are included in the FMS, including the following provision, which is specifically related to the FMS MFR.*

- *A flow requirement of 190 cfs[3] will be established downstream of the H Street Bridge.*

- ***Off-ramp criteria-*** *are triggered if forecasted Folsom Reservoir storage at any time during the next 12 months is less than 200,000 AF.*
  - *From January 1 through September 15, the MFR may be reduced to as low as 250 cfs.*
  - *From September 16 through December 31, the MFR may be reduced to as low as 500 cfs.*

3.0 WATER TEMPERATURE OBJECTIVES

The Water Temperature Objectives of the FMS are consistent with best available information in the literature and recent empirical experience on the American River (refer to FMS Water Temperature Objectives Documentation). The objectives comply with the targets identified in the NMFS BO (2004) for the Long-Term Central Valley Project (CVP) and State Water Project (SWP) Operations and Criteria Plan (OCAP), which are intended to minimize water temperature effects on Central Valley steelhead, including the lower American River. The NMFS BO (2004) includes a target water temperature of 68ºF at Watt Avenue Bridge on the lower American River for the protection of steelhead. The NMFS BO (2004) further states that a target of 68ºF at Watt Avenue will likely provide a limited section of river between Nimbus Dam and Watt Avenue in the preferred 65ºF range without seasonally exhausting the limited cold water available.

The FMS Water Temperature Objectives are consistent with: (1) the public trust doctrine, Fish and Game Code Section 5937, and Water Code provisions protective of fish and wildlife; (2) Reclamation's responsibility to ensure that its actions do not adversely modify critical habitat, including the recently designated lower American River, for steelhead and non-natal juvenile spring-run Chinook salmon rearing and smolt emigration (70 FR 52488) effective January 2, 2006; (3) NMFS' policy of ensuring that effects of management and conservation actions promote listed species' recovery; and (4) the Department of Interior Anadromous Fish Restoration Program's efforts to double the natural production of anadromous fish in the Central Valley (CVPIA 1992) (Reclamation Website).

The following FMS Water Temperature Objectives are to be achieved, to the extent physically controllable[4]:

1. *Subject to Section 2 below, Reclamation shall manage the Folsom/Nimbus Dam complex and the water temperature control shutters at Folsom Dam to maintain a daily average[5] water temperature of 65°F or less at Watt Avenue Bridge from May 15 through October 31 to provide suitable conditions for juvenile steelhead rearing in the lower American River.*

2. *If the 65°F Water Temperature Objective set out in Section 1 cannot be met during all or any portion of the period from May 15 through October 31 because of limited cold water availability in Folsom Reservoir, then at those times it cannot be met, the target daily*

[3] 190 cfs is 75 percent of the flow requirement in D-893 for January through Mid-September.
[4] This is subject to the caveat that the bypass of water in lieu of its use for power generation shall be employed to improve water temperature conditions only when recommended by the Lower American River Group (ARG).
[5] The daily average will be calculated using the average of the hourly readings.

average water temperature at Watt Avenue may be increased incrementally (i.e., in no more than one degree steps, to as high as 68°F).

3. *If the Water Temperature Objectives pursuant to Sections 1 and 2 above are exceeded for three consecutive days or are exceeded by more than 1°F for a single day, Reclamation shall notify and may convene the ARG to obtain input and recommendations regarding potential cold water management alternatives to improve water temperature conditions for the fisheries.*

4. *The Water Temperature Objectives to be met at the Watt Avenue Bridge set forth in Sections 1 and 2 above are based upon steelhead rearing habitat needs. During the month of October, the holding of fall-run Chinook salmon prior to spawning is also a significant concern. Therefore, Reclamation shall operate to achieve a daily average water temperature of 60°F or less as early as possible in October for fall-run Chinook salmon holding and spawning. Reclamation shall strive to maintain a daily average water temperature of 60ºF or less until November 1, and target 56°F or less as early in November as possible, for fall-run Chinook salmon spawning and egg incubation. These Water Temperature Objectives for fall-run Chinook salmon will be met at Hazel Avenue in the lower American River.*

5. *The priority for use of the lowest water temperature control shutters at Folsom Dam shall be to achieve the Water Temperature Objectives for steelhead set forth in Sections 1 and 2. Thereafter, the shutters may also be used to meet the fall-run Chinook salmon spawning water temperature objective.*

Reclamation May 1 Annual Water Temperature Management Plan (Temperature Plan) will incorporate and be prepared in accordance with the above objectives. The Temperature Plan shall be designed to minimize water temperature effects on Central Valley steelhead and provide for Chinook salmon spawning in the fall. If unanticipated conditions arise following the preparation of the May 1 Temperature Plan that affect the water temperatures specified in the Temperature Plan, the Temperature Plan shall be revised to reflect any resulting changes, provided that the revised Temperature Plan shall continue to incorporate and be consistent with the above objectives. The SWRCB shall be provided copies of the May 1 Temperature Plan and any revised Plans.

The foregoing Water Temperature Objectives are consistent to the extent reasonably foreseeable with the MFR element of the FMS. In the event of any conflict, the MFR shall prevail. Compliance with the Water Temperature Objectives set out above shall constitute compliance with these water temperature provisions

4.0 LOWER AMERICAN RIVER GROUP

4.1 INTRODUCTION

4.1.1 Purpose

The purpose of this section is to describe the structure, responsibilities, and procedures of the Lower American River Group (ARG). The purpose, membership, and process of this

interagency group/team that meets to review, deliberate, and coordinate fishery and river operational requirements in the lower American River also are described.

4.1.2 Background

The lower American River is a significant resource of considerable interest to fishery management agencies, the public and Reclamation. The USFWS, NMFS and CDFG are agencies with trust responsibilities for fishery resources in the lower American River. Reclamation is responsible for operating the Folsom/Nimbus Dam complex to meet local and downstream water demands, regulatory requirements, and fish habitat needs. Reclamation has a need to consider its operations as they relate to lower American River instream resources, and other concerns of fisheries agencies that have regulatory and fish management responsibilities, as well as to provide the public with a forum to provide and exchange information.

4.2 PURPOSE OF THE LOWER AMERICAN RIVER GROUP

4.2.1 Mission Statement

The mission of the ARG is to conduct open discussion and deliberation of the biological and operational status of the lower American River, and to provide useful information and formulate recommendations for protection of fisheries and other instream resources consistent with the FMS, and for the operation of the Folsom/Nimbus Dam complex as a unit of the overall CVP.

4.2.2 Objectives

The objectives of the ARG are to:

- Provide information and recommendations to Reclamation for the development and implementation of management strategies and actions beneficial to aquatic resources of the lower American River, including the Temperature Plan and Operations Forecast, and other special studies or events (e.g., MFR defined exceptions[6], water transfers)
- Review physical, biological, and ecological status of the lower American River aquatic resources
- Share information to help create common ground of understanding
- Provide public outreach and opportunity for discussion in a public forum
- Report on actions taken

4.3 MEMBERSHIP

The ARG consists of representatives from Reclamation, USFWS, NMFS, and CDFG.

4.3.1 Sponsor

Reclamation will serve as the ARG sponsor. The sponsor will be responsible for facilitating meetings and maintaining the meeting record, with input from the ARG in accordance with ARG procedures; developing the Temperature Plan and Operations Forecast and amendments thereto;

[6] Please refer to Section 2.0, Minimum Flows.

maintaining and disseminating operational data (flow and water temperature), forecasting operations; providing data sources and other information used in the formulation of the Operations Forecast and the Temperature Plan as needed; providing technical expertise as needed; conducting public outreach; preparing summaries of operational data; reporting relevant monitoring data and research results produced by Reclamation; and taking the lead in preparing and coordinating the compilation of annual and other reports.

4.3.2 Cooperating Agencies

The USFWS, NMFS, and CDFG will be the Cooperating Agencies. The Cooperating Agencies will be responsible for representing their respective agencies at all meetings; providing technical expertise as needed; participating in the development of operational forecasts; reviewing and commenting on the Temperature Plan and Operations Forecast; assessing the biological effects of changes to proposed operations and recommending changes to those operations; participating in public outreach; preparing summaries of biological monitoring and research activities conducted by their respective agencies; reviewing and commenting on biological sections of reports; and participating in the preparation of the annual reports by providing the assessment of biological effects associated with operations during the previous year. Each Cooperating Agency will designate an individual to represent its interests on the ARG and ensure that the responsibilities of their respective agencies are met.

4.4 PROCESS AND PROCEDURES

4.4.1 Regularly Scheduled and Other Meetings

The ARG will hold regularly scheduled meetings that will be convened no less often than every six weeks. Regularly scheduled meetings will be open to the public. Notice of these regularly scheduled meetings will be provided at least five days prior to the date of the regularly scheduled meeting to any person requesting notice. If conditions arise that warrant holding a meeting of the ARG to consider changed circumstances or proposed changes in operations other than at a regularly scheduled meeting, the ARG may meet with such notice, which may be less than five days, as may be practicable in light of the circumstances, and may meet telephonically if circumstances warrant.

4.4.2 Agenda

A typical agenda for a regularly scheduled meeting of the ARG will include, but not be limited to, reviews of the current biological and hydrologic conditions, forecasted operations, and other special studies or events (e.g., Temperature Plan, Operations Forecast; MFR off-ramps, transfers), followed by discussion to identify biological issues or concerns, and to formulate recommendations.

4.4.3 Public Input

Members of the public and other agencies[7] will be encouraged to comment on matters under consideration by the ARG, and the ARG will consider all public comments when developing recommendations to Reclamation and/or the Cooperating Agencies. The public includes other

[7] Agencies other than the previously identified Cooperating Agencies

agencies, individuals, or organizations with an interest in the activities of the ARG and lower American River, or whose interest may be affected by operation of the Folsom/Nimbus Dam complex. The public may attend ARG meetings as desired, provide technical input to issues relevant to project operations and biological resources, articulate special interest in or need for specific hydrologic conditions, report on their independent research activities, coordinate in-river activities, and articulate any other concerns or issues related to their organization or interest as part of the regular meeting process.

4.4.4 Regular Meeting Notes and Supporting Information

Meeting notes summarizing the issues discussed and recommendations, if any, made during each meeting will be prepared by Reclamation and reviewed by the Cooperating Agencies. The final approved meeting notes will be distributed to all meeting participants and interested public following an ARG meeting. Supporting documentation and other information used at ARG meetings also will be made available to all meeting participants and the public at the meeting at which they are considered, or if that cannot be done, as soon as practicable following the meeting.

4.4.5 Annual Report

Reclamation will take the lead in the preparation of an annual report every February that includes the notes from ARG meetings, description and evaluation of lower American River actions taken and effects, and lessons learned during the previous calendar year. The ARG will assist Reclamation in the preparation of the annual report by preparing the section describing the evaluation of the biological effects of the operational actions taken during the previous calendar year.

4.4.6 Operational Decision Making

Reclamation maintains its authority and responsibility for operations of the Folsom/Nimbus Dam complex. The ARG has no authority to make operational decisions.

Emergency and Time Sensitive Decisions

Reclamation will strive to identify all foreseeable hydrologic, physical, and biological issues or conditions that have historically been, or may be expected to be of interest to the ARG during regularly scheduled meetings. If Reclamation needs to take an action, based on emergency conditions or unforeseen changes in biologic, hydrologic, or physical conditions that are so urgent that they require action before discussions with the ARG can take place, Reclamation will immediately notify Cooperating Agencies of the action and the circumstances that required the action. The public will be notified of the action taken through the normal reporting mechanisms and discussion of the action will take place at the next meeting of the ARG.

ARG Recommendations

All recommendations to be presented to Reclamation by the ARG will be vetted and resolved through the decision process described in this document and shown in **Figure 2**. The Cooperating Agencies will seek to reach consensus on all recommendations to be provided to Reclamation. Reclamation and the Cooperating Agencies will consider all known factors that

may require additional discussion of the recommendation outside of the ARG. If ARG discussions on a proposed recommendation result in consensus, Reclamation, in coordination with the Cooperating Agencies, will review the recommendation to ensure additional discussion outside of the ARG is not needed. In the absence of a need for such further discussion, Reclamation will implement an operational decision(s) consistent with the ARG consensus. If there is no consensus, or if Reclamation and/or the Cooperating Agencies identify the need for additional discussion outside of the ARG, the matter will be referred to either the (b)(2) Interagency Team (B2IT) (or a functionally equivalent group) or to the Water Operations Management Team (WOMT) (or a functionally equivalent group), as appropriate. If there is consensus on a recommendation from the B2IT and/or WOMT, Reclamation will implement the operational decision(s) accordingly. If no consensus is reached, Reclamation will weigh the input from either the B2IT and/or WOMT and make and implement the operational decision(s). Reclamation will inform the ARG of the operational decision(s) through the normal reporting mechanisms and discussion of the decision(s) will take place at the next regularly scheduled meeting of the ARG.

4.5 RECLAMATION AND ARG RESPONSIBILITIES

Reclamation and the ARG will have the responsibilities described below.

4.5.1 Annual Water Temperature Management Plan and Annual Operations Forecast

Reclamation will prepare a Temperature Plan for submission to NMFS, and an Operations Forecast of the operations of the Folsom/Nimbus Dam complex based on forecasted conditions covering the 12-month period beginning on May 1 of each year. The Operations Forecast will be in support of the Temperature Plan and will be consistent with the flow and temperature provisions of the FMS on an ongoing basis. The information provided in the Operations Forecast will be used in the development of the Temperature Plan. Reclamation will confer with the ARG in developing the Temperature Plan and the Operations Forecast, and the ARG will be afforded full opportunity to comment and make recommendations on the Temperature Plan prior to its submission to NMFS for approval by May 1, and on the Operations Forecast in the same time frame.

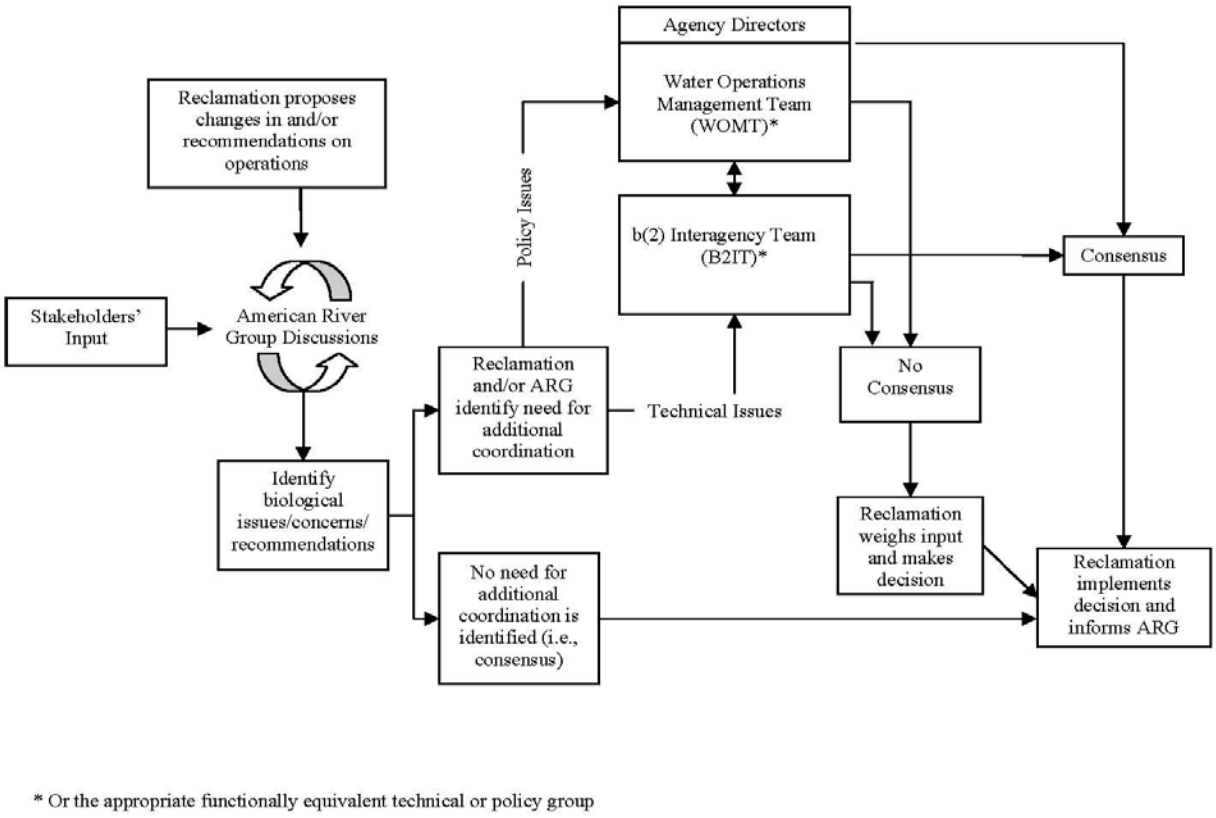

Figure 2. Decision Process

Annual Water Temperature Management Plan

Reclamation will continue to be responsible for the set of data needed to model the use of coldwater resources each spring. Model studies will be developed to evaluate the effects of an incremental series of downstream water temperature targets on the seasonal availability of cold water in Folsom Reservoir. Model results along with input data (operations forecast, reservoir temperature profile, shutter operation assumptions, inflow assumptions, and assumed water temperature conditions), as needed, will be presented to the ARG for discussion. The ARG will consider and discuss the biological tradeoffs of meeting a specific downstream water temperature target during the summer months, and conserving a sufficient volume of cold water for use during the fall-run Chinook salmon spawning period. The ARG will recommend downstream water temperature targets that Reclamation will consider for incorporation into the final Temperature Plan submitted by Reclamation to NMFS. The Temperature Plan will be subject to NMFS approval, which will be documented, and will comply with the terms of NMFS BO on OCAP in effect when the Temperature Plan is due (or functionally equivalent document). The Temperature Plan also will be consistent with the FMS Water Temperature Objectives[8]. Progress towards meeting the water temperature target(s) and impacts to availability of cold water will be routinely reported as part of ARG meetings. The need for modifications or

[8] Please refer to Section 3.0, Water Temperature Objectives.

changes to the Temperature Plan will be fully vetted and resolved through the ARG in a process similar to that used in developing the initial downstream water temperature target(s).

Annual Operations Forecast

Reclamation will prepare an Operations Forecast that will guide operations anticipated for the succeeding 12 months. Conditions described in the Operations Forecast will include forecasted reservoir inflow, forecasted monthly average Nimbus Dam releases, end of month reservoir storages and elevations, hydrological data and indices used to determine the flows prescribed by the FMS (i.e., Minimum Flows), and controlling operations constraints (e.g., Delta water quality, flood control). Reclamation also will provide other information related to Folsom Dam operations, including CVP water allocations, water year classifications, and CVPIA 3406 (b)(2) accounting. Because as the water year progresses, actual conditions will differ from the forecasted conditions, Reclamation will update the Operations Forecast and present the updated Forecast for ARG consideration for each ARG meeting. Deviations from the Operations Forecast that may affect the Temperature Plan will be fully vetted, as described in Annual Water Temperature Management Plan, above.

4.5.2 Adjustments to the Minimum Flows Prescribed by the Appropriate Index

The FMS allows adjustments to the MFR for water conservation and fish protection purposes from August 15 through October 31, under specified conditions (Adjustments). Adjustments will not be relied upon or incorporated into the Operations Forecast or the Temperature Plan. In the event that the monitoring of operations reveals a need for a change in water temperature targets or a need for one or more adjustments to the MFR, Reclamation will utilize the criteria and process described in Section 2.0, Minimum Flows Requirement, and the ARG criteria and process set forth herein to the extent consistent with Section 2.0.

4.5.3 FMS Monitoring and Evaluation Program

The ARG will discuss and interpret data gathered from monitoring efforts in the lower American River.

4.5.4 Water Transfers

ARG Members will utilize the ARG process to discuss potential biological issues and opportunities associated with water transfers affecting the lower American River.

4.5.5 Other

Other special actions or studies may be brought to the ARG as needed.

5.0 MONITORING AND EVALUATION PROGRAM

5.1 INTRODUCTION

Monitoring and evaluation of physical and biological factors is needed to provide information to support real-time operational decision making, and to evaluate the effects of the FMS on the aquatic resources of the lower American River. Monitoring and evaluation also will assist the

ARG[9] in developing and evaluating functional relationships between various riverine ecosystem influences, learn from previous actions, build on successes, and provide input to Reclamation regarding operational adjustments associated with fisheries and habitat changes. Monitoring is necessary to support evaluations of the effects of changes in environmental conditions and to identify potential actions to avoid or minimize adverse impacts, or to beneficially affect, the aquatic resources of the lower American River.

The FMS Monitoring and Evaluation Program consists of the following components:

- River Hydrology
- Water Temperature
- Adult Chinook Salmon Population
- Chinook Salmon Spawning
- Steelhead Spawning
- Steelhead Rearing
- Chinook Salmon Downstream Movement

Each component specifies fundamental monitoring objectives and activities specifically designed to evaluate the FMS, and to provide information on abiotic factors (i.e., hydrology and water temperature) that potentially affect lower American River aquatic resources. Performance indicators that will be used to assess instream conditions associated with implementation of the FMS will be developed in a subsequent effort[10]. Trends in performance indicators over time will serve to determine if the FMS is sufficient to maintain fish in "good condition" (California Fish and Game Code 5937) and to identify areas where supplemental[11] special studies or management emphasis might be needed.

Several resource agencies including CDFG, USFWS, NMFS, Reclamation, California Department of Water Resources (DWR), City and County of Sacramento, Sacramento Area Flood Control Agency, U.S. Army Corps of Engineers, and local water agencies and districts have or are conducting, funding, or otherwise participating in monitoring activities on the lower American River. In fact, most of the identified components of the FMS Monitoring and Evaluation Program are currently being implemented[12] by one or more of the entities listed above. An objective of the FMS Monitoring and Evaluation Program is to help reach consensus among the resource agencies and stakeholders regarding the information needed, and how the information will be developed, and to coordinate the efforts of the various organizations conducting monitoring in the lower American River. For example, efforts under the FMS Monitoring and Evaluation Program should be coordinated with other monitoring efforts in the lower American River, including efforts under the: (1) Central Valley Hatchery Review; (2) Comprehensive Assessment and Monitoring and Anadromous Fish Restoration Programs of the CVPIA; (3) Interagency Ecological Program; and (4) CDFG Central Valley Angler Survey.

[9] For additional information, refer to Section 4.0, Lower American River Group.
[10] Development of performance indicators may be carried out by the ARG.
[11] Supplemental special studies (e.g., Assess Drift and Benthic Communities of the Lower American River) are designed to improve the management of the lower American River by enhancing the understanding of anadromous salmonid populations and developing or confirming potential relationships among habitat conditions, particularly flow and water temperature, and biologic performance indicators.
[12] Some components currently implemented may require sampling protocol modification.

The FMS Monitoring and Evaluation Program will be updated periodically by Reclamation and the ARG to reflect the synchronization of monitoring efforts in the lower American River and/or to incorporate new information and understanding of the lower American River and its physical and biological resources. Moreover, the adaptive management character of the FMS Monitoring and Evaluation Program allows Reclamation and the ARG to update the program, as necessary, to maintain consistency with new regulatory requirements (e.g., new listings under the Endangered Species Act). The purpose of this adaptive management approach is to maintain the FMS Monitoring and Evaluation Program as a "living program" that will retain its utility as a management tool over many years. The objectives, cost and status of each of the components of the FMS Monitoring and Evaluation Program are provided below.

5.2 RIVER HYDROLOGY

The River Hydrology component consists of the use of existing monitoring stations and a future hydrology monitoring station that will be in place near the City of Auburn upon completion of the American River Pump Station Project.

Described below are the fundamental objectives associated with the River Hydrology component of the FMS Monitoring and Evaluation Program.

- Record flow at several operationally and biologically important sites, including tributaries to Folsom Reservoir and the lower American River
- Provide flow data for the real-time management of Nimbus Dam releases, and the rate of change of those releases
- Provide the basic data to evaluate the influence of flows on Chinook salmon and steelhead life stages present in the river

Cost Estimate

Conducting the River Hydrology and Water Temperature monitoring components of the FMS Monitoring and Evaluation Program is estimated to cost approximately $65,000/year (this amount only includes contracting, and does not reflect Reclamation's internal costs).

Currently Responsible Agency

Reclamation is currently conducting flow monitoring in the lower American River with assistance from the U.S. Geological Survey.

5.3 WATER TEMPERATURE

Continuance of existing water temperature monitoring stations/programs on the lower American River, at Nimbus and Folsom dams, in Folsom Reservoir and in tributaries to Folsom Reservoir are sufficient to evaluate potential effects of, and compliance with, the FMS.

Described below are the fundamental objectives associated with the Water Temperature component of the FMS Monitoring and Evaluation Program.

- Record water temperatures at several operationally and biologically important sites within the lower American River
- Provide water temperature data for the real-time management of flow, coldwater pool and water temperature conditions
- Produce water temperature data to evaluate relationships between water temperatures and Chinook salmon and steelhead life stages present in the river

Cost Estimate

Refer to the River Hydrology component.

Currently Responsible Agency

Reclamation is currently conducting water temperature monitoring in the lower American River with assistance from the U.S. Geological Survey.

5.4 ADULT CHINOOK SALMON POPULATION

Evaluation of fish population dynamics is essential for developing appropriate management, restoration and monitoring plans or programs. Population dynamics includes estimating changes in population size and composition. Spawning escapement surveys, also called "carcass surveys," represent one way of determining the size of a salmon population spawning in a river. However, salmon spawning escapement surveys may not necessarily provide an accurate account of the annual run size if other important factors affecting the size of the in-river population of spawning salmon are not adequately evaluated.

Estimating the total annual Chinook salmon run size in the lower American River includes estimating the number of Chinook salmon upstream of the Nimbus Hatchery weir including fish impinged on the weir, the number downstream of the weir, the number harvested by anglers, and the number entering Nimbus Hatchery.

In addition to the numeric estimation of Chinook salmon run-size, sampling of fresh carcasses can provide information regarding the biological characteristics of the run. Biological sampling of adult Chinook salmon carcasses and salmon entering the Nimbus Hatchery can provide information on the length and age distribution of spawning adults, sex ratio, egg retention, pre-spawning mortality, and contribution of hatchery-produced fish to the spawning Chinook salmon population. Descriptions of the composition, general condition and potential spawning success (e.g., egg retention and pre-spawning mortality) of the annual runs are important components in understanding the in-river production of Chinook salmon, and how the production is responding to the habitat conditions (i.e., flows and water temperatures) occurring with implementation of the FMS.

In order to provide a detailed and consistent assessment of the Chinook salmon population returning to the lower American River each year, the adult Chinook salmon population monitoring program has been subdivided into four components including:

- Spawning escapement (carcass) monitoring

- Biological sampling of carcasses
- Assessment of in-river angler harvest
- Monitoring of fish passage into the Nimbus Hatchery (including fish impinged on the Nimbus Hatchery weir)

The annual in-river run size will be calculated each year as the sum of: (1) the corresponding in-river escapement estimate; (2) the annual in-river angler harvest estimate; (3) the total annual count of Chinook salmon that enter the Nimbus Hatchery; and (4) the total number of Chinook salmon that become impinged on the Nimbus Hatchery training weir. The specific fundamental objectives corresponding to each of the four components will provide necessary information to assess whether a stable or increasing trend in the estimate of the annual spawning run size of naturally-produced (i.e., the progeny of naturally spawning parents) Chinook salmon is associated with the FMS. Biological sampling of carcasses provides necessary information to estimate the number of Chinook salmon returning as adults that were naturally-produced in the lower American River.

5.4.1 Spawning Escapement (Carcass Monitoring)

The abundance of adult Chinook salmon avoiding angler harvest and returning to a river to spawn, generally referred to as "escapement," is usually estimated using carcass tag-recapture surveys. Estimating Chinook salmon escapement is a key factor in estimating the annual in-river run size, and is necessary for understanding how the in-river production of Chinook salmon is responding to the habitat conditions (i.e., flows and water temperatures) occurring with implementation of the FMS.

The fundamental activities described below will provide necessary information to meet the objectives of obtaining an annual estimate of Chinook salmon escapement, and describing the spatial and temporal distribution of Chinook salmon spawning.

- Estimate the abundance of Chinook salmon spawning in the lower American River, in a manner consistent with previous escapement estimates
- Estimate the number of hatchery-reared Chinook salmon contributing to the population of in-river-spawning Chinook salmon in the lower American River[13]
- Estimate the number of stray Chinook salmon from other rivers contributing to the population of naturally spawning Chinook salmon in the lower American River
- Examine the age composition of the annual Chinook salmon spawning run (i.e., age composition derived from reading coded-wire tags[14](CWT))[15]

[13] CDFG is developing a comprehensive marking and tagging program for Central Valley hatcheries, including Nimbus Hatchery, that is expected to greatly increase the annual level of Chinook salmon that are coded wire tagged prior to release from those hatcheries. This program will allow the number of hatchery-reared and stray Chinook salmon returning to the lower American River to be estimated.

[14] Prior to implementation of the marking and tagging program, age information of returning adult Chinook salmon can be obtained through scale collection and reading.

[15] The age composition of naturally- and hatchery-produced fish will be derived from reading scales collected as part of the biological sampling of carcasses monitoring component and the Nimbus Hatchery Monitoring component.

- Examine potential relationships between the temporal and spatial distributions of fresh Chinook salmon carcasses, and flows and associated water temperatures[16]

Cost Estimate

Conducting the Spawning Escapement subcomponent of the Adult Chinook Salmon Population component of the FMS Monitoring and Evaluation Program is estimated to cost approximately $435,000 per year. This amount reflects CDFG and Reclamation in-kind services for the carcass survey and the biological sampling of carcasses ($160,000 per year), CWT collection for the carcass survey and monitoring at the Nimbus Hatchery ($160,000 per year), and CWT transportation and head processing ($115,000). This cost estimate assumes a 25% constant fractional marking program.

Currently Responsible Agency

CDFG is currently conducting carcass surveys in the lower American River.

5.4.2 Biological Sampling of Carcasses

Since 1992, CDFG has conducted biological sampling of fresh carcasses during the carcass surveys associated with annual Chinook salmon escapement estimation. Information obtained from biological sampling has provided initial insight regarding the temporal and geographic distribution, length and age distribution, origin, gender composition, level of egg retention (*in vivo* egg mortality), and the level of pre-spawning mortality (adult mortality prior to spawning) of Chinook salmon returning to the lower American River. Lower American River flows and associated water temperatures may influence the temporal and geographic distribution of spawning, the level of egg retention, and the level of pre-spawning mortality. Fish origin information is necessary to differentiate the proportional contribution of naturally-produced, hatchery-produced, and stray fish in the returning Chinook salmon run. Estimating the length distribution of the returning Chinook salmon population allows for more accurate estimates of egg retention to be obtained. The continuation of this sampling in a consistent and expanded manner would facilitate a better understanding of the composition and dynamics of the spawning population, and how in-river production is responding to flows and water temperatures occurring in the lower American River with implementation of the FMS.

The overall objective associated with sampling carcasses is to describe the biological characteristics of naturally spawning Chinook salmon. The activities described below will provide the necessary information to meet this objective.

- Examine the age composition (i.e., derived from reading fish scales) of naturally spawning Chinook salmon
- Examine the weekly and annual male-to-female ratios of the naturally spawning Chinook salmon
- Examine weekly and annual egg retention (i.e., *in vivo* egg mortality) classifications for females in the naturally spawning Chinook salmon population

[16] Potential relationships between the temporal and spatial distributions of Chinook salmon spawning redds, and flows and associated water temperatures, will be examined in the Chinook salmon spawning monitoring component.

- Evaluate weekly and annual pre-spawning mortality (i.e., adult mortality prior to spawning)
- Estimate the length composition of the naturally spawning Chinook salmon
- Examine the influence of flows, water temperature and biologic factors on male-to-female sex ratios, egg retention, and length and age composition of naturally spawning Chinook salmon
- Examine adult escapement relationships with flows and water temperatures during particular periods of in-river residence determined by returning adult age composition
- Describe the temporal and spatial patterns related to pre-spawning mortality and egg retention status and examine the potential relationship between water temperature, fish density, pre-spawning mortality, and egg retention status

Cost Estimate

Costs have been included with the estimated costs provided for the carcass surveys. Please refer to the Escapement Survey subcomponent.

Currently Responsible Agency

Limited biological sampling of carcasses is being conducted in the lower American River by CDFG.

5.4.3 Assessment of In-River Angler Harvest[17]

The inland sport fishery captures Chinook salmon during the adult immigration downstream of, and within, natal rivers. The in-river angler harvest that occurs during the immigration and spawning seasons is considered part of the total in-river run size. Thus, in-river angler harvest monitoring is necessary to accomplish the fundamental objectives of estimating the annual Chinook salmon population returning to the lower American River.

The activities associated with the monitoring of in-river angler harvest in the lower American River are described below.

- Estimate monthly and annual in-river harvest of Chinook salmon and steelhead[18]
- Examine the contribution of hatchery-reared Chinook salmon and strays to the population of Chinook salmon returning to the lower American River
- Examine inter- and intra-annual timing and geographic trends in the angler harvest of Chinook salmon
- Estimate monthly and annual in-river angler catch per unit effort of Chinook salmon and steelhead

[17] CDFG is implementing a Central Valley Angler Survey during 2006-2007 that will provide angler effort and harvest information for Chinook salmon and steelhead on the lower American River.

[18] The objectives for the angler harvest monitoring include steelhead in order to estimate the in-river steelhead population. In order to avoid repetition, the angler harvest monitoring is described once, in this Chinook salmon population monitoring component, and is not repeated in the steelhead spawning monitoring component.

- Evaluate temporal trends in the contribution of Chinook salmon and steelhead harvest to the annual in-river run size

Cost Estimate

No external costs are identified for this component. Seventy-five percent of the Angler Survey is funded by federal Sport Fish Restoration Act Funds; 25 percent is funded by the State Bay-Delta Sport Fishing Enhancement Stamp Fund.

Currently Responsible Agency

CDFG will be conducting angling surveys in the lower American River.

5.4.4 Monitoring of Fish Passage into the Nimbus Hatchery

Every year, numerous Chinook salmon returning to the lower American River ascend the fish ladder leading them into the Nimbus Hatchery. Still other Chinook salmon travel past the Nimbus Hatchery weir and end up being caught by anglers in the Nimbus Basin, or dying. A portion of the dead fish eventually become impinged on the Nimbus Hatchery weir. Hatchery operators normally record the number of Chinook salmon that swim up the hatchery ladder, as well as the number of dead fish impinged on the Nimbus Hatchery weir (also known as "weir fish"). Monitoring of the adult Chinook salmon population in the lower American River must incorporate these two components, which in the last several years represented a low of 8 percent of the estimated annual in-river escapement in 1995, to a high of 25 percent in 1998. Without estimates of the number of fish entering the hatchery and the number impinged on the Nimbus Hatchery weir, accurate estimates of the total run-size returning to the lower American River cannot be obtained; thus, an accurate assessment of how the run-size is responding to the flows and water temperatures occurring with implementation of the FMS also cannot be obtained. The fundamental objective of this subcomponent is to obtain more accurate estimates of this portion of the annual run size.

Activities associated with the Nimbus Hatchery and weir operations monitoring are described below.

- Count the annual number of male and female Chinook salmon that enter Nimbus Hatchery
- Estimate the annual number of male and female Chinook salmon that move upstream of the Nimbus Hatchery weir
- Examine the annual proportion of hatchery-produced salmon (i.e., ad-clipped fish) that either enter Nimbus Hatchery or move upstream of the Nimbus Hatchery weir[19]
- Examine the annual length composition of the Chinook salmon population that enters Nimbus Hatchery
- Examine the annual age composition of the Chinook salmon population that enters Nimbus Hatchery

[19] Estimating the proportion of hatchery-produced salmon cannot be accomplished until a constant fractional or mass marking program has been implemented and in place for approximately four years.

- Compare the length, age, and origin characteristics of fish entering Nimbus Hatchery, weir fish, and fish evaluated during annual carcass surveys

Cost Estimate

The cost associated with monitoring Chinook salmon entering Nimbus Hatchery or becoming impinged on the hatchery weir is estimated to be $80,000 annually. This cost is subject to change based on: (1) the number of fish sampled to obtain length and age composition; (2) operational changes associated with avoiding and/or controlling hatchery disease outbreaks; and (3) whether the monitoring activities will be performed by CDFG or will be contracted outside of the agency. Also, this cost does not include costs associated with CWT recovery and reading. The total cost of recovering and reading CWTs from Chinook salmon sampled in the river and in the hatchery is provided in the spawning escapement monitoring component.

Currently Responsible Agency

CDFG is currently conducting monitoring of fish passage into the Nimbus Hatchery.

5.5 CHINOOK SALMON SPAWNING

The number of redds in a particular area is a measure of Chinook salmon spawning activity, which can be used to: (1) develop relationships between abiotic factors (e.g., flow and water temperature) and spawning; and (2) make inferences about spawning activity resulting from carcass surveys. Also, the number of superimposed redds is an index that also can be examined for potential flow-related effects. Destruction of redds and increased egg and alevin mortality often result from high levels of redd superimposition. Redd superimposition may be a symptom of crowded spawning conditions resulting from an excessive number of spawning salmon, given the amount of suitable spawning habitat available at a particular flow level. The FMS MFR attempt to minimize Chinook salmon redd superimposition by increasing flows (and spawning habitat availability) as the spawning season progresses. Development of this spawning flow progression used the flow-spawning habitat relationship developed and described in USFWS (2003). Thus, theoretically, the FMS MFR increase spawning habitat availability during the spawning season and are expected to minimize redd superimposition. The Chinook salmon spawning monitoring component is designed to assess the effectiveness of the FMS MFR by evaluating whether Chinook salmon spawn in habitat made available by the flow progression. In addition, this monitoring component will provide the information necessary to estimate how the temporal and geographic distributions of Chinook salmon spawning may (or may not) relate to the habitat conditions (i.e., flows and water temperatures) occurring with implementation of the FMS. The Chinook salmon spawning monitoring will be conducted annually until sufficient data are obtained to determine the effectiveness of the spawning flow progression, and to estimate the potential relationships between flow, spawner abundance, and redd superimposition.

The overall objectives of the Chinook salmon spawning component are to:

- Evaluate whether Chinook salmon spawn in habitat made available by the FMS spawning flow progression

- Examine for potential relationships between flow, spawner abundance, and redd superimposition

The activities described below will provide necessary information to meet these objectives.

- Examine potential inter- and intra-annual trends in the magnitude, and temporal and spatial distributions of Chinook salmon spawning
- Examine potential inter- and intra-annual trends in the magnitude, and temporal and spatial distributions of Chinook salmon redd superimposition
- Provide data to compare to the spawning magnitude and timing information derived from the carcass abundance surveys
- Examine potential relationships between the temporal and geographic distributions of Chinook salmon spawning, and flows and associated water temperatures
- Develop baseline information on the distribution of Chinook salmon redds at various flow levels associated with the FMS to examine redd dewatering

Cost Estimate

The estimated cost for conducting this component is $50,000 annually.

Currently Responsible Agency

Reclamation currently conducts limited aerial photography of the lower American River.

5.6 STEELHEAD SPAWNING

A two-part approach for the Steelhead Spawning monitoring component has been identified that consists of: (1) steelhead redd surveys; and (2) steelhead in-river angler harvest surveys. It is expected that the results of the steelhead redd surveys and creel census, when evaluated in conjunction with monthly Nimbus Hatchery steelhead counts for a series of consecutive years, will provide a means to infer the general temporal trend in steelhead abundance occurring in the lower American River while the FMS is implemented.

The activities described below will provide necessary information to meet the overarching objective of obtaining an: (1) annual estimate of steelhead redds; and (2) annual index of in-river steelhead spawning abundance.

- Calculate an annual index of in-river steelhead spawning abundance by enumerating redds
- Examine potential inter- and intra-annual trends in the magnitude, and temporal and spatial distribution of steelhead spawning
- Examine the relationship between the flows and water temperatures, and the temporal and spatial distribution of steelhead spawning
- Develop real-time information on potential steelhead redd dewatering at various flow levels
- Estimate monthly and annual in-river angler harvest of adult steelhead

- Estimate monthly and annual in-river steelhead angler catch per unit effort
- Assess the proportion of steelhead spawning in the river that are wild
- Examine the potential to develop a steelhead production index from spawning through summer rearing or emigration, and its potential relationship to flow and water temperature

Cost Estimate

The estimated cost for the redd surveys described in this component is $40,000 annually. This estimate does not include in-kind services from Reclamation. In-river angler harvest survey estimates will be covered by the upcoming CDFG Central Valley Angler Survey.

Currently Responsible Agency

Reclamation is currently conducting steelhead redd surveys. CDFG will be conducting steelhead angler harvest surveys.

5.7 STEELHEAD REARING

Seining surveys, accompanied by tag-recapture of juvenile steelhead, have been identified as fundamental elements for the Steelhead Rearing component. The Steelhead Rearing component is designed to address questions concerning the abundance, survival, temporal and spatial distributions of rearing juvenile steelhead, particularly during the summer and fall months. Also, it is anticipated that this monitoring component will provide an index of relative abundance, and provide information necessary to examine potential relationships between the FMS resultant flows, resultant water temperatures and: (1) relative abundance of juvenile steelhead; (2) size and age composition; (3) site fidelity during rearing; and (4) fish health (i.e., external abnormalities, including parasites and bacterial infections) and signs of stress (including thermal stress and gas super saturation).

The activities described below will provide necessary information to meet the overarching objective of monitoring the relative abundance of juvenile steelhead.

- Estimate relative abundance of juvenile steelhead
- Examine inter- and intra-annual changes in the relative abundance of juvenile steelhead
- Examine the spatial and temporal distribution of juvenile steelhead
- Examine inter- and intra-annual changes in the size composition of rearing juvenile steelhead
- Examine potential relationships between the relative abundance, size composition, growth, condition, survival, site fidelity and health of juvenile steelhead, and flows and/or water temperatures
- Examine the potential to develop a steelhead production index from spawning through summer rearing or emigration, and its potential relationship to flow and water temperature

Cost Estimate

The estimated cost for the seining surveys described in this component is $25,000, covering temporary help and tag costs. This estimate does not include in-kind services from CDFG.

Currently Responsible Agency

CDFG currently conducts steelhead seining surveys.

5.8 CHINOOK SALMON DOWNSTREAM MOVEMENT

Rotary screw trap (RST) monitoring, accompanied by RST capture efficiency tests, have been identified as fundamental elements for the Chinook Salmon Emigration component. The RST monitoring provides information on the inter-annual trends in abundance, size composition, and timing of juvenile Chinook salmon moving downstream from the primary spawning areas in the lower American River. This information can be compared to flow, water temperature, and/or the estimated number of in-river spawners that produced the downstream moving juveniles, in order to identify potential relationships between the downstream movement of juvenile Chinook salmon, and key abiotic and biotic factors influencing the viability of Chinook salmon populations in the river.

RST capture efficiency tests are necessary to estimate the abundance of downstream moving juvenile Chinook salmon. Therefore, the continuation and refinement of existing juvenile Chinook salmon RST monitoring efforts in the lower American River is merited to determine how the FMS resultant flows and associated water temperatures influence the annual abundance and timing of juvenile Chinook salmon downstream movement.

The activities described below will provide necessary information to meet the overarching objective of obtaining the relative abundance of downstream moving juvenile Chinook salmon.

- Estimate the annual abundance and timing of emigrating juveniles associated with flows and water temperatures
- Provide comparable data to previous RST studies in the lower American River
- Examine the size and life stage composition of the emigrating juvenile Chinook salmon population associated with flows and water temperatures
- Examine inter- and intra-annual trends in abundance, timing and size composition of emigrating juveniles and potential relationships with flows and water temperatures
- Examine the potential to develop a Chinook salmon production index from spawning through emigration, and its potential relationship to flow and water temperature

Cost Estimate

The estimated cost for the emigration survey described in this component is $50,000, covering costs for temporary help, field materials, and Pacific States Marine Fisheries Commission contracting. This estimate does not include in-kind services from CDFG.

Currently Responsible Agency

CDFG currently conducts RST monitoring and RST capture efficiency tests.

6.0 IMPLEMENTATION CRITERIA

This section provides criteria for the impletion of the FMS Minimum Flows. For additional detail regarding description of the FMS Minimum Flows, please refer to Section 2.0.

6.1 NIMBUS DAM FLOW MEASUREMENT

MFR will be measured at Nimbus Dam and are rounded to the nearest cfs. The return flow from the Nimbus Hatchery is credited towards meeting the Minimum Flows. Folsom South Canal flows are not credited towards meeting the Minimum Flows.

The MFR will be maintained on a 5-day moving average of daily instream flows (in cfs), with daily average flows not less than 90 percent of the applicable Minimum Flow. Measuring instream flows in this manner, as opposed to measuring compliance over a shorter duration, reduces the magnitude and frequency of instream flow fluctuations. On days when the MFR changes from the previous day, a new 5-day averaging period will begin.

6.2 OCTOBER THROUGH DECEMBER CONSIDERATIONS

During the October through December period, the MFR is established between 800 cfs and 2,000 cfs with a maximum of 1,500 cfs from October 1 through November 1. The MFR for October through December are based on an index of American River Basin carryover storage conditions (**Figure 3**). The FRI is calculated as the combined end-of-September storage in four reservoirs – French Meadows, Union Valley, Hell Hole, and Folsom. The FRI will be calculated on October 1[20] of each year.

[20] If October 1 occurs during the weekend, the FRI will be calculated on October 2 or 3, as appropriate.

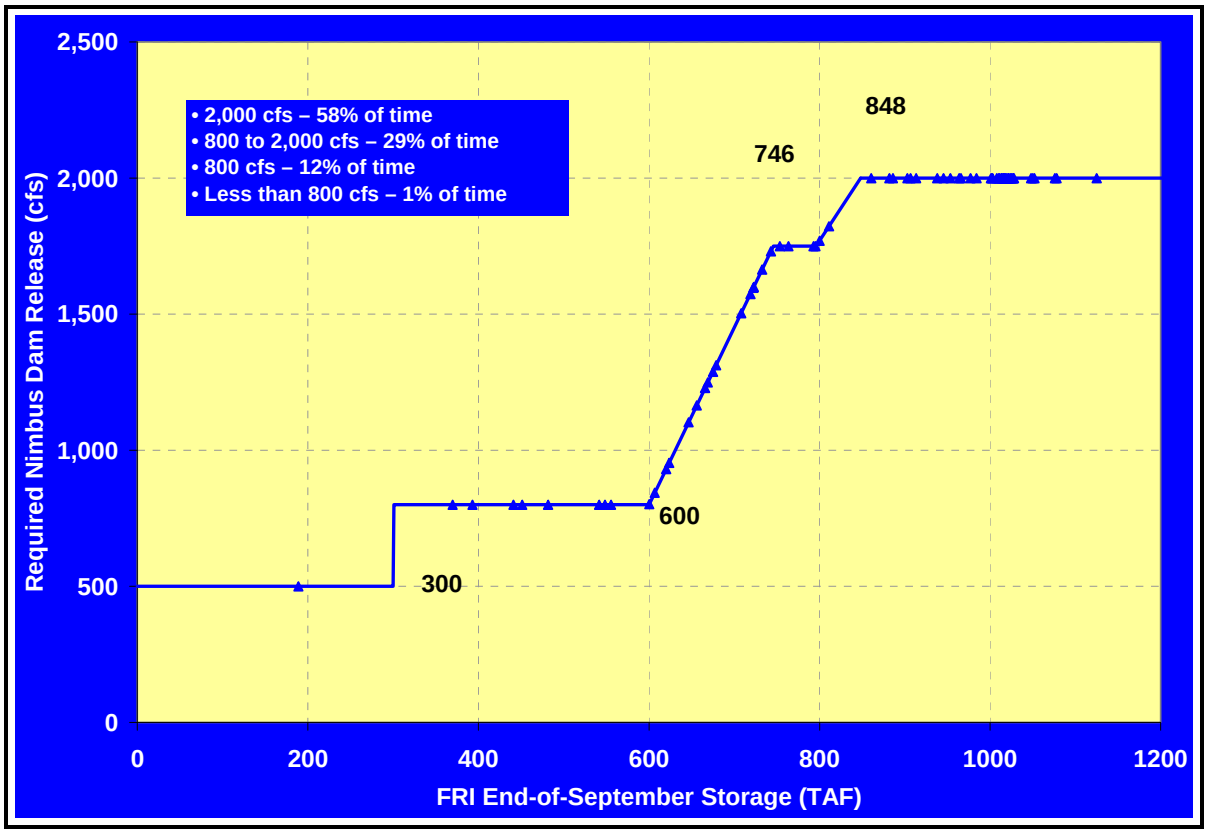

Figure 3. FRI implementation curve with inset depicting percentages of time that MFR would occur based on the CALSIM II 72-year simulation period.

A Chinook Salmon Spawning Flow Progression has been developed to provide more water (and spawning habitat) when more fish are expected to be spawning, thereby potentially minimizing the occurrence of redd superimposition. The Chinook Salmon Spawning Flow Progression consists of two incremental step increases in flows going from 1,500 cfs from October 1 to November 1 up to the October through December Minimum Flows. A 60°F water temperature trigger will be used to identify the date when the first step increase in flow will occur. The first step (scheduled to occur by default on November 2) will increase lower American River flows from 1,500 cfs up to the MFR minus 250 cfs, but no less than 1,500 cfs. The second step increase in flow (scheduled to occur by default on November 9) will occur seven days after the first step and will increase lower American River flows up to the Minimum Flows.

The Spawning Flow Progression will be implemented if the October through December MFR is 1,500 cfs or higher. If the MFR is 1,500 cfs or higher, flows from October 1 through November 1 will be 1,500 cfs. The ARG will meet on the last Thursday of October to examine information presented by Reclamation regarding river (e.g., water temperatures) and reservoir (e.g., coldwater pool volume) conditions to determine if the first step increase of the spawning flow progression should be implemented on November 2. Reclamation with ARG input will consider whether water temperatures of 60°F or less can be maintained at Hazel Avenue from November 2 through the rest of the fall-run Chinook salmon spawning and egg incubation period. If 60°F or less could be achieved and maintained with the first step increase in flows prescribed under the spawning flow progression, then this step increase will be made.

If 60°F or less cannot be maintained, the ARG will recommend a delay in implementing the first step increase of the spawning flow progression until water temperatures are expected to be 60°F or less throughout the fall and winter. The ARG will meet on a regular basis until the date for implementing the first step increase of the spawning flow progression is identified. As previously discussed, implementation of the second step increase will occur seven days after the first step increase. For example, if Reclamation with the ARG's input determines that lower American River water temperatures are expected to be 60°F or less for the remainder of the fall and winter on November 4, then the first incremental step increase in flows associated with the spawning flow progression will be recommended to occur on November 4, and the second incremental step will be recommended to occur on November 11.

In years when the FRI prescribes flows of 1,500 cfs or higher, and if the first step increase will not be implemented on November 2, then Reclamation will explain in a letter to the SWRCB why the ARG recommended to delay implementation of the spawning flow progression. The expected date for implementation of the spawning flow progression does not need to be included in the letter to the SWRCB because the ARG may not have recommended an expected implementation date by the time the letter is prepared. However, the expected date for implementation of the spawning flow progression will be noted in the appropriate ARG meeting notes.

The 60°F water temperature trigger associated with the spawning flow progression will be measured as the daily average at Hazel Avenue.

MFR less than 1,500 cfs will be implemented on October 1 and will remain at the same level through December 31.

6.3 JANUARY AND FEBRUARY CONSIDERATIONS

During January and February, MFR is established between 800 cfs and 1,750 cfs. MFR is based on the preceding month Minimum Flow, adjusted by the SRI, an index of water year runoff for the entire Sacramento River Basin that is updated monthly (**Table 1**).

The decision of whether the January MFR will be adjusted from the December MFR will be made on January 1. If the SRI is not available by January 1, then Reclamation may use their best professional judgment to predict the SRI. Once the SRI is available, if the predicted SRI differs from the actual SRI, Reclamation will adjust the Nimbus Dam releases accordingly. If Reclamation under-predicted the SRI, and the MFR is reduced based on this under-prediction, then Reclamation will write a letter to the SWRCB explaining the basis for their initial decision to predict the SRI. Alternatively, if a high level of uncertainty is involved in predicting the SRI, then Reclamation may choose to continue to implement the December MFR while waiting for the SRI to become available, rather than make a prediction.

Table 1. Minimum FlowsDuring January and February Adjusted by the SRI

Sacramento River Index[a]				
When	SRI < 10.2 MAF (Critical) and December MFR≤ 800 cfs	SRI < 10.2 MAF (Critical) and December MFR> 800 cfs	10.2 MAF ≤ SRI < 15.7 MAF (Dry or Below Normal)	SRI ≥ 15.7 MAF (Above Normal or Wet)
Then	Reduce	Reduce	Maintain	Maximize
Minimum Flows	250 cfs[b]	85% of Previous Month MFR, but not less than 800 cfs	Previous Month MFR not to exceed 1,750 cfs	1,750 cfs

[a] 75 percent of exceedance forecast on first of current month.
[b] D-893 prescribed flow levels.

The decision of whether the February MFR will be adjusted from the January MFR will be made on January 31 each year. If the SRI is not available by January 31, then Reclamation may use their best professional judgment to predict the SRI. Once the SRI is available, if the predicted SRI differs from the actual SRI, Reclamation will adjust the Nimbus Dam releases accordingly. If Reclamation under-predicted the SRI for February, and the MFR were reduced based on this under-prediction, then Reclamation will write a letter to the SWRCB explaining the basis for their initial decision to predict the SRI. Alternatively, if a high level of uncertainty is involved in predicting the SRI, then Reclamation may choose to continue to implement the January MFR while waiting for the SRI to become available, rather than make a prediction.

6.3.1 Reductions Based on End-of-Month Storages

In addition to adjustments based on the SRI during January and February, MFR is subject to reductions based on the storage at the end of the previous month. Based on the end-of-December storage, the January MFR may be modified from the December MFR. If the end-of-December storage is less than 300,000 AF, then the January MFR is set at 85 percent of the December MFR or 800 cfs, whichever is greater. The end-of-December Folsom Reservoir storage will be calculated on January 2[21]. The adjustment to the January MFR based on Folsom Reservoir end-of-December storage will be effective on January 2[22].

Similarly, based on the end-of-January storage, the February MFR may be modified from the January Minimum Flow. If the end-of-January Folsom Reservoir storage is less than 350,000 AF, then the February MFR is set at 85 percent of the January MFR or 800 cfs, whichever is greater. The end-of-January Folsom Reservoir storage will be calculated on February 1[23]. The adjustment to the February MFR based on Folsom Reservoir end-of-January storage will be made and implemented on February 1[24].

The storage-based reductions in Minimum Flow, only apply if the end-of-month storage reductions to below the indicated thresholds (i.e., 300,000 AF for end-of-December storage and 350,000 AF for end-of-January storage) are not induced by flood control operations. If flood control operations are responsible for Folsom Reservoir storage below the indicated thresholds, then the storage-based reductions are not applicable. The indicator used to determine if flood

[21] If January 2 occurs during the weekend, the end-of December Folsom Reservoir storage will be calculated on January 3 or 4, as appropriate.
[22] If January 2 occurs during the weekend, this adjustment will be effective on January 3 or 4, as appropriate.
[23] If February 1 occurs during the weekend, the end-of January Folsom Reservoir storage will be calculated on February 2 or 3, as appropriate.
[24] If February 1 occurs during the weekend, this adjustment will be effective on February 2 or 3, as appropriate.

control releases are driving Folsom Reservoir storage decreasing below the end-of-December (i.e., 300 thousand acre-feet (TAF)) or the end-of-January (i.e., 350 TAF) storage thresholds is the controlling flood control diagram. Because MFR during critically dry years are already subject to adjustments based on the SRI, potential reductions based on the end of the previous month Folsom Reservoir storage are not applicable during critically dry years.

6.4 MARCH THROUGH MAY CONSIDERATIONS

MFR from March through May range between 800 to 1,750 cfs, and are based on the Impaired Folsom Inflow Index (IFII) (**Figure 4**). The IFII is the sum of the 90 percent exceedance forecast Folsom Reservoir inflows for the May through September period. MFR for the entire March through May period are established by March 10.

6.4.1 End-of-May Folsom Reservoir Storage Evaluation

Because of storage considerations, forecasted end-of-May Folsom Reservoir storage is examined to determine if the IFII-based Minimum Flow, or the February Minimum Flow, will be implemented for the March through May period. If the end-of-May Folsom Reservoir storage is forecasted to be equal to or greater than 700,000 AF, then the IFII-based MFR is implemented. If the end-of-May storage is forecasted to be less than 700,000 AF, then March through May MFRis either the IFII-Minimum Flow, or the previously required February flow, whichever is less. This examination is conducted on the last day of February and is not updated during the March through May period.

6.5 JUNE THROUGH SEPTEMBER CONSIDERATIONS

MFR from June through Labor Day range between 800 and 1,750 cfs. MFR post-Labor Day through September range between 800 and 1,500 cfs. The IFII continues to be the index used to establish MFR during the summer (i.e., June through September). It is anticipated that an updated DWR runoff forecast will be used to implement IFII flows for the June through September period. The June through September MFR will be determined by May 15, pending timely review of DWR's Bulletin 120. MFR would be effective on June 1.

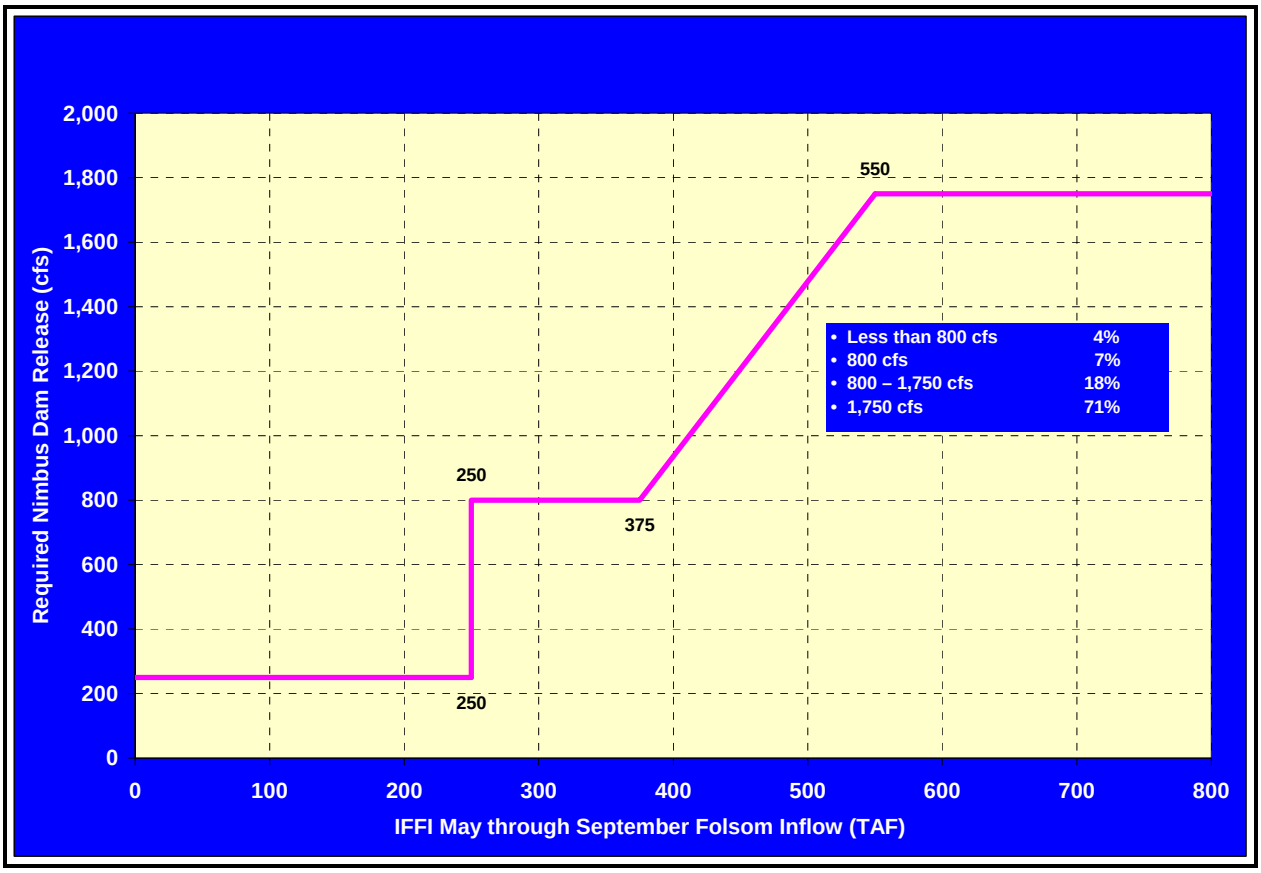

Figure 4. IFII implementation curve with inset depicting percentages of time that MFRwould occur based on the CALSIM II 72-year simulation period.

6.5.1 End-of-September Folsom Reservoir Storage Evaluation

To further minimize adverse Folsom Reservoir end-of-September storage conditions, MFR may be adjusted to avoid reducing Folsom Reservoir end-of-September storage to less than 300,000 AF. This adjustment involves a calculation taking into account end-of-May Folsom Reservoir storage and June though September IFII, and subtracting the end-of-September target storage as:

$$\left[\left\{\begin{array}{l}\left(MayFolsomStorage_{TAF}\right)+\left(ForecastedJunSepFolsomInflow_{TAF}\right)\\ -\left(ForecastedJunSepFolsomDiversions_{TAF}\right)\\ -\left(ForecastedJunSepFolsomEvaporation_{TAF}\right)\\ -\left(ForecastedJunSepFolsomSouthCanalDiversion_{TAF}\right)-\left(300_{TAF}\right)\end{array}\right\}*(1000)\div\left\{\left(122_{days}\right)*(1.9835)\right\}\right]$$

The result of the above calculation is compared to the IFII-based Minimum Flow. MFR for June through September are the lower value of the IFII-based MFR and the target storage based flow, but not less than 250 cfs (**Table 2**).

Table 2. MFR During June Through September Based on Forecasted End-of-September Folsom Reservoir Storage

May Evaluation of Forecasted End-of-Sep Folsom Reservoir Storage	
When	Forecasted end-of-September storage <300 TAF
Then	Calculate target storage-based flow
Minimum Flows	IFII-based MFRor target storage-based flow, whichever is less, but no less than 250 cfs

This adjustment based on the end-of-September target storage-based flow will be calculated and implemented on June 1.

6.6 WATER CONSERVATION ADJUSTMENTS TO MINIMUM FLOWS

Potential adjustments to MFR prescribed by the appropriate index have been developed for August 15 through Labor Day for the purpose of: (1) water conservation; or (2) fish protection. The upper range of the Minimum Flows(i.e., greater than 1,500 cfs) for this period are subject to an adjustment of as much as 250 cfs, as long as resultant flows are not lower than 1,500 cfs.

Hydrologic conditions during August 15 through Labor Day that allow the potential for conserving water in Folsom Reservoir are expected to occur approximately one-third of the 72-year period of simulated operations. Reclamation may consider in early August the desirability of a water conservation adjustment to the MFR, if projected end-of-September Folsom Reservoir storage is below about 600 TAF, which would be lower than the targeted value in the May 1 Annual Operations Forecast[25]. To determine if a water conservation adjustment should be implemented, Reclamation will consider, among other factors, the potential to lose some or all of the conserved Folsom Reservoir storage as a result of: (1) Folsom Reservoir spills during subsequent months; and, (2) higher MFR prescribed by a larger FRI than would occur otherwise because of the addition of conserved Folsom Reservoir storage. Reclamation will consider the multiple purposes of the Folsom/Nimbus Dam complex when determining if water conservation adjustment should be implemented.

Water conservation adjustments will not cause or exacerbate harmful water temperature-related impacts to: (1) rearing juvenile steelhead; or (2) spawning fall-run Chinook salmon. The ARG will examine conditions that may cause or exacerbate harmful water temperatures on a case by case basis. For additional detail on the Water Conservation Adjustments, refer to Section 2.0: MFR.

6.7 FISH PROTECTION ADJUSTMENTS

Potential adjustments to MFR prescribed by the appropriate index have been developed for August 15 through Labor Day for the purpose of fish protection. The upper range of the MFR (i.e., greater than 1,500 cfs) for this period are subject to an adjustment of as much as 250 cfs, as long as resultant flows are not lower than 1,500 cfs. For the post Labor Day through October 31 period, the upper range of the MFR (i.e., greater than 1,250 cfs) is subject to a fish protection adjustment of as much as 250 cfs, as long as resultant flows are not lower than 1,250 cfs. Fish Protection Adjustments can be suspended at any time during the applicable period, particularly if a coldwater pool assessment indicates that sufficient coldwater is available to maintain reported

[25] Water conservation adjustments are unforeseeable; therefore, not planned in the May 1 Annual Operations Forecast.

suitable water temperatures for anadromous salmonids in the lower American River. For additional detail on the Fish Protection Adjustments, refer to Section 2.0: Minimum Flows.

Although a Fish Protection Adjustment may be implemented through October, once the adjustment is terminated, MFR shall be implemented as prescribed by the FRI (**Figure 5**). For example, if a Fish Protection Adjustment is implemented through the end of October, resulting in flows of 1,250 cfs, the FRI prescribes MFR for the October through December period of 2,000 cfs, and the ARG concludes that 60ºF or less can be achieved throughout the fall and winter, then:

- Flows during the month of October would be 1,250 cfs
- MFR on November 1 would be 1,500 cfs
- MFR during November 2 through November 8 would be 1,750 cfs
- MFR during November 9 through December would be 2,000 cfs

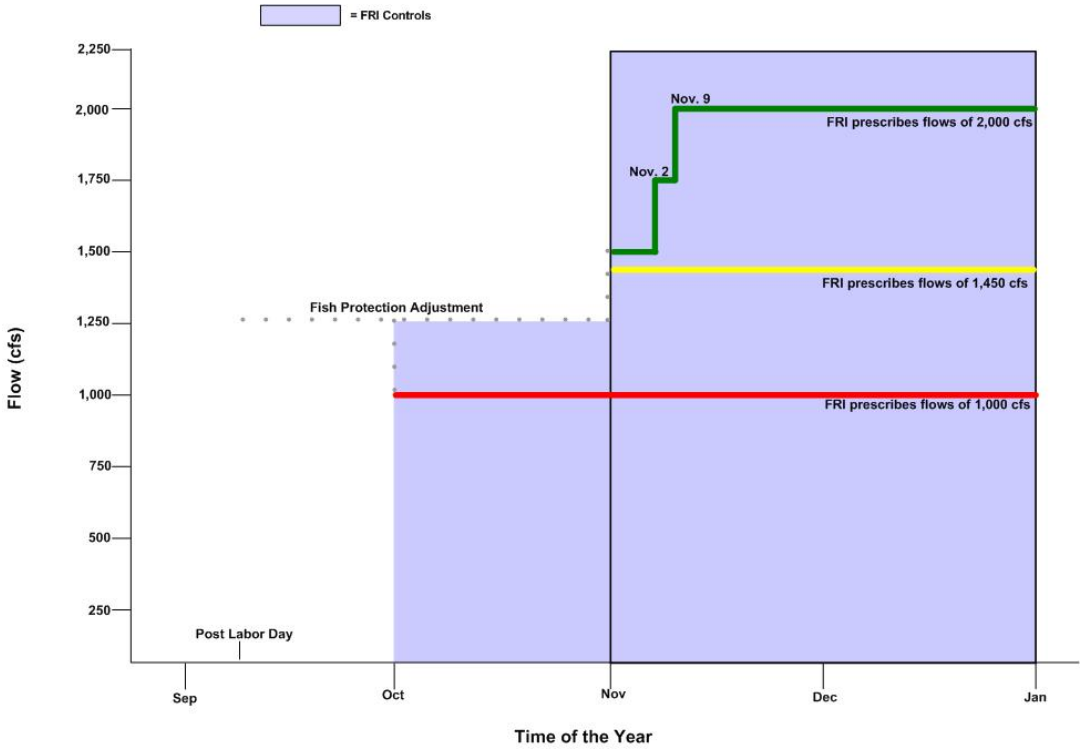

Figure 5. Examples of Transition from the Fish Protection Adjustment to the FRI Minimum Flows

If a Fish Protection Adjustment is implemented through the end of October, resulting in flows of 1,250 cfs, and the FRI indicates that flows for the October through December period should be less than 1,500 cfs, but greater than 1,250 cfs, then FRI-based MFR would be implemented in November and December. For example if the FRI indicates that MFR for the October through December period should be 1,450 cfs, then:

- Flows during the month of October would be 1,250 cfs
- MFR during November through December would be 1,450 cfs

If the FRI prescribes MFR lower than 1,200 cfs for October, and a Fish Protection adjustment is being implemented for September as a result of conditions from the previous water year, the Fish Protection Adjustment will only be applicable through September, in an attempt to sustain stable flows throughout the fall-run Chinook salmon spawning period and, therefore, minimize redd dewatering. For example, if the FRI indicates that MFR for the October through December period should be 1,000 cfs, then:

- MFR during October through December would be 1,000 cfs

6.8 ADDITIONAL IMPLEMENTATION CRITERIA CONSIDERATIONS

6.8.1 Flow Ramping Rate Objectives

Flow ramping rate objectives are included in the NMFS OCAP BO (October 22, 2004) at flow levels ≤ 20,000 cfs. Flow ramping rate objectives are applicable during periods outside of flood control operations and to the extent controllable during flood control operations. At flow levels ≤ 5,000 cfs, flow reductions should not exceed more than 500 cfs/day, and not more than 100 cfs/hour.

Excursions from the above flow ramping rate objectives will be approved by the ARG. Reclamation would document approved excursions through the ARG email reflector and/or the ARG meeting notes.

Reclamation, after consulting with the ARG, may update these ramping rate objectives to reflect modified lower American River ramping rates objectives prescribed in a subsequent BO or functionally equivalent document that supersedes the October 22, 2004 NMFS OCAP BO.

7.0 REFERENCES

Bureau of Reclamation (Reclamation) Website. Title 34 - Central Valley Project Improvement Act (of Public Law 102-575). Available at www.usbr.gov.

Federal Register. 2005. NMFS. Endangered and Threatened Species; Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California; Final Rule. Vol 70:52488-52627. September 2, 2005.

NMFS. 2004. Biological Opinion on the Long-Term Central Valley Project and State Water Project Operations Criteria and Plan.

U.S. Fish and Wildlife Service (USFWS). 2003. Comparison of Phabsim and 2-D Modeling of Habitat for Steelhead and Fall-run Chinook Salmon Spawning in the Lower American River. Prepared by the staff of The Energy Planning and Instream Flow Branch.