



# Fisheries and In-Stream Habitat (FISH)

## Management and Restoration Plan for the Lower American River

### 2019 UPDATE



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# GLOSSARY OF ACRONYMS

ACRONYM	MEANING
ATSP	Automated Temperature Selection Procedure
BPWG	Bank Protection Working Group
CBI	Consensus Building Institute
CDEC	California Data Exchange Center
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CFM	Constant Fractional Marking
CFS	Cubic feet per second
CPMM	Coldwater Pool Management Model
CSUS	California State University, Sacramento
CVPIA	Central Valley Project Improvement Act
CY	Cubic Yards
EID	El Dorado Irrigation District
FISH	Fisheries and In-Stream Habitat
FWG	FISH Working Group
LAR	Lower American River
HSRG	Hatchery Scientific Review Group
iCPMM	Iterative Coldwater Pool Management Model
IWM	Instream Woody Material
LWM	Large Woody Material
NMFS	National Marine Fisheries Service
NRMP	Natural Resource Management Plan
NOAA	National Oceanic and Atmospheric Administration
RMIS	Regional Mark Information System
SAFCA	Sacramento Area Flood Control Agency
SOP	Standard Operating Procedure
SRA	Shaded Riverine Aquatic
TAF	Thousand acre-feet
TCD	Temperature Control Device
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USFWS	United States Fish & Wildlife Service

# EXECUTIVE SUMMARY

The Water Forum updated the Lower American River Fisheries and In-Stream Habitat Management and Restoration Plan (FISH Plan). First completed in 2001, the plan outlines the most critical management and restoration actions needed to improve fisheries health and habitat for priority fish species in the Lower American River, including fall-run chinook salmon and steelhead.

The 2019 update is designed to provide a progress report, as well as refresh and reprioritize the plan's original list of 47 short- and long-term actions, to guide the Water Forum's habitat restoration goals and activities for the next decade. The update was informed by interviews with 17 stakeholders from government agencies and non-profit organizations to identify priorities, challenges and key themes to guide the update conducted by an impartial non-profit group (Appendix 2).

Overall, the FISH Plan conveys that the region is on the right track and identifies progress on many priority issues and actions—some of which are ongoing while others have shifted in priority or concluded. But there are many more opportunities and needs to address.

Key findings include:

## **THE RIVER'S TEMPERATURE AND FLOW CONTINUE TO BE THE MOST CRITICAL FACTORS IN SUPPORTING NATIVE FISH.**

Cold water and proper flows are the foundation to fish survival. Temperature, in particular, is considered to be the greatest limiting factor to species survival in the Lower American River.

Over the past several decades, the Water Forum has been undertaking cutting-edge science on the Lower American River to further understand how changes in temperature and flow affect the river and its potential to nurture fish. For example, understanding and modeling the relationship between river flow, temperature and suitable habitat is key. In pursuit of this, the Water Forum has studied:

- How temperature and flow change according to Folsom Reservoir operations, weather, flows, river mile, drought, depth and other factors.
- The relationship between the river's flow and the quantity and quality of spawning and rearing habitat for both salmon and steelhead.
- How flow and temperature during drought conditions impact the survival rates fry.
- How much habitat is available during different flow conditions, and how much habitat is needed for the species.



## **ABOUT THE WATER FORUM**

*The Water Forum was formed in 1993 to provide a way for stakeholders to design balanced water-use and river management solutions. Today the Water Forum includes a diverse group of business and agricultural leaders, citizen groups, environmentalists, water purveyors and local governments. Members work together under the Water Forum Agreement to balance two co-equal goals: protecting and preserving the fishery, wildlife, recreational and aesthetic values of the lower American River and providing a reliable, long-term water supply for our region.*

The FISH plan identifies 11 actions to improve water temperature and flow issues. Chief among these are continuing the Water Forum's work to:

Implement the Water Forum's Flow Management Standard. The Water Forum developed its first Flow Management Standard (FMS), implemented in 2006, after a five-year long science-based multi-stakeholder process and then refined it after California's historic drought based on real world experience. The Modified Flow Management (MFMS) uses the best available science to set minimum river flows and targets for Folsom water storage to improve temperatures in the lower American River for salmon and steelhead while enhancing the reliability of water supplies for people. Compared to the current flow standard and Folsom Reservoir operations, the Water Forum's guidelines would:

- Significantly lower water temperatures during the crucial rearing season for steelhead
- Create more spawning habitat for fall-run Chinook salmon
- Provide better overall habitat conditions, particularly in the driest years
- Improve water supply reliability in the American River basin

The Water Forum is continuing to work with federal and state agencies to adopt the Flow Standard for the Lower American River.

### **CONSERVE COLD WATER IN FOLSOM RESERVOIR**

by working with the U.S. Bureau of Reclamation to adjust their operations to hold cold water for release during the summer and fall months when river flows are warmest. During these months Steelhead trout are rearing and fall-run salmon begin to arrive in our region. We need to provide protection and adequate habitat for both species.

### **MAKE STRUCTURAL IMPROVEMENTS AT FOLSOM RESERVOIR**

to improve temperature, including shutter mechanization and leak reduction designed to release cold water from the reservoir's deeper elevations when needed to support fish. This idea has been around for decades, but has new urgency.

### **IMPROVE ACCESS TO COLD WATER AT FOLSOM RESERVOIR**

by regularly using a power bypass (also called an "elephant's trunk") to access cold water below the power generating penstocks.



*The Lower American River is home to 43 fish species, including federally threatened Central Valley steelhead and struggling fall-run Chinook salmon and a major water supply source for nearly 2 million people.*

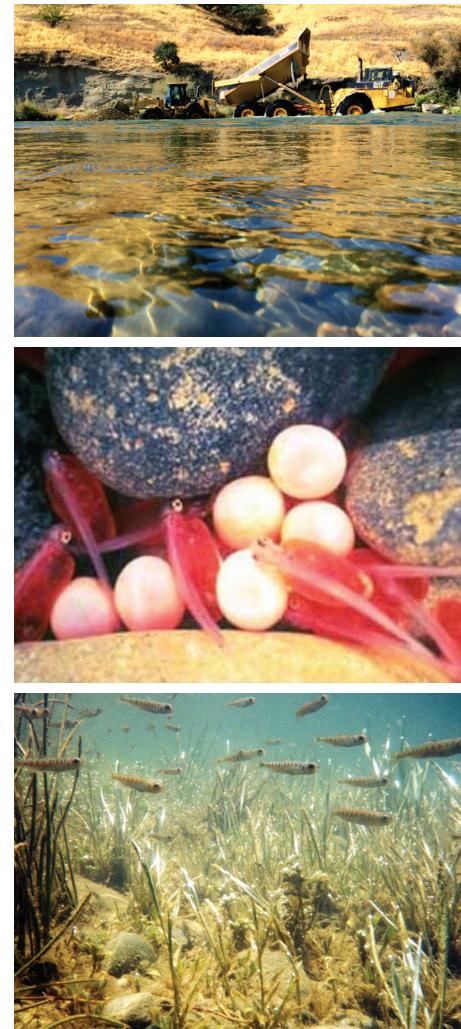
## HABITAT RESTORATION ACTIVITIES HAVE BEEN SUCCESSFUL BUT MORE ARE NEEDED.

The Water Forum leverages funding from local cities and water providers, Sacramento County, Sacramento Municipal Utility District, and state and federal agencies to create protected places for Chinook and steelhead to reproduce and rear their young. Over the past decade, agencies have invested more than \$5 million to create over 30 acres of spawning beds and 1.2 miles of side channels, which are prime rearing zones. Much of this funding has come from grants from partners, including U.S Fish and Wildlife Service, U.S. Bureau of Reclamation, and state grants.

Past restoration efforts have provided invaluable opportunities to study the river, as well as employ adaptive management. For example, step-by-step adaptive management has helped the Water Forum hone in on the exact conditions needed for salmon restoration, providing details about the right depth for gravel placement, flow, rock size, and other parameters. With this information, the Water Forum can work on more complex science with the goal of improving species lifecycle and increasing project effectiveness.

Water Forum studies have:

- Produced detailed underwater maps of the Lower American River to identify the best locations for enhancing habitat that also won't impact flood safety.
- Identified the amount of sediment that is naturally lost and must be replaced to encourage salmon spawning.
- Identified how long it takes salmon to use a restoration site after construction, and how long each site stays utilized.
- Identified how cover (woody material, branches or tree roots) in a side channel improves survival for juvenile fish.
- Clarified lifecycle data for fish in the Lower American River, including how long fish rear in the river, how many fish stray from other rivers, successful life strategies (for example, whether a salmon is more likely to survive by spending more time in the Sacramento River vs. going straight to the ocean).
- Revealed drought impacts on fish populations in the Lower American River.
- Demonstrated how the Water Forum's habitat restoration projects are benefitting fish.



### ABOUT THE WATER FORUM SCIENCE AND HABITAT RESTORATION PROGRAM

*Since 2008, the Water Forum has invested more than \$7 million in restoring habitat, much of that provided by grants. Forming community partnerships is critical to this work... We work together to undertake science-based studies and actions to preserve and protect the Lower American River now and for generations to come.*

Additional funding could accelerate and expand this work to include longer-term studies with the potential to provide insight into system-wide issues, including those beyond the Sacramento region.

Priority actions identified in the FISH plan include:

## IDENTIFY AND CONSTRUCT IN-STREAM SPAWNING AND REARING HABITAT.

Diverse spawning and rearing habitat are critical factors for population viability. The Water Forum's early habitat restoration projects focused on gravel projects designed to create or enhance spawning habitat. That focus has evolved to add projects designed to enhance cold water and rearing habitat.

*The lower American River and parkway, which runs 23 miles along the river's shores, hosts up to 8 million visitors and brings \$364 million into the economy each year.*

In 2018, the Water Forum worked with Reclamation and the Sacramento Area Flood Control Agency to develop environmental documents for the next phase of restoration projects. This phase is slated to include maintenance at previous locations focused on enhancing spawning habitat, as well as our additional sites. All of these are slated to include new spawning habitat and the development or enhancement of side channels for rearing habitat.

Ultimately, the FISH Plan update demonstrates that Water Forum and its partners have greatly improved conditions for salmon and steelhead on the Lower American River, but there is more work to do. We are committed to this effort—to long-term research, action and adaptive management—for the benefit of the Lower American River today and for the generations to come.

## THE SACRAMENTO WATER FORUM

### WATER PROVIDERS

- California American Water
- Carmichael Water District
- Citrus Heights Water District
- City of Folsom
- City of Roseville
- Clay Water District
- Del Paso Manor Water District
- El Dorado County Water Agency
- El Dorado Irrigation District Fair Oaks Water District
- Georgetown Divide Public Utility District
- Golden State Water Company / Arden-Cordova Water Service
- Natomas Central Mutual Water Company
- Omochumne-Hartnell Water District
- Orange Vale Water Company
- Placer County Water Agency
- Rancho Murieta Community Services District
- Regional Water Authority
- Rio Linda/Elverta Community Water District
- Sacramento County Water Agency
- Farm Bureau
- Sacramento Suburban Water District
- San Juan Water District

### BUSINESS

- AKT Development Corp.
- Associated General Contractors of California
- North State Building Industry Association
- Sacramento Association of REALTORS
- Sacramento Metropolitan Chamber of Commerce
- Sacramento-Sierra Building & Construction Trades Council

### ENVIRONMENTAL

- Environmental Council of Sacramento
- Friends of the River
- Save the American River Association
- Sierra Club, Mother Lode Chapter

### PUBLIC

- City of Sacramento
- County of Sacramento
- League of Women Voters of Sacramento County
- Sacramento County Taxpayers League
- Sacramento Municipal Utility District



## Action Plan Update



## **1. Implement FMS Through State Water Board**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Develop and implement an ecologically-based flow management plan for the LAR, including water temperature management considerations, subject to SWRCB approval.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 1

### **Progress Update:**

The Water Forum, working with U.S. Bureau of Reclamation (USBR), U.S. Fish & Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), California Department of Fish and Wildlife (CDFW) and other agencies has made the following progress on developing and implementing an ecologically-based flow management plan for the LAR:

- The Flow Management Standard (FMS) was implemented in 2006 after a rigorous 5-year, science-based, multi-stakeholder development process.
- The FMS includes four components:
  - minimum release requirements (MRR) from Nimbus Dam,
  - water temperature objectives for salmonids (i.e., Chinook salmon and steelhead),
  - the lower American River Group (ARG), and
  - a monitoring and evaluation program.
- USBR has operated to the FMS since 2006, and compliance with the FMS was ordered as a reasonable and prudent alternative (RPA) in the 2009 Biological Opinion<sup>1</sup> on the Long-term Operations of the Central Valley Project and State Water Project (NMFS, 2009).
- During the 2013-2016 drought, it became evident that the FMS was not as protective of the LAR as desired and the development of a Modified Flow Management Standard (MFMS) began.
- The MFMS is comprised of the following major elements:
  - hydrologic indices and a family of MRR curves that prescribe higher flows during wetter hydrologic conditions,
  - end-of-May and end-of-December storage requirements to retain water in Folsom Dam to protect water temperatures and water supplies for local purveyors,
  - redd dewatering protective adjustments to the MRR during certain months,
  - a spring pulse flow event to aid outmigration of juvenile salmonids in certain water year types,
  - water temperature management requirements (same as FMS),
  - the lower American River Group (same as FMS), and
  - operations forecasts by USBR to provide transparency regarding system operations decisions.
- If adopted by USBR, the MFMS will:

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<sup>1</sup> The American River RPAs were not modified in the 2011 amendments to the 2009 Biological Opinion.

- Significantly lower water temperatures in the LAR during the crucial rearing season for juvenile steelhead.
- Provide better overall habitat conditions, particularly in the driest years. Under the MFMS, flows never drop below 500 cubic feet per second (cfs) and only rarely drop to 800 cfs, under conditions modeled in the simulation.
- Significantly improve water supply reliability in the American River basin by avoiding low Folsom Reservoir levels.
- Avoid redirected impacts to Sacramento River fisheries (i.e. Winter-run Chinook salmon).
- Discussions have taken place with the USBR regarding their voluntary adoption of the MFMS, however concrete progress toward adoption has not been made.
- The American River purveyors have submitted a protest to the proposed California Water Fix and have requested that the MFMS be included in the USBR's revised water rights permit if Water Fix is approved.

**Recommendations Moving Forward:** Continue to drive adoption of the MFMS.

**Relevant Documents / Resources:**

- Water Forum website: <http://www.waterforum.org/the-river/flow-management-standard/>
- LAR FMS Technical Report (2006)
- MMR calculator
- NMFS 2009 Biological Opinion (plus relevant appendix and amendments)
- LAR MFMS (2015)
- Water Forum testimony to the California Water Fix Hearing (2017)

## **2. Develop and Implement a Comprehensive LAR Water Temperature Monitoring Plan**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Develop and implement a comprehensive water temperature monitoring plan for the LAR.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 2

### **Progress Update:**

This action called for a long-term, continuous and comprehensive temperature monitoring program to better inform the management of cold water in Folsom Reservoir. The monitoring effort includes temperature monitoring, thermal profiling and flow gaging for the North and South Forks American River, Folsom Reservoir, Lake Natoma and the lower American River. A formal comprehensive water temperature monitoring program has not been developed. However, a number of temperature data collection efforts have been conducted by various entities (e.g., USGS, CDWR, USBR, Water Forum, etc.), some of which have reached completion and others of which are ongoing. These data collection efforts include the gages summarized below in Table 2 as well as routine collection of temperature profiles within Folsom Reservoir. The gage locations are shown in Figure 1.

### **Recommendations Moving Forward:**

Develop a comprehensive plan to improve the spatial and temporal monitoring of LAR water temperatures. This would be significant undertaking and would require the input of numerous key stakeholders (e.g., USBR, CDFW, NMFS, etc.). Elements of this plan could include maintaining current temperature monitoring stations, adding real-time temperature monitoring stations on the LAR below Nimbus Dam (e.g., 4-5 miles downstream of Hazel) and installing a real-time continuous temperature profile station within Folsom Reservoir near Folsom Dam.

### **Relevant Documents / Resources:**

- Water Forum website: <http://www.waterforum.org/the-river/river-dashboard/>
- USGS website: <https://waterdata.usgs.gov/ca/nwis/rt>
- CDEC website: <https://cdec.water.ca.gov/>

**Table 1. Summary of LAR Temperature Monitoring Station Locations and Data Records**

Water Body	Site Name	Collecting Entity	Start Date	End Date <sup>1</sup>	Notes
LAR	Jiboom St	Water Forum	8/2008	4/2015	
LAR	Hwy 160	Water Forum	8/2008	Ongoing	
LAR	SPRR Bridge	Water Forum	8/2008	7/2014	
LAR	H St	Water Forum	12/2008	Ongoing	
LAR	Sac State	Water Forum	7/2008	7/2015	
LAR	Howe Ave	Water Forum	12/2009	10/2014	
LAR	Watt Avenue (AWB)	USGS	11/1998	Ongoing	USGS 11446980
LAR	Watt Ave	Water Forum	7/2008	Ongoing	
LAR	Gristmill	Water Forum	7/2008	7/2013	
LAR	William Pond (AWP)	USGS	10/2000	Ongoing	USGS 11446700
LAR	River Bend Park	Water Forum	12/2008	Ongoing	
LAR	Hagan Park	Water Forum	7/2008	7/2015	
LAR	Rossmoor Bar	Water Forum	1/2009	7/2016	
LAR	Lower Sunrise	Water Forum	1/2009	4/2009	
LAR	Sailor Bar	Water Forum	12/2008	Ongoing	
LAR	Sailor Bar - Lower	Water Forum	10/2015	Ongoing	
LAR	Sailor Bar - Upper	Water Forum	8/2015	Ongoing	
LAR	Fair Oaks (AFO)	USGS	10/1961	Ongoing	Discharge measured since 1904, USGS 11446500
LAR	Hazel Ave	Water Forum	7/2008	7/2015	
LAR	Hazel Bridge (AHZ)	USGS	6/2011	Ongoing	
LAR	Folsom Dam (AFD)	USGS	10/1998	Ongoing	USGS 1446220
Folsom Reservoir	Folsom Reservoir Temperature Profiling Stations	USBR			
NFAR	Auburn Dam (NFA)	USGS	06/1999	Ongoing	USGS 11433790
SFAR	Pilot Hill (ARP)	USGS	08/05/1999	Ongoing	USGS 11446030

<sup>1</sup>Temperature dataset date ranges do not indicate data gaps present within each record

### **3. Improve LAR Water Temperatures**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Develop and implement physical actions and operational and management measures to improve water temperatures in the LAR.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 3

#### **Progress Update:**

A total of 11 sub-actions exist for this initiative to improve LAR water temperatures. Progress updates are provided in the following subsections for each of the 11 sub-actions listed below.

- 3.1 Conserve Cold Water in Folsom Reservoir
  - 3.1.1 Evaluate Thermal Curtains for Tributary Inflows to Folsom
  - 3.1.2 Permit Releases from Spillway Gates to Preserve Cold Water
  - 3.1.3 Evaluate Re-Operation of Upstream Reservoirs to Improve Folsom Coldwater Pool
  - 3.1.4 Construct and Operate Temperature Control Device for El Dorado Irrigation District
- 3.2 Improve Access and Management of Coldwater in Folsom Reservoir
  - 3.2.1 Improve Existing Folsom Dam Temperature Control Device Operations and Management
  - 3.2.2 Evaluate and Construct Automated Temperature Control Device
  - 3.2.3 Evaluate Feasibility of Accessing Cold Water Below Penstocks
  - 3.2.4 Assess Feasibility and Cost-Effectiveness of Accessing Low-Elevation Coldwater for Hydropower
  - 3.2.5 Modify ATSP Schedule to Accommodate Potential Infrastructure Modifications
- 3.3 Improve the transport of cold water from Folsom Dam to Nimbus Dam through Lake Natoma and release to the lower American River
  - 3.3.1 Evaluate Efficacy of Temperature Control Structures for Nimbus Dam Spillway and Power Intake
  - 3.3.2 Improve Efficiency of Water Transport through Lake Natoma

#### **Recommendations Moving Forward:**

Recommendations for each of the sub-actions are detailed in each of the following sections. The highest priority actions for the future include:

- Implement and monitor the performance of the EID TCD.
- Update Folsom Dam TCD shutter hardware to address leakage and monitor for improved performance.
- Incorporate improved temperature models and continue annual cold water pool management plan.

- Develop and implement biological monitoring plan to better understand temperature effects on species.
- Implement one or more of the temperature improvement options considered in the 2014 Value Planning Study.
- Until a structural alternative is implemented, formalize a plan for the utilization of power bypass via the lower river gates when ever water temperatures are expected to be unsuitable.
- Revisit the ATSP to determine if modifications are desired/required by the fisheries agencies.
- Conduct a value planning study to identify and investigate actions to improve the access to cold water at Nimbus Dam and the efficiency of cold water transport through Lake Natomas.
- Utilize best available tools/models and develop new tools/models to improve the management of cold water resources

**Relevant Documents / Resources:**

- Cook, Thomas et al. 2014. Structural Improvement Alternative Comparison for Temperature Management – Lower American River: Value Planning Study July 14-18, 2014 Final Report. August 2014.
- U. S. Bureau of Reclamation Technical Service Center. 2007. Temperature Modeling of Folsom Lake, Lake Natoma, and the Lower American River Special Report. April 2007.

## **3.1 Conserve Cold Water in Folsom Reservoir**

### **3.1.1 Evaluate Thermal Curtains for Tributary Inflows to Folsom**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Evaluate potential to construct curtains at tributary inflows to Folsom Reservoir, forcing cold water to bottom of reservoir.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 3.1.1

#### **Progress Update:**

This work had been started as of 2005. The recommendation was that USBR assign several individuals with curtains and modeling experience to perform a subjective analysis and determine whether a more quantitative evaluation was merited. The outcome of this initial investigation is not known.

#### **Recommendations Moving Forward:**

Document outcome of initial subjective analysis, if that has not yet happened.

#### **Relevant Documents / Resources:**

### **3.1.2 Permit Releases from Spillway Gates to Preserve Cold Water**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Formalize change in USBR standard operating procedure for Folsom Dam to permit release from the spillway gates to save cold water.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 3.1.2

**Progress Update:**

As detailed in the 2005 FISH Plan Update, the benefits of changing the standard operating procedure (SOP) were considered by USBR and it updated its SOP for Folsom Dam in 2003. The updated SOP provides for first using spillway gate 3, when possible, to conserve cold water. Using spillway gate 3 first is optional, at the discretion of USBR.

**Recommendations Moving Forward:**

As long as the revised SOP continues to be followed, no further action is necessary.

**Relevant Documents / Resources:**

### **3.1.3 Evaluate Re-Operation of Upstream Reservoirs to Improve Folsom Coldwater Pool**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Evaluate opportunities for re-operation of upstream reservoirs for benefit of Folsom Reservoir coldwater pool management.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 3.1.3

#### **Progress Update:**

As reported in the 2005 update, USBR conducted cursory evaluation of the benefits of re- operating upstream reservoirs and concluded that there is little opportunity to enhance the coldwater pool. Recently the upstream operators of the major water storage reservoirs have either completed Federal Energy Regulatory Commission (FERC) relicensing for their facilities or relicensing is pending issuance of the new license. Relicensing of the upstream projects was an arduous process that involved working collaboratively with state and federal resource agencies, local agencies, non-governmental organizations (NGO), Native American tribes, and members of the public for multiple years. Several hundred stakeholder meetings were held to develop a common understanding of the projects, discuss technical study results, and collaborate on new license conditions. The collaboration entailed extensive negotiation between stakeholders representing a diverse and often competing set of interests. The new operating licenses include minimum reservoir elevations, higher minimum instream flow requirements in most water year types, extensive recreational boating flow releases, and new spill ramp down and pulse flow requirements that result in additional releases of water, particularly in the wetter years. These new requirements, which are in place for the duration of the license terms (40+ years), provide modest coldwater pool benefits to Folsom Reservoir, particularly in the drier years. Additionally, the development of detailed inflow temperature models and a CE-QUAL-W2 reservoir water temperature model for Folsom Reservoir and Lake Natomas provides a robust platform to facilitate improved coldwater pool and Lower American River water temperature management.

#### **Recommendations Moving Forward:**

This topic has been thoroughly investigated at this time. FERC licensing controls the operation of the upstream projects and downstream temperature benefits were considered during the negotiation project. When future water transfers are proposed, the new temperature modeling tools such as the CE-QUAL-W2 reservoir models and HEC-RAS model for the LAR should be applied to identifying the most thermally beneficial way to transfer the water to Folsom Dam and through Lake Natomas the LAR.

#### **Relevant Documents / Resources:**

- FERC relicensing documents

### **3.1.4 Construct and Operate Temperature Control Device for El Dorado Irrigation District**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Construct and operate a temperature control device for El Dorado Irrigation District.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 3.1.4

**Progress Update:**

In March 2019 the public review period for El Dorado Irrigation District's (EID) Folsom Lake Intake Improvements Project CEQA document closed. Construction of the EID Intake TCD is scheduled to begin in the fall of 2019 if permitting and USBR cost share progress as planned.

**Recommendations Moving Forward:**

Monitor operations of the EID TCD to ensure that it is functioning as intended (i.e., withdrawing warmer water from higher up in the reservoir).

**Relevant Documents / Resources:**

- GEI Consultants. 2019. Initial Study/Proposed Mitigated Negative Declaration – El Dorado Irrigation District Folsom Lake Improvements Project. Prepared for El Dorado Irrigation District. February 2019.
- <https://www.eid.org/Home/Components/RFP/RFP/1541/138>

## **3.2 Improve Access and Management of Cold Water in Folsom Reservoir**

### **3.2.1 Improve Existing Folsom Dam Temperature Control Device Operations and Management**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Improve capability to control Folsom Dam release water temperatures for the benefit of priority lower American River fish species by improving effectiveness of Folsom Dam power penstock inlet port, shutters, and guidance structure.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 3.2.1

#### **Progress Update:**

In the 2005 FISH Plan Update, this action includes: (1) understand if current operations meet temperature requirements; (2) investigate temperature control device shutter leakage; and (3) improve temperature control operations.

(1) Current Operations: Since 2001 USBR has been operating to an annual temperature management plan. This plan balances cold water needs for over-summering steelhead and spawning salmon using the ATSP (automated temperature selection procedure). The ATSP schedule is determined using the Coldwater Pool Management Model (CPMM now iCPMM) with the following inputs: meteorological conditions; available cold water pool; expected inflows; and forecasted Folsom Reservoir. It is clear that in some years there is not enough cold water available to meet target temperatures for one or both species.

(2) Shutter Leakage: The cause and magnitude of shutter leakage was investigated by USBR's Technical Service Center. This showed there is significant leakage around the shutter superstructure (above elevation 428 ft) and to a lesser degree around the shutter guides (below elevation 428 ft). Debris in the superstructure and guides can also cause leakage around the shutters. The amount of leakage varies due to the number of shutters that are in place (with more shutters there is greater leakage). Temperature modeling conducted by cbec and separately by Cardno has documented an average leakage rate of approximately 35%.

(3) Improve Operations: USBR has improved the magnitude of the "stair-step" changes in water temperature by making more frequent shutter changes, drawing water from different levels and by blending the water through the penstocks. Significant additional improvements would require modification of the shutter hardware.

#### **Recommendations Moving Forward:**

- Update shutter hardware to address leakage.

- Continue the annual cold water pool management plan while incorporating better numerical models (e.g., CE-QUAL-W2), including the biological monitoring component.
- Secure reliable, long-term, funding for biological monitoring (FISH Plan priority 1).
- Regularly check for leakage.

**Relevant Documents / Resources:**

- Vermeyen, T. 2001. Shutter System Leakage – Draft Copy.
- Cardno. 2017. Technical Memorandum 5 – Folsom Reservoir CE-QUAL-W2 Temperature Model. Prepared for Placer County Water Agency. Submitted as exhibit ARWA-903 in the California WaterFix Proceedings.

### **3.2.2 Evaluate and Construct Automated Temperature Control Device**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Evaluate the effectiveness and construct, as appropriate, of a fully automated temperature control device.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 3.2.2

**Progress Update:**

In 2014, USBR undertook a value planning study regarding structural improvements at Folsom Dam and Reservoir in order to improve temperature management of the LAR. The value planning study focused specifically on structural improvements for Folsom Dam and Reservoir, improvements related to Lake Natoma and the LAR were not included. The value planning study group included representatives of El Dorado Irrigation District, NOAA Fisheries, U. S. Army Corps of Engineers – Sacramento District, Sacramento Area Flood Control Agency (SAFCA), Sacramento Water Forum, and USBR Central California Area Office, and USBR Technical Service Center. The group developed and evaluated the following alternatives:

- Reducing leakage of the existing Folsom Dam TCD,
- A 500 cfs capacity coldwater access conduit that would connect to the existing TCD and utilize the existing penstocks and power generation units,
- A 2,000 cfs capacity coldwater access conduit that would connect to the existing TCD and utilize the existing penstocks and power generation units,
- A power bypass monetary fund to account for lost power generation revenue when power bypass is performed to improve downstream temperatures,
- A 2,000 cfs capacity shunt through the dam at a lower elevation (to access more cold water) connected to one of the existing power generation units,
- A 500 cfs capacity conduit through the dam to a new 15 MW power generation unit,
- degang and mechanize existing TCD shutters (without leakage reduction),
- New mechanized TCD following the 2012 USACE 35% TCD design (without leakage reduction),
- EID intake cold water blocking curtain.

The effort quantified the potential thermal benefits of each alternative as well as developed planning level cost estimates. The lowest cost, highest benefit alternatives were found to be reducing leakage of the existing TCD (or of a future TCD) and developing a power bypass monetary fund. The high cost, high benefit alternatives were found to be the 2,000 cfs capacity coldwater access conduit, 2,000 cfs capacity shunt to existing power generation unit, and 500 cfs capacity conduit to a new power generation unit.

The 2012 USACE 35% TCD design includes 5 independent shutters, allowing for a finer resolution to the elevation that water can be withdrawn from. Feedback on the design, specifically the need to address leakage, was provided to USACE during the 2014 Value Planning Study effort. It is unclear if any progress has been made by USBR on this topic following the completion of the 2014 Value Planning Study. Further development of the USACE 35% TCD design has not occurred. At present there are not funds available for further design development and implementation. If the project is to proceed, the project will need to be included in the FY 2020 work plan.

**Recommendations Moving Forward:**

It is recommended that USBR and its project partners determine on a plan for implementation of one or more of the options consider in the 2014 Value Planning Study. If the project is to proceed, funding for the project should be included in the FY 2020 work plan.

**Relevant Documents / Resources:**

- Cook, Thomas et al. 2014. Structural Improvement Alternative Comparison for Temperature Management – Lower American River: Value Planning Study July 14-18, 2014 Final Report. August 2014.

### **3.2.3 Evaluate Feasibility of Accessing Cold Water Below Penstocks**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Evaluate the effectiveness of accessing coldwater between the lower river outlet works and the penstocks to address needs of priority lower American River fish species.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 3.2.3

**Progress Update:**

See Section 3.2.2 for a summary of the USBR Value Planning Study held in 2014 (Cook et al., 2014), which considered this action.

In recent years, at the request of the fisheries agencies, USBR has implemented power bypass operations through the lower river gates in order to access the approximately 50 thousand acre-feet (TAF) of coldwater that is available below the penstock intakes. Power bypass operations occurred in the fall months of 2001, 2002, 2007, 2008, 2009, 2012, 2013, 2014, 2015, 2016 and 2018. The volume of power bypass has ranged from 13.4 to 33.4 TAF

**Recommendations Moving Forward:**

Develop a plan for shutter mechanization and leak reduction and implement that plan.

**Relevant Documents / Resources:**

- Cook, Thomas et al. 2014. Structural Improvement Alternative Comparison for Temperature Management – Lower American River: Value Planning Study July 14-18, 2014 Final Report. August 2014.

### **3.2.4 Assess Feasibility and Cost-Effectiveness of Accessing Low-Elevation Coldwater for Hydropower**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Assess ability to access low-elevation coldwater pool with hydroelectric power generation and to economically utilize coldwater pool below penstock intakes.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 3.2.4

#### **Progress Update:**

See Section 3.2.2 for a summary of the USBR Value Planning Study held in 2014 (Cook et al., 2014), which considered this action.

#### **Recommendations Moving Forward:**

It is recommended that USBR, determine a path forward, and seek funding to implement that plan. If a power bypass monetary fund is determined to be the best approach, this action can be removed from the FISH Plan

#### **Relevant Documents / Resources:**

- Cook, Thomas et al. 2014. Structural Improvement Alternative Comparison for Temperature Management – Lower American River: Value Planning Study July 14-18, 2014 Final Report. August 2014.

### **3.2.5 Modify ATSP Schedule to Accommodate Potential Infrastructure Modifications**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Modify the existing automated temperature selection schedule for multi-species benefits to accommodate potential modifications to the existing power penstock shutters at Folsom Dam, or other infrastructure actions.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 3.2.5

**Progress Update:**

An automated temperature selection procedure (ATSP) schedule that considers multi-species benefits/impacts was developed as a component of the 2006 FMS. In 2009, this revised ATSP was incorporated into the coldwater pool management model (CPMM) for USBR temperature management planning applications. The current ATSP includes 78 schedules that were developed in consideration of juvenile steelhead rearing temperature requirements during the summer months and fall-run Chinook salmon spawning and egg incubation during the fall. At times during the temperature management planning process custom temperature schedules are applied by USBR, which typically have lower fall temperatures applied than those found in ATSP, and therefore shift the balance toward benefitting Chinook salmon over steelhead. No infrastructure modifications have occurred at this time so changes to the ATSP to accommodate that are not needed at this time.

**Recommendations Moving Forward:**

Revisit the ATSP to determine if modifications are desired/required by the fisheries agencies. USBR should not apply custom ATSP schedules prior to this formal process occurring.

**Relevant Documents / Resources:**

- HDR, Inc. 2019. Draft Master Automated Temperature Selection Procedure Description

### **3.3 Improve the Transport of Cold Water from Folsom Dam to Nimbus Dam through Lake Natoma and Release to the lower American River**

#### **3.3.1 Evaluate Efficacy of Temperature Control Structures for Nimbus Dam Spillway and Power Intake**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Evaluate the effectiveness of temperature control structures for the Nimbus Dam spillway and power intake to help address needs of priority lower American River fish species. Potential actions include the installation of temperature curtains at the plunge zone of Lake Natoma and around the Nimbus Dam powerplant intake, and removal of a portion or all of the concrete debris wall in front of the intake. Also, evaluate operations of Nimbus Dam during occasional spills to minimize release of warm water from Lake Natoma.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 3.3.1

#### **Progress Update:**

Using various numerical hydraulic and water temperature models, in 2007, USBR's Technical Service Center evaluated the following potential temperature management alternatives for Lake Natoma and Nimbus Dam: temperature curtain upstream of Nimbus Dam, temperature curtain in the Lake Natoma plunge zone, removal of the debris wall present upstream of Nimbus Dam and dredging of Lake Natomas. The modeling effort found that construction of a temperature curtain upstream of Nimbus Dam could slightly reduce the temperature of Nimbus Dam release, and this showed greater potential benefit than alteration of the debris wall. Dredging of Lake Natoma has the potential to provide a slight reduction in Nimbus Dam release temperature. A plunge zone curtain was found to undesirably increase release temperatures due to more mixing that would occur. The results of the study indicate that substantial temperature reductions are possible through a combination of some of the alternatives considered. The study recommended a physical modeling study as the next step in this process.

#### **Recommendations Moving Forward:**

It is recommended that a value planning study or similar process be conducted to revisit this topic. First the results of the 2007 USBR modeling effort would be reviewed then a brainstorming effort identifying other alternatives should be considered. There was a desire to include Lake Natoma alternatives in the 2014 Value Planning Study regarding Folsom Dam, but this was not done in order to keep the effort focused on Folsom Dam. Following the completion of the proposed Nimbus Value Planning Study, if merited additional studies should be conducted, followed by a decision made by USBR as to what action(s) to implement.

#### **Relevant Documents / Resources:**

- U. S. Bureau of Reclamation Technical Service Center. 2007. Temperature Modeling of Folsom Lake, Lake Natoma, and the Lower American River Special Report. April 2007.

### **3.3.2 Improve Efficiency of Water Transport through Lake Natoma**

**Category:** Lower American River Flow/Temperature Regime

**2001 FISH Plan Title:** Improving efficiency of water transport through Lake Natoma (e.g., modifying channel in Lake Natoma).

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 3.3.2

**Progress Update:**

This work was completed in conjunction with item 3.3.1. Using various numerical hydraulic and water temperature models, in 2007, USBR's Technical Service Center evaluated several potential temperature management alternatives for Lake Natoma, and Nimbus Dam include dredging of Lake Natoma. The study applied a calibrated CE-QUAL-W2 water temperature model of lake Natoma to an alternative that considered the removal of 500,000 cubic yards of material from the bed of Lake Natoma between Nimbus Dam and 2.4 miles upstream of the dam. The model results indicate a minimal (i.e., 0.18 °F) decrease in the two-week moving average water temperature during the summer and fall of a dry year. Smaller reductions occurred in modeling conducted to simulate a wet year.

**Recommendations Moving Forward:**

It is recommended that a value planning study be conducted to revisit Lake Natoma temperature reduction alternatives. First the results of the 2007 USBR modeling effort would be reviewed then a brainstorming effort identifying other alternatives should be considered. There was a desire to include Lake Natoma alternatives in the 2014 Value Planning Study regarding Folsom Dam, but this was not done in order to keep the effort focused on Folsom Dam. Following the completion of the proposed Nimbus Value Planning Study, if merited additional studies should be conducted, followed by a decision made by USBR as to what action(s) to implement.

**Relevant Documents / Resources:**

- U. S. Bureau of Reclamation Technical Service Center. 2007. Temperature Modeling of Folsom Lake, Lake Natoma, and the Lower American River Special Report. April 2007.

## **4. Create Floodplain Habitat**

**Category:** Natural Floodplain & Flood Processes

**2001 FISH Plan Title:** Inventory locations for creating shallow inundated floodplain habitat for multi-species benefits, and implement where suitable opportunities are available. Protect existing overflow areas.

**2001 Priority Tier:** 2nd

**2001 FISH Plan Original Action Number:** 12

### **Progress Update:**

A formal identification and prioritization project for potential salmonid rearing habitat projects is underway (cbec, in prep.). Seasonally inundated floodplain habitat is one of the types of enhancement projects that are being considered in that effort.

In 2017, SAFCA completed the implementation of the RM 0.5 project which lowered 3.3 acres of land adjacent to the LAR to provide floodplain inundation at lower flow rates. In addition, SAFCA has implemented several bank protection projects that have in some cases included floodplain benches that provide seasonally inundated habitat.

### **Recommendations Moving Forward:**

Complete the identification and prioritization of potential rearing habitat projects (including floodplain enhancement projects), which is underway. Seek funding to design, permit, implement and monitor high priority projects that are identified.

### **Relevant Documents / Resources:**

- cbec, inc. In preparation. Identification and Prioritization of Potential Salmonid Rearing Habitat Projects along the Lower American River. Prepared for the Water Forum and USFWS.
- SAFCA RM 0.5 Basis of Design Report

## **5. Identify and Construct In-Stream Spawning and Rearing Habitat**

**Category:** Natural Floodplain & Flood Processes

**2001 FISH Plan Title:** Identify opportunities to, and potential benefits and detriments of, enhancing or constructing mainstem and side channel habitats that provide salmon and steelhead spawning and rearing habitat, and implement measures where suitable opportunities are available.

**2001 Priority Tier:** 2nd

**2001 FISH Plan Original Action Number:** 13

### **Progress Update:**

While an assessment was not formally developed, USBR began implementation of the Lower American River Salmonid Spawning Gravel Augmentation and Side-Channel Habitat Establishment Program (Gravel Program) in 2008 in order to comply with Central Valley Project Improvement Act (CVPIA) Section 3406(b)(13). The 2008 Gravel Program identified eight sites: Nimbus Basin, Upper Sailor Bar-Upstream, Upper Sailor Bar-Downstream, Lower Sailor Bar, Upper Sunrise, Upper Sunrise Side Channel, and River Bend Park (Figure 2). Between 2008 and 2014, USBR implemented projects at each of these locations. The Nimbus Basin, Lower Sailor Bar, Upper Sunrise Side Channel and River Bend Park sites all included the creation or enhancement of side channel habitat. In 2016 an additional Gravel Program project was implemented at Sacramento Bar. Beyond the activities of the Gravel Program, the Water Forum implemented the Sunrise Side Channel Project in 2008. Regular physical and biological monitoring of each of the aforementioned sites/projects has occurred documenting the spawning and rearing benefits that have resulted from the projects.

In 2019, USBR working in coordination with SAFCA and the Water Forum developed environmental documents for the next phase of the Gravel Program. This second phase of the Gravel Program includes all previous project locations (where ongoing maintenance activities are proposed) and 4 additional sites: Sunrise, El Manto, Ancil Hoffman, Upper River Bend, all of which include the creation of spawning habitat and the creation or enhancement of side channel habitat. The intention is for one or more projects to be implemented annually going forward.

In addition to the projects discussed above, Water Forum consultants (cbec, in prep.) are in the process of identifying and prioritizing potential rearing projects within the LAR.

### **Recommendations Moving Forward:**

Obtain permits and begin implementation of the second phase of the Lower American River Salmonid Spawning Gravel Augmentation and Side-Channel Habitat Establishment Program. Complete the identification and prioritization of potential salmonid rearing habitat projects, which is underway. Seek funding to design, permit, implement and monitor high priority projects that are identified.

**Relevant Documents / Resources:**

- Phillip Williams & Associates, Ltd. 2009. Lower American River – Sunrise Side Channel Design – Basis of Design Report. Prepared for Sacramento Water Forum. March 2009.
- U.S. Department of the Interior Bureau of Reclamation Mid Pacific Region (USBR). 2008. Final Environmental Assessment Lower American River Salmonid Spawning Gravel Augmentation and Side-Channel Habitat Establishment Program. August 2008.
- cbec, inc. In preparation. Identification and Prioritization of Potential Salmonid Rearing Habitat Projects along the Lower American River. Prepared for the Water Forum and USFWS.
- cbec, inc. 2014. Lower American River Salmonid Gravel Augmentation and Side Channel Enhancement Program, 2013 Project at River Bend Park, Basis of Design Report. Prepared for USBR, USFWS and the Water Forum.
- cbec, inc. 2015. Lower American River Salmonid Gravel Augmentation and Side Channel Enhancement Program, 2014 Project at Nimbus Basin, Basis of Design Report. Prepared for USBR, USFWS and the Water Forum.
- cbec, inc. 2017. Lower American River Salmonid Gravel Augmentation and Side Channel Enhancement Program, 2015/2016 Project at Sacramento Bar, Basis of Design Report. Prepared for USBR, USFWS and the Water Forum.

## 6. Study Sediment Transport

**Category:** Coarse Sediment Supply

**2001 FISH Plan Title:** Develop a collaborative program to investigate erosion, bedload movement, sediment transport, and depositional processes and their relationship to the formation and maintenance of fish habitat in the LAR.

**2001 Priority Tier:** 2nd

**2001 FISH Plan Original Action Number:** 16

### Progress Update:

A gravel budget for the LAR was developed in 2007 by David Fairman at CSUS as part of his graduate studies. This study included the analysis of historical aerial imagery, a tracer rock study, analysis of cross sections from the USGS Fair Oaks gage, and gravel bar thickness investigation. This study estimated that: 1) 440,000 m<sup>3</sup> of gravel was eroded from the banks in the upper 17 km of the LAR between 1957-2002; 2) 1,600,000 m<sup>3</sup> of gravel was eroded from the bed of the channel between 1962 and 1998; and 3) 2,000,000 m<sup>3</sup> of gravel was transported out of the upper 17 km of the LAR between 1960 and 2000.

Ayers Associates have applied a two-dimensional hydraulic model to provide estimates of the degree of bed material mobility at various flow rates. In 2001, their work indicated that existing bed material is generally immobile at flows less than 50,000 cfs (this is not true for coarse sediment added as part of spawning gravel augmentation projects). Subsequent work conducted by Ayers Associates in 2004 assessed erosion susceptibility between river miles 0 and 14.5 for infrequent floods (i.e., floods of 115,000 cfs, 130,000 cfs, 145,000 cfs, and 160,000 cfs).

Under contract to SAFCA and the Water Forum, cbec developed a high-resolution Digital Elevation Model (DEM) of the LAR in 2017. With this DEM a high resolution two-dimensional hydraulic model (HEC-RAS) was developed and applied to predict hydraulic conditions to quantitatively identify morphological units (e.g. pool, riffle, run, floodplain, flood runner, terrace, etc.) throughout the LAR. A topographic change analysis compared DEMs from 1997, 2006/8<sup>2</sup> and 2017, and calculated spatially explicit erosion and deposition patterns that occurred between surfaces for the entire LAR corridor. In the 1997 – 2006/8 period the river exported a net of 16,000 cubic yards (CY)/year, while in the 2006/8 – 2017 period the exported a net of 31,000 CY/year. In addition to quantifying reach scale changes, the amount of change of different morphological unit types was quantified to identify the mechanisms driving the morphological adjustments.

NHC conducted a Lower American River Geomorphology Assessment for SAFCA which looked at geomorphic trends in the leveed reach (i.e., downstream of RM 15). NHC also completed for USACE the “Sacramento River Sediment Study Phase II, CA Folsom Dam Modification Water Control Manual Update Lower American River HEC-6T Model” which looked at potential impacts in the Folsom Water Control

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<sup>2</sup> This surface was developed using bathymetric data collected on behalf of USACE in 2006 and LiDAR data for out of channel areas collected on behalf of DWR in 2008.

Manual on sediment transport in the entire LAR. NHC also investigated the addition of gravel at proposed gravel augmentation sites as well as simulating specific events where the updated Folsom Dam Water Control Manual may cause more sediment to be moved relative to previous operations.

Looking into the future, a study plan has been developed to quantify gravel movement from existing and proposed gravel augmentation sites. The plan includes the deployment of radio-tagged tracer rocks, as well as repeat bathymetric surveys to provide a finer temporal resolution to quantifying the movement of the placed sediment.

#### **Recommendations Moving Forward:**

Conduct full river topographic change detection and morphological unit analysis again in approximately 5 years. Implement the fine scale sediment movement studies in the vicinity of gravel augmentation sites.

#### **Relevant Documents / Resources:**

- cbec, inc. In preparation. Morphological Units of the Lower American River: 2006-2017. Prepared for SAFCA and the Sacramento Water Forum.
- cbec, inc. In preparation. Topographic Change of the Lower American River: 2006-2017. Prepared for SAFCA and the Sacramento Water Forum.
- cbec, inc. In preparation. Topographic Change of the Lower American River: 1997-2006. Prepared for SAFCA and the Sacramento Water Forum.
- Fairman, D. 2007. A Gravel Budget for the Lower American River. Master of Science Thesis at California State University of Sacramento. Submitted Spring 2007.
- Ayres Associates. 2001. Two-dimensional modeling and analysis of spawning bed mobilization Lower American River: Report prepared for Sacramento District Army Corps of Engineers.
- NHC. 2015. Sacramento River Sediment Study, Phase II, CA; Folsom Dam Modification, Water Control Manual Update; Lower American River HEC-6T Model. Report prepared for U.S. Army Corps of Engineers, Sacramento District by Northwest Hydraulic Consultants Inc., Sacramento, CA. 30 September 2015.
- NHC. 2017. U.S. Army Corps of Engineers Supplemental Analysis, Folsom Dam Water Control Manual Update, HEC-6T Sediment Modeling. Report prepared for Sacramento Area Flood Control Agency and U.S. Army Corps of Engineers, Sacramento District by Northwest Hydraulic Consultants Inc., Sacramento, CA. 9 August 2017.
- NHC. 2018. Folsom WCM Update – Spawning Gravel Erosion Analysis. Prepared for Sacramento Area Flood Control Agency.
- NHC. 2018. Lower American River Anadromous Fish Habitat Restoration Project Assessment of Potential Downstream Geomorphic and Hydraulic Impacts. Prepared for Sacramento Area Flood Control Agency.

## **7. Monitor and Prioritize Gravel Projects**

**Category:** Coarse Sediment Supply

**2001 FISH Plan Title:** Assess the need to develop a spawning gravel monitoring and management program for steelhead and fall-run Chinook in which intervention would be based on identification of specific sites where intervention would enhance or increase salmonid spawning habitat.

**2001 Priority Tier:** 2nd

**2001 FISH Plan Original Action Number:** 17

### **Progress Update:**

While an assessment was not formally developed, USBR began implementation of the Lower American River Salmonid Spawning Gravel Augmentation and Side-Channel Habitat Establishment Program (Gravel Program) in 2008 in order to comply with CVPPIA Section 3406(b)(13). Prior to the implementation of the Gravel Program, USBR and California Department of Fish and Game (CDFG) augmented and manipulated gravel in the LAR in 1999. The 2008 Gravel Program identified eight sites: Nimbus Basin, Upper Sailor Bar-Upstream, Upper Sailor Bar- Downstream, Lower Sailor Bar, Upper Sunrise, Upper Sunrise Side Channel, and River Bend Park. Between 2008 and 2014, USBR implemented projects at each of these locations annually. In 2016 an additional Gravel Program project was implemented at Sacramento Bar. Beyond the activities of the Gravel Program, the Water Forum implemented the Sunrise Side Channel Project in 2008. Regular physical and biological monitoring of each of the aforementioned sites/projects has occurred.

In 2018, USBR working in coordination with SAFCA and the Water Forum developed environmental documents for the next phase of the Gravel Program. This second phase of the Gravel Program includes all previous project locations (where ongoing maintenance activities are proposed) and 4 additional sites: Sunrise, El Manto, Ancil Hoffman, Upper River Bend. The intention is for one or more projects to be implemented annually going forward.

In 2011, members of the Gravel Program planning team joined by other members of the fisheries agencies worked with Jim Peterson of the USGS and Oregon State University to develop a Structured Decision Making (SDM) Model for the LAR, to inform future project actions. The goal of this effort was to prioritize the timing, location and type of future gravel augmentation and rearing habitat creation efforts. This model has undergone several iterations following the prototype model developed in 2011, and model refinement continues at present.

### **Recommendations Moving Forward:**

Finalize permitting for the second phase of the Gravel Program in order to implement at least one project each year. Continue outreach with parkway stakeholders and advocates including early check-ins with the Recreation and Park Commission. Continue development of the SDM model for the LAR as new data become available and utilize the SDM model in present and future forms to prioritize Gravel Program actions in the future.

### **Relevant Documents / Resources:**

- cbec, inc. 2014. Lower American River Salmonid Gravel Augmentation and Side Channel Enhancement Program, 2013 Project at River Bend Park, Basis of Design Report. Prepared for USBR, USFWS and the Water Forum.
- cbec, inc. 2015. Lower American River Salmonid Gravel Augmentation and Side Channel Enhancement Program, 2014 Project at Nimbus Basin, Basis of Design Report. Prepared for USBR, USFWS and the Water Forum.
- cbec, inc. 2017. Lower American River Salmonid Gravel Augmentation and Side Channel Enhancement Program, 2015/2016 Project at Sacramento Bar, Basis of Design Report. Prepared for USBR, USFWS and the Water Forum.
- Peterson, J. et al. 2012. Structured Decision Making Workshop Case Study: Monitoring and Adaptive Management for Lower American River Channel and Floodplain Restoration.
- Phillip Williams & Associates, Ltd. 2009. Lower American River – Sunrise Side Channel Design – Basis of Design Report. Prepared for Sacramento Water Forum. March 2009.
- U.S. Department of the Interior Bureau of Reclamation Mid Pacific Region (USBR). 2008. Final Environmental Assessment Lower American River Salmonid Spawning Gravel Augmentation and Side-Channel Habitat Establishment Program. August 2008.
- U.S. Department of the Interior Bureau of Reclamation Mid Pacific Region (USBR). 2008. Finding of No Significant Impact Lower American River Salmonid Spawning Gravel Augmentation and Side-Channel Habitat Establishment Program. August 2008.
- SAFCA. 2019. Environmental Documents for the Second Phase?

## **8. Develop Large Wood Management Plan / Policy**

**Category:** Aquatic, Riparian, and Wetland Habitat

**2001 FISH Plan Title:** Develop a plan or policy for management of large woody debris in the LAR, consistent with recreation safety needs, including a pilot project.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 4

### **Progress Update:**

The 2008 American River Parkway Plan provides a concise policy statement on large woody material as part of the Aquatic Communities Policies (3.10): “In-stream woody material shall be managed to provide fish habitat in the lower American River consistent with recreational safety needs.”

In 2010, SAFCA developed an Instream Woody Material Installation and Monitoring Guidance Manual intended for general contractors installing in-stream woody material as part of flood protection, bank stabilization and other in-stream projects within SAFCA’s jurisdiction. The manual provides guidance on selecting material sources, placement and anchoring of woody material as well as recreational safety considerations.

Since 2001, several bank protection and side channel creation / enhancement projects that incorporate large wood to increase habitat value have been implemented. These efforts include pilot projects that have introduced woody complexes in the water and which fulfill the pilot project goal identified in the 2001 FISH Plan.

Despite these actions, the liability associated with placing woody material into the river, especially as it relates to health and safety, remains a significant concern of the agencies managing the LAR corridor. At the same time, restoration best practices increasingly include the installation of large woody material to provide habitat and cover for juvenile salmonids and many future habitat enhancement projects on the LAR would benefit significantly from increased incorporation of large woody material. Establishing clearer policy and guidance on this topic is critical for addressing the salmonid habitat enhancement needs and recreational safety concerns on the river.

### **Recommendations Moving Forward:**

It is recommended that the development of a more comprehensive policy and guidance document on the placement of large woody material in the river be revitalized and that it include a statement/position related to the liability issue. Such a guidance document should identify sections of the river where installation of large woody material poses minimal recreational risk (e.g., side channels, low-traffic reaches, etc.). This comprehensive policy and guidance document could be taken to the Recreation and Parks Commission for formal review and approval. Also, it is recommended that broadening legislation related to the liability issue be pursued.

**Relevant Documents / Resources:**

- 2008. American River Parkway Plan
- ICF International and Northwest Hydraulic Consultants. 2010. Instream Woody Material Installation and Monitoring Guidance Manual.

DRAFT

## **9. Identify and Evaluate Wetland/Slough Restoration Opportunities**

**Category:** Aquatic, Riparian, and Wetland Habitat

**2001 FISH Plan Title:** Identify and evaluate opportunities to implement Wetland/Slough Complex restoration, with needs of all priority species in mind.

**2001 Priority Tier:** 2nd

**2001 FISH Plan Original Action Number:** 11

### **Progress Update:**

Through the American River Parkway Plan Update Process, three sites were investigated including, Woodlake, Bushy Lake, and the Gardenland/Urrutia property. It was noted that Woodlake might be a possible candidate for a slough complex or wetland that would filter out drainage water from pumps 151 and 152. Bushy Lake was also identified for a similar type of enhancement. Both the Woodlake and Bushy Lake sites have been authorized by Congress as potential U.S. Army Corps of Engineers (Corps) mitigation sites as part of the Folsom Dam Raise project. Restoration efforts at these sites would need to be advanced in coordination with the Corps' planning process and such that it fulfills the Corps' mitigation requirements. A restoration project for the Gardenland/Urrutia property has also been explored and funding was obtained to advance the project. However, the property owners were unwilling to sell the property to the County at market value.

### **Recommendations Moving Forward:**

It is recommended to continue developing ideas on how to enhance these areas in the parkway. Outreach to the Corps should also be conducted to determine the status of the Corps' planning process with respect to these sites and how any restoration concepts could be integrated with the Corps' efforts.

### **Relevant Documents / Resources:**

- U.S. Army Corps of Engineers. 2002. American River Watershed, California. Long-Term Study. Final Supplemental Plan Formulations Report/EIS/EIR.

## **10. Identify, Evaluate and Implement SRA Habitat Improvement Projects**

**Category:** Aquatic, Riparian, and Wetland Habitat

**2001 FISH Plan Title:** Identify and evaluate suitable locations and benefits of establishing or providing SRA habitat along the lower American River to benefit priority fish species, and implement measures where appropriate opportunities exist.

**2001 Priority Tier:** 3rd

**2001 FISH Plan Original Action Number:** 21

### **Progress Update:**

Although a comprehensive study has not been performed, some site-specific evaluations have been conducted associated with flood control projects along the river and some of these opportunities have been implemented. In 2015, the elevated floodplain along approximately 1,000 linear feet of the shoreline at RM 0.5 adjacent to Discovery Park was lowered by SAFCA to create high quality riparian within and along seasonally inundated aquatic habitat. Planting of the site was delayed until the summer of 2017 due to inundation of the site during the high flows in late 2016 and early 2017.

Through a study conducted between 2014 and 2016, SAFCA also identified SRA habitat improvement opportunities at previously constructed bank erosion repair sites. These include projects located at RM 0.3L, 3. 7L (Site 2), 4.4L (Site 3), 6.8L (Site 4), 8.7L (Site 5), and 10.6L. The study resulted in guidelines for bank repairs to improve soil volume and water content to support vegetation at the water's edge. Currently SAFCA is working with USACE, CVFPB on bank protection along the LAR from Howe Ave to the confluence. The first phase of designs reflect the guidance of the study are underway in a coordinated effort between the USACE, CVFPB, SAFCA and the Bank Protection Working Group (a subset of the Lower American River Task Force). As part of the design process SAFCA conducted a resource assessment in 2018 that collected data on human use (recreational, utilities and infrastructure), cultural resources, terrestrial habitat, and aquatic habitat. The aquatic habitat survey identified characteristics of the bank, bed, vegetation and instream woody material. Specifically, the presence and quality of SRA was assessed, as well as the potential for future recruitment and contribution to instream woody material as banks retreat due to future erosion and intermittent flooding.

The ongoing American River Parkway (Parkway) Natural Resource Management Plan (NRMP) update also includes an SRA evaluation effort that involves identifying SRA habitat criteria and identifying and mapping opportunities to protect, establish and enhance SRA habitat within the Parkway.

### **Recommendations Moving Forward:**

In conjunction with the current Parkway NRMP efforts and SAFCA efforts, continue to look for additional opportunities to provide high quality SRA habitat and potentially synthesize results within a systematic evaluation and prioritization of SRA habitat enhancement opportunities. Encourage collaboration and data sharing among NRMP and SAFCA consultants. Implement identified high-priority opportunities including recommendations from the NRMP once they are made available.

**Relevant Documents / Resources:**

- Internal Review Draft: Evaluation of Existing Bank Protection Sites (1999-2011) on the Lower American and Sacramento Rivers: Lessons Learned, and Design and Management Recommendations.
- [Lower American River Subreach 2: Summary of Bank Protection Conceptual Design Process \(November 2018\)](#)
- cbec, inc. 2017. Evaluation of Levee Erosion Repairs and Recommendations for Future Repairs. Prepared for Sacramento Area Flood Control Agency and GEI Consultants.

## **11. Increase Channel Complexity with Structural Elements**

**Category:** Aquatic, Riparian, and Wetland Habitat

**2001 FISH Plan Title:** Identify and evaluate suitable locations to use large in-stream objects (e.g., boulders) to modify flow dynamics to increase cover and diversity of in-stream habitat for priority fish species. Implement measures where suitable opportunities are available.

**2001 Priority Tier:** 3rd

**2001 FISH Plan Original Action Number:** 22

### **Progress Update:**

Although a comprehensive effort to identify and evaluate suitable locations where the placement of in-stream structural objects (e.g., boulders and large wood) for the purpose in-stream habitat has not been undertaken, several projects that have been implemented have included structural elements. Several of the Gravel Program projects (see Section 5) have used boulders, small cobble islands, and large woody material (LWM) to improve in-stream habitat, and these types of features will likely be included in all future projects implemented by the Gravel Program. In addition, the River Mile 0.5 project and several of the bank protection projects implemented by SAFCA have included large woody material (and large rock, but not for habitat purposes). Beyond the implemented projects, LWM has been proposed for several bank protection project designs that are currently under development. SAFCA also developed an Instream Woody Material Guidance Manual which provides implementation and monitoring information. An effort is currently underway lead by the Water Forum and funded by USFWS (cbec, in prep.), to identify and prioritize potential juvenile salmonid habitat enhancement projects within the LAR. While its specific focus was not to identify and evaluating suitable locations where the placement of in-stream habitat structures for habitat, these types of elements have been included in many of the projects that have been identified.

### **Recommendations Moving Forward:**

Conduct an effort to identify and evaluate suitable locations where the placement of in-stream structural objects is both beneficial for priority fish species as well as acceptable from a public safety and risk point of view. This effort should consider the geomorphic context of the LAR, acknowledging that LWM is more appropriate than the placement of boulders.

### **Relevant Documents / Resources:**

- cbec, inc. In preparation. Preliminary identification and prioritization of juvenile salmonid rearing habitat enhancement projects. Prepared for the Water Forum and USFWS.
- ICF International and NHC. 2010. Instream Woody Material Installation and Monitoring, Guidance Manual. Prepared for Sacramento Area Flood Control Agency.

## **12. Identify, Evaluate and Implement Runoff Inflow Bio-Filtration Opportunities**

**Category:** Aquatic, Riparian, and Wetland Habitat

**2001 FISH Plan Title:** Identify and evaluate suitable locations to establish or provide wetland filtration habitat on inflow point source discharges; create such habitat if suitable opportunities can be identified.

**2001 Priority Tier:** 3rd

**2001 FISH Plan Original Action Number:** 23

### **Progress Update:**

An evaluation was conducted by MIG, Inc. in the 2000s as part of the Integrated Area Plan associated with the American River Parkway Plan Update. Three sites were identified where wetlands could be developed or enhanced using urban runoff resulting in improved water quality of the runoff. The water sources and locations included Chicken and Strong Ranch Slough at Bushy Lake, Sump 152 west of Bushy Lake, and Sump 151 near the Woodlake area. Since this identification effort, SAFCA has determined that treating flows in Chicken and Strong Ranch Slough would require pumping to transfer stormwater to a potential treatment area. While opportunities exist to pursue these projects, the benefit relative to cost makes these projects less attractive than other opportunities as well as other FISH Plan actions. The Water Forum, Sacramento County Regional Parks, SAFCA and other organizations have also evaluated opportunities to treat stormwater discharged from small outfalls along the American River Parkway but have concluded that their relative benefits do not justify their cost at this time.

Other sites have been identified and pursued for wetland filtration and point source discharge inflow treatment. In 2017, SACFA, Sacramento County and the Water Forum completed a restoration project of Cordova Creek within the American River Parkway. The concrete-lined channel was realigned to a meandering, cobble-bed channel with significantly improved floodplain connectivity. The increased infiltration capacity of the project reach along with abundant wetland and riparian plantings significantly improve the opportunity for wetland filtration of urban discharge from Cordova Creek before it reaches the lower American River.

A potential restoration project on portions of Carmichael Creek could also support this action. Carmichael Creek is a concrete and earth packed lined channel in Carmichael CA which could be enhanced and restored in Ancil Hoffman Park adjacent to the lower American River. This project could provide measurable ecological and water quality benefits with improved floodplain connectivity and peak flow attenuation. In 2009 concepts were developed for Sacramento County Regional Parks, the Water Forum, and SAFCA.

### **Recommendations Moving Forward:**

Continue to identify, develop and implement cost-effective wetland filtration habitat designs to treat inflow point source discharges.

**Priority Moving Forward:**

2005 update recommended that this be raised to a second priority action.

**Relevant Documents / Resources:**

- American River Parkway Plan 2008.
- Cordova Creek Naturalization Project Basis of Design Report
- Philp Williams & Associates. 2009. Restoration Concepts for Carmichael Creek in Ancil Hoffman Park. Prepared for Sacramento County Regional Parks and Sacramento Regional Water Forum.

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## **13. Improve Revetments for Fish**

**Category:** Levees and Bank Protection

**2001 FISH Plan Title:** Identify and evaluate locations in the LAR where existing revetments could be modified to incorporate bank protection habitat features to aid in preservation and re-establishment of both high-quality nearshore aquatic and riparian habitats, and implement measures where appropriate and possible to do so without having an impact on the integrity of the bank protection.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 5

### **Progress Update:**

Several revetment sites on the LAR have been evaluated for their potential to provide improved habitat value while maintaining bank protection capacity, and several measures have been implemented. A site of RM 1.8 was planted through existing riprap and through additional riprap added in 2004 as part of the FEMA Emergency Erosion Control Sites. Trees, shrubs and herbaceous plants were also planted at RM 4.2 and RM 7.6. These sites were irrigated and maintained for several years and were considered self-sustaining SRA habitat areas after several years of monitoring without supplemental irrigation.

More recently, erosion repairs at RM 0.3L and 10.6L were installed in 2008 and 2011, respectively, with design features incorporating instream woody material to improve nearshore aquatic habitat. The RM 0.3L site design included instream woody material on the low-berm riparian bench surface of the design. The RM 10.6L design included instream woody material installed in the waterside rock revetment. Both sites also included a riparian bench onto which a layer of soil was placed over the rock revetment and into which vegetation was planted. Both sites were included in a 2014-2016 SAFCA study of recent bank repair sites that aimed to improve designs to more successfully establish vegetation at the water's edge. Vegetation establishment and health was evaluated as a part of this study.

### **Recommendations Moving Forward:**

Continue to develop and implement fish-friendly revetment designs.

### **Relevant Documents / Resources:**

## **14. Estimate Natural to Hatchery Ratio**

**Category:** Artificial Propagation of Fish

**2001 FISH Plan Title:** Estimate relative proportion of hatchery and naturally produced Chinook and steelhead to annual spawning escapement and commercial and sports fisheries to enhance management capabilities.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 6

### **Progress Update:**

The Constant Fractional Marking (CFM) program is a multi-agency effort, centered with CDFW, that addresses this information need. Implementation began with BY 2006 hatchery-origin fall-run Chinook Salmon that were released as juveniles in 2007. At least 25% of all Central Valley hatchery production of Chinook Salmon is adipose fin-clipped and coded-wire tagged (CWT). All (100%) *O. mykiss* produced at the Nimbus hatchery are adipose fin-clipped. Carcass surveys, escapement to hatchery and ocean recovery all use CWT data to inform estimates of hatchery production to natural fish to and from the American River. Seasonal seining surveys and redd surveys provide an estimate for hatchery fish in the wild. Counts at the hatchery should provide an estimate of natural *O. mykiss* entering the hatchery. The CFM program continues with results reported through the 2013 program. Hatchery fish continue to be the dominant component of LAR escapement and production.

The CFM program has been supported through various funding sources (CALFED, USBR, DWR, state Prop 84 funds, and more) since its inception, and has no stable long-term funding.

### **Recommendations Moving Forward:**

Continue the CFM program and support the provision of a stable funding source for this program. A unified goal for how hatchery fish should influence the river population and vice versa is needed for both species, including methods to meet such goal. This should include developing targets for the proportion of naturally produced fish in the LAR.

### **Relevant Documents / Resources:**

- CDFW tag recovery reports
- Regional Mark Information System (RMIS)
- Annual CFM reports available through 2013 program year

## **15. Modify Fish Ladder**

**Category:** Artificial Propagation of Fish

**2001 FISH Plan Title:** Undertake long-term modification of the diversion structure at the Nimbus Salmon and steelhead Hatchery to protect salmon and steelhead and other LAR resources from potential impacts associated with flow fluctuations for operations and maintenance.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 7

### **Progress Update:**

USBR evaluated several alternatives for replacing or removing the existing fish diversion structure below Nimbus Basin and has since developed designs for the preferred concept. This project will eliminate the need to seasonally install and remove the existing, river-spanning fish weir which has limited efficacy in excluding fish from Nimbus Basin and can be a safety risk to staff installing and removing it. In the current condition, fish that access Nimbus Basin overwhelm the available habitat and are unable to access the hatchery. The new ladder entrance to the hatchery will be located close to the base of the existing dam and the fish exclusion weir will no longer be seasonally installed, thereby enabling all fish to freely use the habitat of the Nimbus Basin which was also the site of a 2014 gravel augmentation and side channel enhancement project. The NEPA EIS for the project has been completed and permitting is nearing completion. Upon receiving the required 401, 404 and 408 permits, USBR will put the project out to bid with construction anticipated for 2020.

### **Recommendations Moving Forward:**

Advance the proposed project to construction. Integrate fish passage needs into the fish ladder (e.g. provision for adult fish from top of ladder into truck for transport upstream; this action is dependent on the steelhead broodstock replacement program for the LAR).

### **Relevant Documents / Resources:**

- Nimbus Fish Ladder EIS:  
[https://www.usbr.gov/mp/nepa/includes/documentShow.php?Doc\\_ID=8063](https://www.usbr.gov/mp/nepa/includes/documentShow.php?Doc_ID=8063)
- Nimbus Fish Ladder Design Package

## **16. Evaluate Hatchery Production and Stocking**

**Category:** Artificial Propagation of Fish

**2001 FISH Plan Title:** Evaluate Nimbus Salmon & Steelhead Hatchery production and stocking practices to identify measures that would promote restoration of native fish species in the LAR.

**2001 Priority Tier:** 2nd

**2001 FISH Plan Original Action Number:** 18

### **Progress Update:**

The California Hatchery Scientific Review Group (HSRG) conducted a comprehensive scientific review of Central Valley and Klamath/Trinity salmon hatcheries. The group generated a report in 2012 that identifies various recommendations for improving the balance between production of salmon and steelhead to support fisheries, and conservation of natural stock integrity and productivity, including specific recommendations for Nimbus Hatchery. Hatchery and Genetic Management Plans (HGMP) have been drafted for Chinook Salmon and steelhead at Nimbus Hatchery. The HGMPs likely need to be updated (Mark Clifford, CDFW, Program Manager for Fish Production, pers. comm., 9 Feb 2018).

### **Recommendations Moving Forward:**

This effort is being advanced by others. While it is a priority for the LAR and entire Central Valley, this initiative should be promoted and managed in a more comprehensive manner that considers the full Central Valley fishery.

### **Relevant Documents / Resources:**

- California Hatchery Scientific Review Group final report (2012):  
<http://cahatcheryreview.com/reports/>
- Draft HGMP for Chinook Salmon produced at Nimbus Hatchery
- Draft HGMP for winter-run steelhead produced at Nimbus Hatchery

## **17. Improve Hatchery Temperature**

**Category:** Artificial Propagation of Fish

**2001 FISH Plan Title:** Evaluate alternative ways for addressing temperature-related issues at the Nimbus and American River Fish Hatcheries which would not jeopardize the needs of in-stream spawning fall-run Chinook salmon and steelhead.

**2001 Priority Tier:** 3rd

**2001 FISH Plan Original Action Number:** 26

### **Progress Update:**

The Nimbus Hatchery uses river water and is virtually at the same temperature as the LAR. Addressing hatchery temperature needs for the Nimbus Fish Hatchery October through late-November for fall-run Chinook salmon requires that river temperature be addressed. This includes the issue of the LAR not providing temperatures low enough to support spawning or hatchery cultivation of early-returning fall-run Chinook salmon that require water temperatures lower than what are generally available in October and early November. Due to the overly warm water temperatures generally present during the early spawning season, the Nimbus Hatchery is unable to collect sufficient numbers of eggs to represent this earlier arriving portion of the gene pool.

Measures that can be pursued to try addressing these temperature issues including the following:

1. Alternative water operations to better manage coldwater pool in Folsom
2. Power bypass
3. TCD / infrastructure improvements
4. Additional Chiller/Recirculating Aquatic System (RAS) units for Nimbus Hatchery

While additional chillers for the hatchery can provide a partial solution, they are costly to install and operate. The chillers currently in the Nimbus Hatchery cost between \$60,000 and \$100,000 per year to operate and the only chill 900 gallons per minute to 10 degrees below ambient. Chilling 10 raceways at around 4 cfs each (~18,000 gallons per minute) would be cost prohibitive (pers. comm. Jay Rowan, CDFW, 15 March 2019). RAS chilling units can be more effective in reducing temperatures due to their recirculation capacity and insulated tanks. However, chilling units will not address the overly warm river water temperatures that delay fall-run Chinook salmon from being physiologically ready to spawn (or be a source of eggs for the hatchery) early in the season.

### **Recommendations Moving Forward:**

It is recommended that USBR continue to manage the LAR such that the coolest thermal regimes possible are provided, as well as to pursue other temperature management solutions as discussed in Sections 1 and 3 to further improve the thermal regime of the LAR. These efforts will improve thermal conditions for in-river salmonids, which is also protective of salmonids being collected, spawned, incubated, and reared in the hatchery.

### **Relevant Documents / Resources:**

## **18. Reduce Stranding**

**Category:** Stranding

**2001 FISH Plan Title:** Complete the inventory of areas that pose a stranding threat to juvenile salmonids. Conduct a function analysis workshop to identify measures to reduce or eliminate stranding. Implement measures where appropriate opportunities exist.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 8

### **Progress Update:**

CDFW identified stranding and isolation areas in its "Evaluation of Effects of Flow Fluctuations on the Anadromous Fish Populations in the Lower American River" report published in 2001. USBR, and others, sponsored a Lower American River Flow Fluctuation Function Analysis Workshop in 2002, and a variety of operational and physical solutions were recommended. Through ongoing monitoring, several problematic areas were identified that lent themselves to physical solutions, including one at a side channel at Lower Sunrise and one at an isolation pool below the Sunrise Boulevard Bridge.

Measures to correct stranding and isolation problems include both operational changes and physical modifications to the riverbed. USBR has modified its historical operations to minimize flow fluctuations that can lead to the stranding and isolation of juvenile salmonids. Flow ramping rate objectives were included in the 2004 OCAP Biological Opinion, and these ramping rate objectives were included as a component of the 2006 Flow Management Standard.

In addition to operational changes, modification of the riverbed has also occurred, motivated by the stranding issue. In 2008, the Water Forum, with the assistance of other agencies, implemented a project to physically modify the Lower Sunrise Side Channel to prevent it from becoming dewatered at flows that might typically occur during the time of steelhead spawning and incubation. Additionally, in cooperation with several agencies, in 2005, the Water Forum designed and implemented through volunteer labor a small channel to connect the Sunrise Isolation Pool to the main river at lower river flows. Beyond these two projects, starting in 2008, the Lower American River Salmonid Spawning Gravel Augmentation and Side-Channel Habitat Establishment Program (discussed in Section 5) has implemented eight enhancement projects within the river. As these projects are designed and implemented, consideration is given to avoidance of topographic conditions that could lead to stranding of fish. For example, when side channels are included in the design, they are designed to stay hydraulically connected under flows as low as 800 cfs.

USBR performs annual surveys of steelhead redd and juvenile salmonid stranding surveys for the LAR. These surveys estimate the area of stranding and number of fish by species stranded in isolated pools that occur during flow reductions. Once a month on average (and no more than twice a month), consultants to USBR determine how flow reductions may affect steelhead embryos and juveniles through stranding and isolation pool surveys that are dictated by flow reductions of more than 1,000 cfs when the initial flow is greater than 2,000 cfs, and reductions of 250 cfs and when initial flows are to be

reduced below 1,000 cfs. Although replication is needed for a variety of water years and flow scenarios, coupled with inundation models, water quality measurements and estimates of survival and predation, these surveys will provide estimates of potential stranding for water managers and offer potential suggestions for future habitat enhancement. To aid these stranding surveys, the Water Forum conducted an analysis with a two-dimensional hydraulic model based upon 2017 topographic/bathymetric conditions to identify various potential stranding areas as well as the flow rate where they would be expected to become disconnected from the main channel.

#### **Recommendations Moving Forward:**

It is recommended that the stranding and isolation areas identified in the 2001 CDFW report, the 2017 stranding areas analysis, and the monitoring work by USBR be systematically evaluated for potential of implementing physical solutions and to re-affirm critical inundation threshold flows, and that USBR continue to implement operational solutions to minimize stranding and isolation of juvenile salmonids.

#### **Relevant Documents / Resources:**

- Snider et al. (2001)
- Rod Hall and Mike Healey, CDFG. 2006. Lower American River Isolation Pool Survey 2006.
- cbec, inc. In preparation. Stranding Areas of the Lower American River. Prepared for the Sacramento Water Forum.
- PWA. 2009. Lower American River – Sunrise Side Channel Design Basis of Design Report. Prepared for Sacramento Water Forum.
- LAR FMS Technical Report (2006)
- Rod Hall. 2005. Sunrise Isolation Pool Project. Prepared for the Sacramento Water Forum.

## **19. Mark>Select Salmonids**

**Category:** Harvest of Fish and Wildlife

**2001 FISH Plan Title:** To assist in protecting and enhancing the natural production of LAR salmonids, develop and implement a marking and selective harvest program for LAR Chinook salmon and steelhead, ideally in the context of a Central Valley-wide effort.

**2001 Priority Tier:** 2nd

**2001 FISH Plan Original Action Number:** 14

Spawning, Rearing, Migration, Escapement, Stressors (Water Quality, Temperature, Invasive Species Management), Hatchery Management, Flood Protection, Science / Data Gaps, Others

### **Progress Update:**

Since 1998, all hatchery-origin steelhead in the Central Valley are adipose fin-clipped including Nimbus hatchery. Wild steelhead are by default recognizable via the lack of fin-clipping. Current regulations only allow harvest of clipped steelhead so a selective sport fishery is in place. The effect of this program on LAR steelhead has not been well studied.

Hatchery production of Chinook Salmon in the Central Valley is subject to a constant fractional marking program such that only a portion (25%) of hatchery fish are clipped and coded-wire tagged. Consequently, anglers cannot clearly distinguish hatchery-produced fish from natural production, and there is no selective fishery. Some discussion is being made on a selective fishery for salmon but no consensus has been met. There is also some confusion and differences of opinion on natural production goals within the river environment.

### **Recommendations Moving Forward:**

Continue the current steelhead adipose fin-clipping program and the Chinook Salmon CFM program.

### **Relevant Documents / Resources:**

## **20. Assess Salmonid Poaching**

**Category:** Harvest of Fish and Wildlife

**2001 FISH Plan Title:** To assist with management decision making, ascertain whether in-river illegal harvest of Chinook salmon and steelhead is acting as a stressor on those species in the lower American River.

**2001 Priority Tier:** 3rd

**2001 FISH Plan Original Action Number:** 25

Spawning, Rearing, Migration, Escapement, Hatchery Management, Science / Data Gaps, Others

**Progress Update:**

Based on observations of CDFW's Central Valley Angler Survey and associated acoustic tagging assessments, CDFW (Rob Titus) believes that with the present level of law enforcement, illegal harvest of Chinook salmon and steelhead is not of sufficient magnitude to act as a stressor on the populations of those species in the lower American River. Snagging and flossing are also being further addressed through gear restrictions. More recently, Nimbus Basin has been closed to fishing.

**Recommendations Moving Forward:**

It is recommended that CDFW and local park rangers continue to enforce existing state fishing regulations along the lower American River and to monitor whether illegal harvest becomes a significant stressor in the future.

**Relevant Documents / Resources:**

## **21. Estimate Folsom First Responder Impacts**

**Category:** Other Potential Management Actions

**2001 FISH Plan Title:** Identify the fishery impacts on LAR priority species caused by meeting Sacramento/San Joaquin Delta WQCP requirements and needs from Folsom Reservoir.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 9

**Progress Update:**

The Water Forum completed an analysis and a draft report of the impacts on the lower American River salmonid fisheries of USBR meeting Delta water quality standards as it did in 2001 through 2004 (*Impacts on Lower American River Salmonids and Recommendations Associated with Folsom Reservoir Operations to Meet Delta Water Quality Objectives and Demands*, December 2004). The draft report was sent to the SWRCB and the CALFED Operations Group. Although the draft report was not prepared in final, nor did it include an evaluation of long-term historical operations or USBR criteria for balancing the operations of Folsom and Shasta, it did present the conclusion that meeting Delta water quality requirements and needs has a major effect on the protection of salmonids in the lower American River.

**Recommendations Moving Forward:**

While this issue has been investigated previously, additional management constraints (e.g., status of winter-run Chinook Salmon in the Sacramento River) have developed that continue to require management decisions that ultimately result in the detriment to the lower American River fishery. Additional quantitative tools (e.g., water temperature models for various tributaries) are available to would allow for quantitative evaluation of the ongoing impacts. The additional constraints, ongoing impact, and availability additional quantitative tools may warrant an updated evaluation. In addition to an updated evaluation, USBR's operations to meet Delta standards should be continually monitored through the American River Operations Work Group, or its successor.

**Relevant Documents / Resources:**

- Surface Water Resources, Inc. 2005. Impacts on the Lower American River Salmonids and Recommendations Associated with Folsom Reservoir Operations to Meet Delta Water Quality Objectives and Demands. Draft Report. Prepared for the Water Forum.

## **22. Improve Research Data**

**Category:** Other Potential Management Actions

**2001 FISH Plan Title:** Improve availability and management of LAR research data, with attention to quality control.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** 10

**Progress Update:**

Storage of existing lower American River data is scattered among various organizations. While data accessibility has improved for some types of data (e.g., flow and water temperature data available on CDEC, USGS and Water Forum websites), other data types such as habitat characterization, biologic monitoring and operations information exists in various formats and resides with numerous entities and individuals and, therefore, is not easily accessible. There is still significant opportunity to consolidate databases or at least metadata to make it common knowledge what data is available and where it can be accessed.

**Recommendations Moving Forward:**

It is recommended that this effort be changed to a 2nd priority. Collect and consolidate LAR data in one repository where it can be easily accessed and utilized.

**Relevant Documents / Resources:**

## **23. Assist LAR Task Force**

**Category:** Other Potential Management Actions

**2001 FISH Plan Title:** Continue to provide ongoing long-term consultation/technical assistance to LAR Task Force, its component committees, and responsible agencies for LAR management.

**2001 Priority Tier:** 2nd

**2001 FISH Plan Original Action Number:** 15

**Progress Update:**

The Lower American River Task Force (Task Force) focuses on the integration of flood, environmental and recreational management issues affecting the lower reach of the American River from Folsom Dam to the Sacramento River. The objective of the Task Force is to provide cross-agency input and stakeholder outreach. The Task Force is co-convened by the Water Forum and the Sacramento Area Flood Control Agency (SAFCA). The Task Force, established in 1994, has been meeting quarterly since 2008 and is the umbrella body for activities related to the lower American River. A few of subgroups are: Bank Protection Working Group (BPWG), USACE 408 permitting, Salmon and steelhead restoration projects, vegetation management, and the Fisheries and In-Stream Habitat (FISH) Working Group (FWG).

The BPWG, initially formed in the mid-1990s to inform pressing levee stabilization efforts at that time, was re-formed in 2015 to help advise, plan, design, and implement bank protection features along the lower American River. A primary goal of the BPWG is to support federal, state, and local efforts to provide the highest level of flood protection for the surrounding community and the conservation of irreplaceable natural resources along the American River Parkway. The initial FWG was established to develop the FISH Habitat Management and Restoration Plan (FISH Plan) and included over 45 diverse stakeholders who contributed to the 2001 FISH Plan. The FWG has since convened on a quarterly / as-needed basis.

**Recommendations Moving Forward:** Continue to co-convene quarterly Task Force meetings

**Relevant Documents / Resources:**

- Task Force website: [http://www.safca.org/Protection/Environmental\\_Collaboration\\_LARTF.html](http://www.safca.org/Protection/Environmental_Collaboration_LARTF.html)
- Bank Protection Working Group website:  
[http://www.safca.org/protection/Environmental\\_Collaboration\\_BPWG.html](http://www.safca.org/protection/Environmental_Collaboration_BPWG.html)

## **24. Coordinate Permitting**

**Category:** Other Potential Management Actions

**2001 FISH Plan Title:** Coordinate the permitting process for LAR restoration actions, where possible.

**2001 Priority Tier:** 3rd

**2001 FISH Plan Original Action Number:** 27

**Progress Update:**

As of December 2018, the NOAA Restoration Center has a programmatic permit for anadromous fisheries restoration efforts in the Central Valley. This programmatic permit covers all anadromous waters of the LAR and its tributaries. Covered fisheries restoration activities include in-channel work (e.g., gravel augmentation, fish passage improvement, etc.), side channel and floodplain projects, riparian corridor enhancement, road improvements and numerous other actions that improve the health of anadromous fisheries. The programmatic permit covers federal permitting for Section 404 and 408, although details of the 408 coverage are still being worked out. The desired outcome is to obtain 408 categorical permissions for fisheries restoration projects. Overall, this initiative streamlines federal permitting for fisheries restoration efforts, accelerates timelines and reduces costs by eliminating the need for a new permitting effort for every fisheries restoration project. The programmatic does not cover state or local permitting requirements.

The Water Forum, SAFCA and USBR are working to permit 10 in river salmon restoration sites for 15 years through USACE 408 and the Central Valley Flood Protection Board. As part of the development of the NRMP, a coordinated permitting effort is also being undertaken to cover all restoration actions identified by the NRMP. This will potentially include CEQA, NEPA and 408 coverage.

**Recommendations Moving Forward:**

It is recommended that permitting coordination continue. For federal programmatic permit coverage, continue working to include 401 coverage in the Central Valley programmatic for anadromous fisheries restoration efforts

**Relevant Documents / Resources:**

- Sustainable Conservation Website (for federal programmatic permitting information):
  - <https://suscon.org/project/simplified-permitting/>
  - <https://suscon.org/blog/2018/08/cv-restoration-bo/>

## **25. Assess Steelhead Suitability in Lake Natoma**

**Category:** Other Potential Management Actions

**2001 FISH Plan Title:** Conduct habitat suitability assessment for steelhead in the mile below Folsom Dam in Lake Natoma.

**2001 Priority Tier:** 3rd

**2001 FISH Plan Original Action Number:** 28

### **Progress Update:**

This action was intended to assess whether steelhead could successfully spawn upstream of Nimbus Dam in the area close to Folsom Dam. Nimbus Dam backs water up to the base of Folsom Dam and high releases regularly produce scouring flows in the canyon below Folsom. No spawning habitat exists in this reach and there is low potential to create any new habitat. The Department of Water Resources and USBR conducted assessments in the early 2000s (Department of Water Resources, Preliminary Analysis, Natural Fish Bypass Channel, Lake Natoma, June 2002; USBR, e-mail from Brian Deason, March 17, 2005). The lack of suitable spawning habitat has subsequently been confirmed by John Hannon of USBR in February of 2018. Willow Creek may offer suitable habitat at times but flows are too inconsistent to be reliable.

### **Recommendations Moving Forward:**

Since the evaluation is complete and no habitat suitable for restoration was identified, it is recommended that this item be documented and eliminated from the FISH Plan. However, there is value in continuing to explore passage around Nimbus and Folsom Dams per the 2009 NMFS Biological Opinion on CVP and SWP operations.

### **Relevant Documents / Resources:**

- 2009 NMFS Biological Opinion

## **26. Assess Off-Site Steelhead Habitat**

**Category:** Other Potential Restoration Actions

**2001 FISH Plan Title:** Assess feasibility of providing enhanced off-site (e.g., Auburn Ravine, Coon Creek, Dry Creek) steelhead habitat.

**2001 Priority Tier:** 2nd

**2001 FISH Plan Original Action Number:** 19

### **Progress Update:**

Since 2001, a number of watershed and habitat assessments have been conducted to evaluate the quality of steelhead habitat in other American River Basin tributaries (e.g., Dry Creek, Coon Creek, Auburn Ravine, etc.) and to identify opportunities for improving habitat quality and access. While all of these efforts may not have been initiated with the express purposes of enhancing “off-site” steelhead habitat to mitigate for the loss of habitat above Nimbus Dam or with the intent of supporting this specific FISH Plan action, they ultimately have helped advance this action.

CDFW (Fisheries Branch – Rob Titus) conducted a comparative fish community survey with application of an Index of Biotic Integrity (IBI) on Coon Creek, Auburn Ravine, and Dry Creek (including Secret and Miners ravines) during 2004-2005. The objective of the study was to assess the utility of the IBI for stream survey purposes on a landscape scale, with emphasis on steelhead use of these foothill stream systems.

Dry Creek and several of its tributaries have been evaluated through salmonid habitat assessment efforts that have included a focus on steelhead habitat. These efforts have included a Dry Creek Watershed Coordinated Resource Management Plan (2003), Miners Ravine Habitat Assessment (2002), and the Secret Ravine Adaptive Management Plan (2001). A partial migratory barrier on Secret Ravine was also removed to improve access to approximately 10 additional miles of spawning and rearing habitat for steelhead and Central Valley fall-run Chinook salmon.

Coon Creek and Auburn Ravine were the subject of a watershed assessment and ecosystem restoration planning effort in 2002 that included a high-level synopsis of stressors to salmonids. More recently, a more detailed watershed assessment of Coon Creek was completed on behalf of Placer County (cbec and H.T. Harvey & Associates, 2017). The assessment included evaluation of anadromous fisheries habitat along Coon Creek and Doty Ravine with respect to in-stream habitat conditions, physical processes, passage barriers, flow management practices and temperature. Opportunities exist to enhance potential steelhead habitat in the system by addressing partial migration barriers (e.g., Coppin Dam, Doty Ravine South at Head Diversion Dam, Doty Ravine Garden Bar Road Culvert, etc.), enhancing in-stream and floodplain habitat, enhancing riparian habitat and canopy cover and reducing negative effects of flow management.

**Recommendations Moving Forward:**

Continue to assess opportunities to protect, restore, and enhance habitat, including fish passage, for steelhead use of these production areas.

**Relevant Documents / Resources:**

- Draft report by Titus et al., CDFW
- ECORP Consulting, Inc. 2003. Dry Creek Watershed Coordinated Resource Management Plan.
- State of California, The Resources Agency and California Department of Water Resources. 2002. Miners Ravine Habitat Assessment.
- Dry Creek Conservancy. 2001. Secret Ravine Adaptive Management Plan.
- cbec, inc. and H.T. Harvey & Associates. 2017. Coon Creek Watershed Assessment. Prepared for Placer County.

## **27. Reduce Toxin Load to LAR**

**Category:** Contaminants

**2001 FISH Plan Title:** Develop collaborative guidelines to reduce the application of toxins on lands that have the greatest risk to fish populations.

**2001 Priority Tier:** 3rd

**2001 FISH Plan Original Action Number:** 24

### **Progress Update:**

Although development of comprehensive guidelines has not started, some activities are underway to reduce the inflow of toxins into the lower American River. The Central Valley Regional Water Quality Control Board required, as part of its permit conditions, that the County Department of Water Resources study the feasibility of diverting dry season discharge from Chicken Slough and Strong Ranch Slough into the sewer system for treatment. In addition, SAFCA requested that the County study the feasibility of using the USACE's proposed treatment wetlands at Cal Expo as an alternative means of improving water quality from these two urban watersheds prior to discharge into the Lower American River. However, this option is unlikely to be pursued.

Education initiatives have also begun in the Parkway to encourage reduced application of pesticides and herbicides, offered by Soil Born Farms. Additionally, the Parkway's invasive management plan does include judicious application of herbicides. County Parks personnel involved in herbicide application for invasive control and vegetation management are licensed and trained to conduct important eradication efforts while posing minimal risk to fish.

### **Recommendations Moving Forward:**

Continue to drive this initiative forward.

### **Relevant Documents / Resources:**

## **A. Estimate Fall-Run Fry Migration**

**Category:** Monitoring and Evaluation Components

**2001 FISH Plan Title:** To improve management capabilities, determine the relative contribution of fall-run Chinook salmon that leave the LAR early as post emergent fry to the LAR spawning stock escapement.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** A

**Progress Update:**

Rotary screw traps are operated and regularly calibrated at Watt Avenue. These traps provide an estimate of juvenile Chinook salmon moving past Watt Avenue on a daily basis. The traps also provide a measure of fish size. However, Watt Avenue is approximately 9-10 miles upstream of the river mouth and therefore may not accurately represent the population that leaves the Lower American River to enter the Sacramento River. A second rotary screw trap location between Watt Avenue and the Sacramento River confluence would substantially add to the body of knowledge regarding juvenile salmonid movement, rearing and out migration. The operation of a downstream screw trap site is complicated by the tidal conditions present below RM 5. A rotary screw trap was deployed in this area previously by CDFW in the 1990s. Recently a CVPIA AFRP grant was awarded to purchase and operate a second set of rotary screw traps downstream of the Watt Avenue traps. The traps were purchased, however permitting issues arose and the downstream traps were not deployed.

Recently, otoliths have been harvested from post-spawned adults on the LAR. Microchemistry from these otoliths can estimate the size of these fish when they left the LAR and entered the estuary and ocean. However, these data do not allow us to estimate the proportion of juveniles that left the river as fry.

**Recommendations Moving Forward:**

Continue operating rotary screw traps at Watt Avenue. Develop consensus on the need for operation of a second set of rotary screw traps (or functional equivalent) between Watt Avenue and the Sacramento River confluence. If consensus is reached regarding the need for the data provided by a downstream trap, permit, deploy and operate traps at this location.

**Relevant Documents / Resources:**

## **B. Estimate Steelhead Extent (Time and Space)**

**Category:** Monitoring and Evaluation Components

**2001 FISH Plan Title:** Investigate temporal and spatial distribution of steelhead in the lower American River to strengthen the information base for management decisions.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** B

### **Progress Update:**

USBR document steelhead spawning locations through repeat redd surveys each year. The timing of the redd observations are used along with water temperatures to estimate fry emergence timing.

CDFW (Fisheries Branch – Rob Titus) has monitored steelhead use of the LAR, with emphasis on over summer rearing relative to flow and temperature, since 2001 (not all years inclusive). This work has, in some years, included collaboration with the NMFS Santa Cruz Lab and UCSC, and with California State University at Sacramento most recently. The identification of 65 °F summer temperature target stated by the NMFS 2009 Biological Opinion is one of the management results of this work. Rearing time, emigration, and survival of steelhead smolts was assessed through acoustic tagging.

### **Recommendations Moving Forward:**

Seek mechanism for stable funding to continue summer rearing surveys.

### **Relevant Documents / Resources:**

- Publications by Sattherwaite et al. and Sogard et al.
- M.S. theses at Sac State on the acoustic tagging work (Erin Ferguson) and habitat use (Whitney Thorpe)
- Posters, PowerPoints, and summaries by Titus et al.

## C. Upgrade LAR Temperature Model

**Category:** Monitoring and Evaluation Components

**2001 FISH Plan Title:** Use best available information (or develop new information as needed) to cost-effectively create a multi-point LAR water temperature predicting and estimating model with shorter time steps to strengthen adaptive management capabilities.

**2001 Priority Tier:** 1st

**2001 FISH Plan Original Action Number:** C

### Progress Update:

Annual temperature management planning utilizes the Coldwater Pool Management Model (CPMM) that was developed by SWRI in 1999. The CPMM model provides weekly average water temperature estimates for a limited number of locations within Lake Natomas and the LAR. In 2010 CPMM was updated to function on modern personal computers (i.e., those operating on Windows 7 and later), and the Lotus 1-2-3 graphical user interface was replaced with a Microsoft Excel interface. Multiple improvements were made to the model providing multiple user options, as well as the ability to iteratively simulate multiple release patterns and Automated Temperature Selection Procedure (ATSP) Temperature schedules. As a result of these modifications and improvements the model was renamed the Iterative Coldwater Pool Management Model (iCPMM).

In 2007, the USBR Technical Service Center developed several water temperature models for Folsom Reservoir, Lake Natomas and the LAR. These models were used to investigate the feasibility of potential water temperature improvement actions including changes to infrastructure and operations. Beyond this specific study, the models were not applied further to inform temperature management planning activities.

In 2010, consultants to the Water Forum developed a HEC-RAS water temperature model for the LAR that runs on a sub-hourly time step. This model does not include upstream reservoir operations but can be used to simulate water temperature throughout the LAR under various reservoir release and meteorological scenarios.

In 2017, CE-QUAL-W2 models of Folsom Reservoir and Lake Natomas were developed by consultants to Placer County Water Agency (PCWA). The models work on a sub-daily timestep and provide considerable improvement to the iCPMM model with regards to the versatility and accuracy of the model results. While water temperatures in the LAR are not mechanistically simulated, regression equations were developed that allow for the prediction of water temperature at many locations within the LAR as a result of release temperature, meteorological conditions and flow rate. The CE-QUAL-W2 models have been applied to inform real-time temperature management decisions, as well as to simulate water temperatures resulting from various 82-year management scenarios simulated with the system wide operations optimization model CalSim II.

**Recommendations Moving Forward:**

Develop a user-friendly graphical user interface for PCWA's CE-QUAL-W2 model suite such that these models in concert can replace iCPMM for annual temperature management planning activities.

**Relevant Documents / Resources:**

- Cardno. 2017. Technical Memorandum 5 – Folsom Reservoir CE-QUAL-W2 Temperature Model. Prepared for Placer County Water Agency. Submitted as exhibit ARWA-903 in the California WaterFix Proceedings.
- Cardno. 2017. Technical Memorandum 6 – Lake Natoma CE-QUAL-W2 Model and Calibration. Prepared for Placer County Water Agency. Submitted as exhibit ARWA-904 in the California WaterFix Proceedings.
- U. S. Bureau of Reclamation Technical Service Center. 2007. Temperature Modeling of Folsom Lake, Lake Natoma, and the Lower American River Special Report. April 2007.

## **D. Estimate Steelhead Population and Trends**

**Category:** Monitoring and Evaluation Components

**2001 FISH Plan Title:** Develop and implement a method of estimating annual steelhead in-river spawning population and population trends to assist in management decision-making.

**2001 Priority Tier:** 2nd

**2001 FISH Plan Original Action Number:** D

### **Progress Update:**

A steelhead spawning survey protocol was developed by USBR starting in 2002 and has been used annually since then to estimate in-river spawning steelhead. Surveys have generally estimated somewhere between 70 to 400 pairs of steelhead spawning in the river. Steelhead numbers returning to the hatchery are generally in the range of 1,000 to 3,000 fish. However, steelhead tend to immigrate and spawn during periods of fluctuating flow and relatively high turbidity, complicating spawning estimates. The annual USBR surveys on the LAR coupled with hatchery escapement and other data offer a method to track steelhead population trends in the LAR. Additional data sources include juvenile steelhead captured at the rotary screw traps operated at Watt Ave. Although the traps are not calibrated for steelhead, they do indicate general trends in juvenile steelhead presence, size, and timing. SAFCA also performs consistent snorkel surveys and CDFW performs irregular seining surveys.

### **Recommendations Moving Forward:**

Continue annual USBR surveys and other monitoring efforts indefinitely as a FISH Plan priority 2. Continue the broodstock replacement study to identify a Central Valley DPS compatible broodstock per the 2009 Biological Opinion. Seek ways to improve survival of naturally spawned steelhead. Identify a target for hatchery produced proportion of in-river spawners. A fish-counting weir (see Action I) can also be further considered to improve accuracy of estimates.

### **Relevant Documents / Resources:**

- Annual steelhead survey reports
- Steelhead broodstock study reports
- 2009 NMFS BO

## **E. Develop Fall-Run Production Model**

**Category:** Monitoring and Evaluation Components

**2001 FISH Plan Title:** Develop an in-river production model for fall-run Chinook salmon to assist in understanding factors critical to the well being of this species.

**2001 Priority Tier:** 2nd

**2001 FISH Plan Original Action Number:** E

### **Progress Update:**

Some simple modeling was conducted by CDFG (Titus and Snider) in the early 2000s that related a juvenile production index to escapement and flow. More recently, two structured decision making models have been developed (LAR specific fine grained SDM model and CVPIA SIT coarse grained SDM model) that allow for the prediction of future population size based upon a given stock, release patterns, habitat availability, temperature, and a host of other variables both within and external to the LAR.

### **Recommendations Moving Forward:**

Look at models started by Titus and Snider and augment with data collected since the late 1990s and early 2000s, if warranted. Continue development and refinement of both the LAR specific fine grained SDM model and CVPIA SIT coarse grained SDM model and utilize these models to inform management decisions for the LAR.

### **Relevant Documents / Resources:**

- CDFW (Titus) file documents regarding simple modeling conducted in the early 2000s..
- Peterson, J. et al. 2012. Structured Decision Making Workshop Case Study: Monitoring and Adaptive Management for Lower American River Channel and Floodplain Restoration.
- Peterson, J., McDonnel, K., and Michael Colvin. 2014. Coarse Resolution Planning Tools for Prioritizing Central Valley Project Improvement Act Fisheries Activities. Draft Progress Report.

## **F. Develop Steelhead Survival Model**

**Category:** Monitoring and Evaluation Components

**2001 FISH Plan Title:** Develop a juvenile steelhead over-summer survival model to assist in understanding factors critical to the well-being of this species.

**2001 Priority Tier:** 2nd

**2001 FISH Plan Original Action Number:** F

### **Summary Description:**

From 2001 FISH Plan: Presently, no single indicator exists to succinctly describe the sequential, cumulative effects of water temperature on the survival of juvenile steelhead in the lower American River. Specifically, frequently elevated water temperatures during the critical over-summer juvenile steelhead rearing period may affect the ultimate survival of juvenile steelhead through direct mortality and physiologic stress, and indirectly through increased susceptibility to predation. Development of a juvenile steelhead over-summer model will provide an inclusive indicator of these potential effects to facilitate management decisions, particularly regarding coldwater pool management.

### **Progress Update:**

A steelhead survival model has not been developed nor are we aware of anyone working on one. Some progress has been made on collecting information that could facilitate the development of a model. These efforts include Whitney Thorpe's M.S. thesis and synthesized CDFW seining data from c. 1990 and onward. Erin Ferguson's acoustic tagging data on survival may also be helpful.

### **Recommendations Moving Forward:**

Re-visit this action to identify specific needs relative to information that has been collected to date. Identify an individual or agency to drive this effort forward.

### **Relevant Documents / Resources:**

- Thorpe and Ferguson theses from CSUS
- CDFW data

## **G. Develop Fall-Run Recruitment Model**

**Category:** Monitoring and Evaluation Components

**2001 FISH Plan Title:** Develop a stock recruitment model for fall-run Chinook salmon to guide management decision-making.

**2001 Priority Tier:** 2nd

**2001 FISH Plan Original Action Number:** G

### **Progress Update:**

A classic Ricker type stock-recruitment model has not been developed for the LAR, however two structured decision making models have been developed (LAR specific fine grained SDM model and CVPIA SIT coarse grained SDM model) that allow for the prediction of future escapement based upon a given stock, release patterns, habitat availability, temperature, and a host of other variables both within and external to the LAR.

### **Recommendations Moving Forward:**

Continue development and refinement of both the LAR specific fine grained SDM model and CVPIA SIT coarse grained SDM model and utilize these models to inform management decisions for the LAR.

### **Relevant Documents / Resources:**

- Peterson, J. et al. 2012. Structured Decision Making Workshop Case Study: Monitoring and Adaptive Management for Lower American River Channel and Floodplain Restoration.
- Peterson, J., McDonnel, K., and Michael Colvin. 2014. Coarse Resolution Planning Tools for Prioritizing Central Valley Project Improvement Act Fisheries Activities. Draft Progress Report.

## H. Use Aerial Photos as Baseline

**Category:** Monitoring and Evaluation Components

**2001 FISH Plan Title:** Use existing aerial photographs as a baseline for monitoring activities requiring positional accuracy

**2001 Priority Tier:** 3rd

**2001 FISH Plan Original Action Number:** H

### **Progress Update:**

A number of aerial images have been collected through the years. These include georectified imagery collected for Sacramento County as part of the National Agricultural Imagery Program (NAIP) and non-georectified imagery collected on behalf of USBR (typically three sets of photos are collected each fall) in order to document Chinook salmon spawning activities. Working on behalf of USBR, CSUS has collected and geo-rectified a subset of these images (1991 and 2012) in order to digitize the locations of redds. In addition, CSUS has georectified habitat unit mapping conducted by CDFG (led by Bill Snider).

In 2017, high resolution geo-rectified aerial imagery was collected in conjunction with green-band LiDAR acquisition in order to develop a Digital Elevation Model (DEM) for the LAR corridor. These data provide an important dataset for monitoring the shape and condition of the LAR moving forward.

Also in 2017 aerial images were collected via drone for the lower reaches of the LAR in order to document the extents of flood inundation at multiple elevated flow rates.

### **Recommendations Moving Forward:**

Continue annual collection of aerial imagery to support quantification of abundance and distribution of Chinook salmon redds. Plan to collect high resolution aerial imagery and LiDAR data in 2022 in order to continue monitoring regarding topographic/bathymetric changes within the LAR.

### **Relevant Documents / Resources:**

- Aerial photos archived with CDFW and USBR
- Horner, T., J. Bean, J. Rosenbery. 2014. Degradation of natural Fall run Chinook salmon spawning sites on the American River. Prepared for United State Bureau of Reclamation. June 2014.

## **I. Evaluate Fish Counting Weir**

**Category:** Monitoring and Evaluation Components

**2001 FISH Plan Title:** Evaluate efficacy of installing and operating a fish counting weir to improve estimates of: (a) spawning stock escapement; and (b) juvenile out-migrant population.

**2001 Priority Tier:** 3rd

**2001 FISH Plan Original Action Number:** I

**Progress Update:**

A proposal to site and operate a pilot weir project was developed for the USFWS in 2012. Weirs have been successfully installed and operated on several Central Valley Rivers. No formal project has been proposed.

**Recommendations Moving Forward:**

If determined a high priority, install and maintain a pilot weir project.

**Relevant Documents / Resources:**

## **J. Map Aquatic Habitat Diversity**

**Category:** Monitoring and Evaluation Components

**2001 FISH Plan Title:** Identify and characterize the complexity and diversity of aquatic habitats in the LAR, and implement measures where suitable opportunities are available.

**2001 Priority Tier:** 3rd

**2001 FISH Plan Original Action Number:** 20

### **Progress Update:**

CSUS georeferenced and digitized the habitat unit maps that were developed by CDFG in the 1990s.

Under contract to SAFCA and the Water Forum, cbec developed a high-resolution Digital Elevation Model (DEM) of the LAR in 2017. With this DEM a high resolution two-dimensional hydraulic model (HEC-RAS) was developed and applied to predict hydraulic conditions to quantitatively identify morphological units (e.g. pool, riffle, run, floodplain, flood runner, terrace, etc.) throughout the LAR.

Under contract to Water Forum, cbec is applying the results of the hydraulic model (HEC-RAS) to predict hydraulic conditions to quantitatively identify the spatial extent and suitability of salmonid spawning and rearing habitats throughout the LAR.

### **Recommendations Moving Forward:**

Utilize morphological unit mapping as a baseline against which to assess future changes to the extent of various morphological unit types. Re-visit, and possibly re-define, this priority. Connection between identification/characterization and implementation in unclear. Implementation of aquatic habitat enhancement is covered under other priorities

### **Relevant Documents / Resources:**

- cbec, inc. In preparation. Morphological Units of the Lower American River: 2006-2017. Prepared for SAFCA and the Sacramento Water Forum.
- CSUS report of Snider report

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This 2019 update to the FISH Plan actions also includes direct text excerpts from the 2001 FISH Plan and 2005 FISH Plan Status Report.

## GENERAL REFERENCES

2005. Initial Fisheries and In-Stream Habitat Management and Restoration Plan For The Lower American River (FISH Plan). Status Report.

Surface Water Resources, Inc. 2001. Initial Fisheries and In-stream Habitat Management and Restoration Plan for the Lower American River (FISH Plan). Prepared for the Water Forum. October 2001.

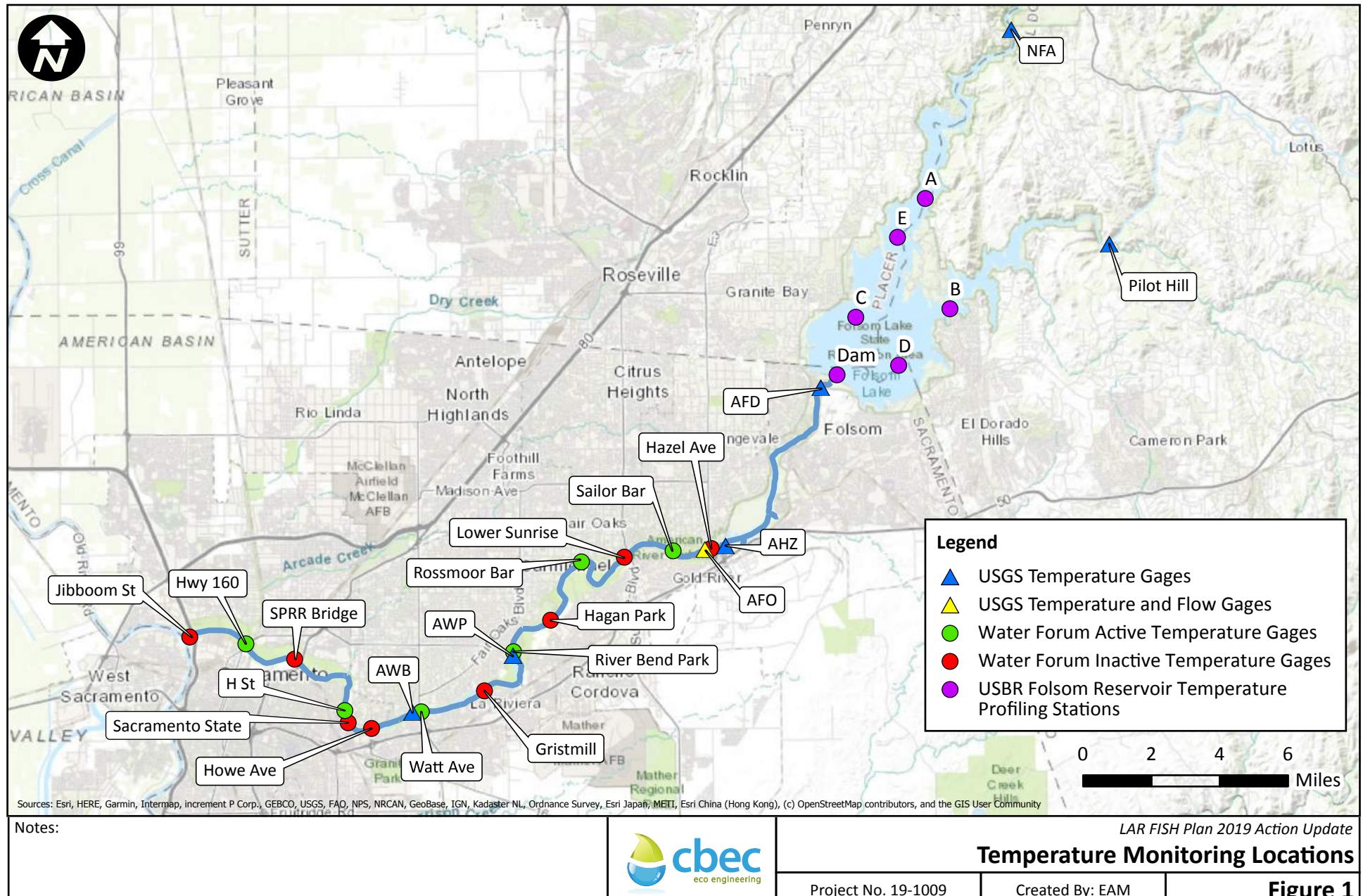
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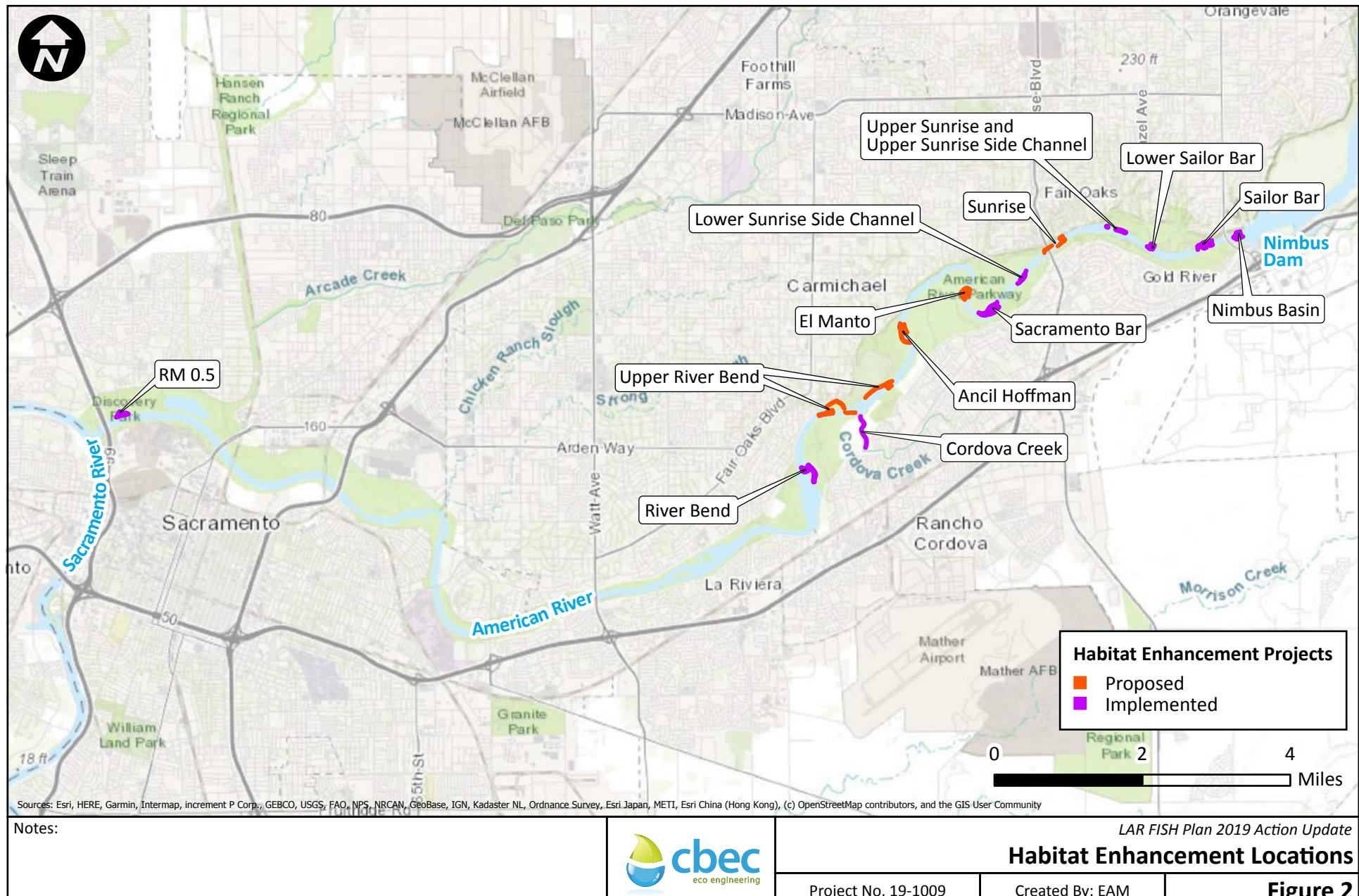


**Table 1. Summary of LAR Temperature Monitoring Station Locations and Data Records**

Water Body	Site Name	Collecting Entity	Start Date	End Date <sup>1</sup>	Notes
LAR	Jiboom St	Water Forum	8/2008	4/2015	
LAR	Hwy 160	Water Forum	8/2008	Ongoing	
LAR	SPRR Bridge	Water Forum	8/2008	7/2014	
LAR	H St	Water Forum	12/2008	Ongoing	
LAR	Sac State	Water Forum	7/2008	7/2015	
LAR	Howe Ave	Water Forum	12/2009	10/2014	
LAR	Watt Avenue (AWB)	USGS	11/1998	Ongoing	USGS 11446980
LAR	Watt Ave	Water Forum	7/2008	Ongoing	
LAR	Gristmill	Water Forum	7/2008	7/2013	
LAR	William Pond (AWP)	USGS	10/2000	Ongoing	USGS 11446700
LAR	River Bend Park	Water Forum	12/2008	Ongoing	
LAR	Hagan Park	Water Forum	7/2008	7/2015	
LAR	Rossmoor Bar	Water Forum	1/2009	7/2016	
LAR	Lower Sunrise	Water Forum	1/2009	4/2009	
LAR	Sailor Bar	Water Forum	12/2008	Ongoing	
LAR	Sailor Bar - Lower	Water Forum	10/2015	Ongoing	
LAR	Sailor Bar - Upper	Water Forum	8/2015	Ongoing	
LAR	Fair Oaks (AFO)	USGS	10/1961	Ongoing	Discharge measured since 1904, USGS 11446500
LAR	Hazel Ave	Water Forum	7/2008	7/2015	
LAR	Hazel Bridge (AHZ)	USGS	6/2011	Ongoing	
LAR	Folsom Dam (AFD)	USGS	10/1998	Ongoing	USGS 1446220
Folsom Reservoir	Folsom Reservoir Temperature Profiling Stations	USBR			
NFAR	Auburn Dam (NFA)	USGS	06/1999	Ongoing	USGS 11433790
SFAR	Pilot Hill (ARP)	USGS	08/05/1999	Ongoing	USGS 11446030

<sup>1</sup>Temperature dataset date ranges do not indicate data gaps present within each record





# **APPENDIX 1. 2019**

## **FISH Plan Action Update Summary**

Appendix 1. FISH Plan Action Update Summary			
2001 Action #	2019 Action #	At-a-Glance Title	Full 2001 Title
<b>Lower American River Flow/Temperature Regime</b>			
1.	1.	Implement FMS Through State Water Board	Develop and implement an ecologically-based flow management plan for the LAR, including water temperature management considerations, subject to SWRCB approval.
2.	2.	Develop and Implement a Comprehensive LAR Water Temperature Monitoring Plan	Develop and implement a comprehensive water temperature monitoring plan for the LAR.
<b>3.0 Improve LAR Water Temperatures</b>		Develop and implement physical actions and operational and management measures to improve water temperatures in the LAR.	
<b>3.1 Conserve Cold Water in Folsom Reservoir</b>			
3.1.1	3.1.1	Evaluate Thermal Curtains for Tributary Inflows to Folsom	Evaluate potential to construct curtains at tributary inflows to Folsom Reservoir, forcing cold water to bottom of reservoir.
3.1.2	3.1.2	Permit Releases from Spillway Gates to Preserve Cold Water	Formalize change in USBR standard operating procedure for Folsom Dam to permit release from the spillway gates to save cold water.
3.1.3	3.1.3	Evaluate Re-Operation of Upstream Reservoirs to Improve Folsom Coldwater Pool	Evaluate opportunities for re-operation of upstream reservoirs for benefit of Folsom Reservoir coldwater pool management.
3.1.4	3.1.4	Construct and Operate Temperature Control Device for El Dorado Irrigation District	Construct and operate a temperature control device for El Dorado Irrigation District.
<b>3.2 Improve Access and Management of Coldwater in Folsom Reservoir</b>			
3.2.1	3.2.1	Improve Existing Folsom Dam Temperature Control Device Operations and Management	Improve capability to control Folsom Dam release water temperatures for the benefit of priority lower American River fish species by improving effectiveness of Folsom Dam power penstock inlet port, shutters, and guidance structure.
3.2.2	3.2.2	Evaluate and Construct Automated Temperature Control Device	Evaluate the effectiveness and construct, as appropriate, of a fully automated temperature control device.
3.2.3	3.2.3	Evaluate Feasibility of Accessing Cold Water Below Penstocks	Evaluate the effectiveness of accessing coldwater between the lower river outlet works and the penstocks to address needs of priority lower American River fish species.
3.2.4	3.2.4	Assess Feasibility and Cost-Effectiveness of Accessing Low-Elevation Coldwater for Hydropower	Assess ability to access low-elevation coldwater pool with hydroelectric power generation and to economically utilize coldwater pool below penstock intakes.
3.2.5	3.2.5	Modify ATSP Schedule to Accommodate Potential Infrastructure Modifications	Modify the existing automated temperature selection schedule for multi-species benefits to accommodate potential modifications to the existing power penstock shutters at Folsom Dam, or other infrastructure actions.
<b>3.3 Improve the transport of cold water from Folsom Dam to Nimbus Dam through Lake Natoma and release to the lower American River</b>			
3.3.1	3.3.1	Evaluate Efficacy of Temperature Control Structures for Nimbus Dam Spillway and Power Intake	Evaluate the effectiveness of temperature control structures for the Nimbus Dam spillway and power intake to help address needs of priority lower American River fish species. Potential actions include the installation of temperature
3.3.2	3.3.2	Improve Efficiency of Water Transport through Lake Natoma	Improving efficiency of water transport through Lake Natoma (e.g., modifying channel in Lake Natoma).

Appendix 1. FISH Plan Action Update Summary			
2001 Action #	2019 Action #	At-a-Glance Title	Full 2001 Title
<b>Natural Floodplain and Flood Processes</b>			
12.	4.	Create Floodplain Habitat	Inventory locations for creating shallow inundated floodplain habitat for multi-species benefits, and implement where suitable opportunities are available. Protect existing overflow areas.
13.	5.	Identify and Construct In-Stream Spawning and Rearing Habitat	Identify opportunities to, and potential benefits of, enhancing or constructing mainstem and side channel habitats that provide salmon and steelhead spawning and rearing habitat, and implement measures where suitable opportunities are available.
<b>Coarse Sediment Supply</b>			
16.	6.	Study Sediment Transport	Develop a collaborative program to investigate erosion, bedload movement, sediment transport, and depositional processes and their relationship to the formation and maintenance of fish habitat in the LAR.
17.	7.	Monitor and Prioritize Gravel Projects	Assess the need to develop a spawning gravel monitoring and management program for steelhead and fall-run Chinook in which intervention would be based on identification of specific sites where intervention would enhance or increase salmonid spawning habitat.
<b>Aquatic, Riparian, and Wetland Habitat</b>			
4.	8.	Develop Large Wood Management Plan / Policy	Develop a plan or policy for management of large woody debris in the LAR, consistent with recreation safety needs, including a pilot project.
11.	9.	Identify and Evaluate Wetland/Slough Restoration Opportunities	Identify and evaluate opportunities to implement Wetland/Slough Complex restoration, with needs of all priority species in mind.
21.	10.	Identify, Evaluate and Implement SRA Habitat Improvement Projects	Identify and evaluate suitable locations and benefits of establishing or providing SRA habitat along the lower American River to benefit priority fish species, and implement measures where appropriate opportunities exist.
22.	11.	Increase Channel Complexity with Structural Elements	Identify and evaluate suitable locations to use large in-stream objects (e.g., boulders) to modify flow dynamics to increase cover and diversity of in-stream habitat for priority fish species. Implement measures where suitable opportunities are available.
23.	12.	Identify, Evaluate and Implement Runoff Inflow Bio-Filtration Opportunities	Identify and evaluate suitable locations to establish or provide wetland filtration habitat on inflow point source discharges; create such habitat if suitable opportunities can be identified.
<b>Levees and Bank Protection</b>			
5.	13.	Improve Revetments for Fish	Identify and evaluate locations in the LAR where existing revetments could be modified to incorporate bank protection habitat features to aid in preservation and re-establishment of both high-quality nearshore aquatic and riparian habitats, and implement measures where appropriate and possible to do so without having an impact on the integrity of the bank protection.

**Appendix 1. FISH Plan Action Update Summary**

<b>2001 Action #</b>	<b>2019 Action #</b>	<b>At-a-Glance Title</b>	<b>Full 2001 Title</b>
<b>Artificial Propagation of Fish</b>			
6.	14.	Estimate Natural to Hatchery Ratio	Estimate relative proportion of hatchery and naturally produced Chinook and steelhead to annual spawning escapement and commercial and sports fisheries to enhance management capabilities.
7.	15.	Modify Fish Ladder	Undertake long-term modification of the diversion structure at the Nimbus Salmon and Steelhead Hatchery to protect salmon and steelhead and other LAR resources from potential impacts associated with flow fluctuations for operations and maintenance.
18.	16.	Evaluate Hatchery Production and Stocking	Evaluate Nimbus Salmon & Steelhead Hatchery production and stocking practices to identify measures that would promote restoration of native fish species in the LAR.
26.	17.	Improve Hatchery Temperature	Evaluate alternative ways for addressing temperature-related issues at the Nimbus and American River Fish Hatcheries which would not jeopardize the needs of in-stream spawning fall-run Chinook salmon and steelhead.
<b>Stranding</b>			
8.	18.	Reduce Stranding	Complete the inventory of areas that pose a stranding threat to juvenile salmonids. Conduct a function analysis workshop to identify measures to reduce or eliminate stranding. Implement measures where appropriate opportunities exist.
<b>Harvest of Fish and Wildlife</b>			
14.	19.	Mark>Select Salmonids	To assist in protecting and enhancing the natural production of LAR salmonids, develop and implement a marking and selective harvest program for LAR Chinook salmon and steelhead, ideally in the context of a Central Valley-wide effort.
25.	20.	Assess Salmonid Poaching	To assist with management decision making, ascertain whether in-river illegal harvest of Chinook salmon and steelhead is acting as a stressor on those species in the lower American River.
<b>Other Potential Management Actions</b>			
9.	21.	Estimate Folsom First Responder Impacts	Identify the fishery impacts on LAR priority species caused by meeting Sacramento/San Joaquin Delta WQCP requirements and needs from Folsom Reservoir.
10.	22.	Improve Research Data	Improve availability and management of LAR research data, with attention to quality control.
15.	23.	Assist LAR Task Force	Continue to provide ongoing long-term consultation/technical assistance to LAR Task Force, its component committees, and responsible agencies for LAR management.
27.	24.	Coordinate Permitting	Coordinate the permitting process for LAR restoration actions through the RCMP, where possible.

**Appendix 1. FISH Plan Action Update Summary**

<b>2001 Action #</b>	<b>2019 Action #</b>	<b>At-a-Glance Title</b>	<b>Full 2001 Title</b>
28.	25.	Assess Steelhead Suitability in Lake Natoma	Conduct habitat suitability assessment for steelhead in the mile below Folsom Dam in Lake Natoma.
<b>Other Potential Restoration Actions</b>			
19.	26.	Assess Off-Site Steelhead Habitat	Assess feasibility of providing enhanced off-site (e.g., Auburn Ravine, Coon Creek, Dry Creek) steelhead habitat.
<b>Contaminants</b>			
24.	27.	Reduce Toxin Load to LAR	Develop collaborative guidelines to reduce the application of toxins on lands that have the greatest risk to fish populations, where possible.
<b>Monitoring and Evaluation Components</b>			
A.	A.	Estimate Fall-Run Fry Migration	To improve management capabilities, determine the relative contribution of fall-run Chinook salmon that leave the LAR early as post emergent fry to the LAR spawning stock escapement.
B.	B.	Estimate Steelhead Extent (Time and Space)	Investigate temporal and spatial distribution of steelhead in the lower American River to strengthen the information base for management decisions.
C.	C.	Upgrade LAR Temperature Model	Use best available information (or develop new information as needed) to cost-effectively create a multi-point LAR water temperature predicting and estimating model with shorter time steps to strengthen adaptive management capabilities.
D.	D.	Estimate Steelhead Population and Trends	Develop and implement a method of estimating annual steelhead in-river spawning population and population trends to assist in management decision-making.
E.	E.	Develop Fall-Run Production Model	Develop an in-river production model for fall-run Chinook salmon to assist in understanding factors critical to the well-being of this species.
F.	F.	Develop Steelhead Survival Model	Develop a juvenile steelhead over-summer survival model to assist in understanding factors critical to the well-being of this species.
G.	G.	Develop Fall-Run Recruitment Model	Develop a stock recruitment model for fall-run Chinook salmon to guide management decision-making.
H.	H.	Use Aerial Photos as Baseline	Use existing aerial photographs as a baseline for monitoring activities requiring positional accuracy
I.	I.	Evaluate Fish Counting Weir	Evaluate efficacy of installing and operating a fish counting weir to improve estimates of: (a) spawning stock escapement; and (b) juvenile out-migrant population.
20.	J.	Map Aquatic Habitat Diversity	Identify and characterize the complexity and diversity of aquatic habitats in the LAR, and implement measures where suitable opportunities are available.

**Appendix 1. FISH Plan Action Update Summary**

<b>2001 Action #</b>	<b>2019 Action #</b>	<b>At-a-Glance Title</b>	<b>Full 2001 Title</b>
28.	25.	Assess Steelhead Suitability in Lake Natoma	Conduct habitat suitability assessment for steelhead in the mile below Folsom Dam in Lake Natoma.
<b>Other Potential Restoration Actions</b>			
19.	26.	Assess Off-Site Steelhead Habitat	Assess feasibility of providing enhanced off-site (e.g., Auburn Ravine, Coon Creek, Dry Creek) steelhead habitat.
<b>Contaminants</b>			
24.	27.	Reduce Toxin Load to LAR	Develop collaborative guidelines to reduce the application of toxins on lands that have the greatest risk to fish populations, where possible.
<b>Monitoring and Evaluation Components</b>			
A.	A.	Estimate Fall-Run Fry Migration	To improve management capabilities, determine the relative contribution of fall-run Chinook salmon that leave the LAR early as post emergent fry to the LAR spawning stock escapement.
B.	B.	Estimate Steelhead Extent (Time and Space)	Investigate temporal and spatial distribution of steelhead in the lower American River to strengthen the information base for management decisions.
C.	C.	Upgrade LAR Temperature Model	Use best available information (or develop new information as needed) to cost-effectively create a multi-point LAR water temperature predicting and estimating model with shorter time steps to strengthen adaptive management capabilities.
D.	D.	Estimate Steelhead Population and Trends	Develop and implement a method of estimating annual steelhead in-river spawning population and population trends to assist in management decision-making.
E.	E.	Develop Fall-Run Production Model	Develop an in-river production model for fall-run Chinook salmon to assist in understanding factors critical to the well-being of this species.
F.	F.	Develop Steelhead Survival Model	Develop a juvenile steelhead over-summer survival model to assist in understanding factors critical to the well-being of this species.
G.	G.	Develop Fall-Run Recruitment Model	Develop a stock recruitment model for fall-run Chinook salmon to guide management decision-making.
H.	H.	Use Aerial Photos as Baseline	Use existing aerial photographs as a baseline for monitoring activities requiring positional accuracy
I.	I.	Evaluate Fish Counting Weir	Evaluate efficacy of installing and operating a fish counting weir to improve estimates of: (a) spawning stock escapement; and (b) juvenile out-migrant population.
20.	J.	Map Aquatic Habitat Diversity	Identify and characterize the complexity and diversity of aquatic habitats in the LAR, and implement measures where suitable opportunities are available.

# **APPENDIX 2. LOWER AMERICAN RIVER**

## FISH Plan Update Assessment of Priorities

# Lower American River FISH Plan Update

## Assessment of Priorities

Developed by Associate Julia Golomb, Consensus Building Institute  
October 30, 2018

### Executive Summary

In summer 2018, the Consensus Building Institute, an impartial nonprofit that helps groups collaborate, conducted an assessment on priorities for the 2018 update to the Lower American River Fisheries and In-Stream Habitat Management and Restoration Plan (Lower American River FISH Plan). CBI's role was to speak with individuals from a range of backgrounds to better understand perspectives on priority FISH Plan objectives and projects, such that the priorities outlined in the FISH Plan update reflect local expertise.

To understand and reflect the range of perspectives and to develop recommendations on priority project areas, CBI conducted 14 in-depth interviews with 17 individuals involved in managing of the Lower American River. This report presents CBI's assessment findings and recommendations for key considerations and priorities in the FISH Plan update.

### Findings

Findings reflect a range of feedback on the future of the Lower American River, priority issues and challenges. In brief, interviewees articulate the following themes:

- A healthy, biodiverse ecosystem is a cornerstone for a thriving Lower American River.
- Interviewees highlight the need for a balanced management approach.
- All interviewees name temperature and flow regimes as the most critical factor for supporting native anadromous fish populations.
- Interviewees see value in implementing "a holistic swath" of habitat restoration projects.
- Most interviewees urge for removal of riprap and minimizing bank protection.
- Interviewees envision new approaches to managing floodplains and levees.
- Most interviewees do not view stranding as a significant issue.
- There are a range of perspectives on the influence of hatcheries on the Lower American River, though interviewees share the goal of increasing natural wild anadromous fish production.
- Design projects for resilience, as climate change will exacerbate flooding, drought and fires.

- It is critical to weave rigorous monitoring, evaluation and adaptive management throughout all projects.
- “Water quality is not a top issue, but important to monitor.”
- Interviewees are concerned by the ecological impacts of homelessness on the American River Parkway.
- A challenging regulatory environment creates unique management barriers.

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## **Part 1: Assessment Findings**

The Sacramento Water Forum plans to update the Lower American River Fisheries and In-Stream Habitat Management and Restoration Plan (FISH Plan) in late 2018. The update seeks to utilize broad stakeholder input to refresh the FISH Plan action list and priorities, increase preparedness for pursuing grants, and conduct project review and prioritization.

At the request of the Water Forum, the [Consensus Building Institute](#) (CBI) - an impartial non-profit that helps groups engage collaboratively on a wide range of issues - conducted in-depth interviews with a range of experts and interested parties in the region to identify priorities, challenges and key themes to inform the 2018 FISH Plan update. This report synthesizes findings from these stakeholder assessment interviews.

### **Approach**

CBI's assessment is intended to understand and then reflect to interested parties the range of perspectives and management priorities considered by stakeholders involved in management of Lower American River. The findings included in this report are drawn from in-depth discussion with a variety of Lower American River stakeholders. CBI Associate Julia Golomb gathered this feedback through 14 in-depth interviews with 17 individuals between July and September, 2018. Interviews were confidential (to foster candor) and were conducted by phone. Interviews focused on a set of questions intended to provide feedback on interests, priority issues, and challenges related to fisheries and habitat restoration on the Lower American River.

CBI initially worked with the Water Forum and CBEC to identify a preliminary stakeholder list. Once interviews began, participants recommended other stakeholders for the assessment process, many of whom CBI then interviewed. This incremental process continued until Julia began to hear similar information with no significant new information put forth. A list of those interviewed, as well as the interview protocol, is included as an appendix.

After preparing this report, CBI invited interview participants to review the draft findings and provide feedback to ensure accuracy. CBI will also present the draft findings at the November FISH Group meeting. After this, CBI will finalize the report and its recommendations.

**Please note that CBI did not attempt to independently validate the claims or concerns of the interviewees or survey respondents. Rather, this report seeks to summarize the range of views, ideas, and concerns expressed.** Additionally, this brief report cannot do justice to the deep knowledge, experience, and nuances of the many stakeholders interviewed. Rather, the report tries to reflect back key themes and concerns that help shape the way forward. CBI has sought to present these findings, in our role as an impartial facilitator, as accurately and fairly as possible. Any errors or omissions are the sole responsibility of CBI.

## **Findings**

The following summarizes findings from interviews conducted by the Consensus Building Institute. The orange sub-bullets, titled "Possible Actions," reflect potential actions - many from the 2001 FISH plan and some new suggestions by the Water Forum - that the FISH Group could take to respond to each of the key management themes. Others are encouraged to submit potential actions as well.

### **Desired Future State of the Lower American River**

**A healthy, biodiverse ecosystem is a cornerstone for a thriving Lower American River.** While interviewees hold varying perspectives on the Lower American River's primary management objectives, everyone concurs that a healthy river will establish and maintain viable anadromous salmonid populations. Many interviewees articulate a desired future state of the Lower American River as one in which natural resources and ecosystem services drive the approach to water management. Some hope that the river continues to be "naturalistic," with large areas for fish, wildlife, native plants and riparian habitat, while continuing to support recreational activities. One interviewee expressed hope that the Lower American River – often referred to as "Sacramento's crown jewel" – will continue to offer urban dwellers a unique sense of connection to the natural world.

**Interviewees highlight the need for a balanced management approach.** Many interviewees note that the Lower American River currently faces numerous competing demands. Interviewees urge a balanced management approach that reflects the holistic value of management actions in order to meet multiple goals, while accounting for a variety of uses, including fisheries, flood control, water supply, power generation, and recreation. Some note that flood control and irrigation are the U.S. Bureau of Reclamation's top management priorities, often at the expense of actions to sustain anadromous fish populations. One person encourages bringing agency partners to the table early - particularly CDFW - so that they can help shape and support actions.

Another person expressed hope that management of the Lower American River can ultimately serve as a model of strong collaboration between stakeholders with different objectives and perspectives. Some participants noted that all projects should fully account for the American River Parkway Plan, Wild and Scenic River issues and the Natural Resource Management Plan for the American River Parkway, once that document is completed. Another interviewee suggested that quantification of habitat needs and restoration benefits on the Lower American River could help support a balanced management approach.

#### *Possible Actions:*

- Regular meetings with broad stakeholder attendance; extensive outreach to stakeholder groups to disseminate information.

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*"I envision a Venn Diagram of interests, where one circle represents fisheries and the other circle represents water supply and power generation. Getting those two circles to overlap is the holy grail."*

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**Many interviewees view Lower American River restoration activities to-date as successful, albeit small-scale given the vast need.** Interviewees described the following past restoration activities:

- Gravel placement for spawning habitat, all of which were utilized in the first year;
- Grading down of riparian areas to provide floodplain habitat that inundates more frequently and provides rearing habitat;
- Creation of side channels, some of which washed out;
- River Mile 0.5: A flood enhancement project on the north shore near Discovery Park, which involved a slight widening of the river along with installation of vegetation plantings and large woody material. An interviewee observed that this project created multiple benefits for habitat and flood management.

Several interviewees view past restoration efforts as offering valuable learning opportunities. As one person explained, "We learned a lot. Now we can take information gathered from earlier restoration projects and use it to make better informed decisions and implement better actions on the river." Yet at least three people acknowledged that "we are probably not doing as much as we can relative to the needs of anadromous fish," with one person noting that there is "a huge amount of ground to make up." One person described the efforts to-date as meeting only baseline requirements of the Central Valley Project Improvement Act and expressed hope that future actions will be "above and beyond in order to support a thriving salmonid population." Another interviewee observed that each project was possible only because of significant collaboration between local, state and federal agencies.

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*"There's an understanding that habitat restoration is a new science and we are learning as we go."*

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### **Management Priorities and Challenges**

All interviewees name temperature and flow regimes as the most critical factor for supporting native anadromous fish populations. Correct temperatures and flows are a prerequisite to survival of anadromous fish, with water temperature described as "the greatest limiting factor to species survival." At the same time, establishing properly-timed temperature and flow regimes is widely viewed as among the most challenging issues to address on the Lower American River. As one interviewee commented, "Because of hydrology and operations, we're cooking the Lower American River." According to several interviewees, mimicking natural functional flows is an important aspect of a beneficial flow regime. Many believe that it is critical to implement the Modified Flow Management Standard (FMS). One interviewee perceives the Bureau of Reclamation's institutional framework as the greatest challenge to implementing the Modified FMS; this interviewee observes that Reclamation is reluctant to implement the Modified FMS due to how it would impact Reclamation's other objectives. Nonetheless, this interviewee believes that it is possible to operate the dam in such a way that would improve temperature conditions. Some would like to readjust the hydrograph such that it is more akin to historic flow patterns. One interviewee agrees that temperature and

flows are critical, yet warns against focusing on these factors at the exclusion of all else, instead urging a holistic management approach.

*Possible Actions:*

- Implement Modified FMS
- CE-QUAL W2 model used by Reclamation
- New, automated, leak free, temperature shutters
- Regular use of power bypass / elephant's trunk
- Address warming across Lake Natoma

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*"Without proper flows and good water temperature, we can't address in-stream habitat issues."*

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**Interviewees see value in implementing “a holistic swath” of habitat restoration projects.**

While interviewees emphasize that a favorable temperature and flow regime is foundational for native anadromous fish habitat, participants frequently cite both diverse spawning and rearing habitat as critical factors for population viability. One interviewee emphasized the importance of designing restoration projects that integrate an understanding of Lower American River fluvial geomorphic processes and dynamics.

*Spawning Habitat:* Many interviewees point to the success of the existing coarse sediment supply program, noting that when coarse sediment is added to a spawning area, utilization of that area increases dramatically. Nearly all interviewees agree that gravel augmentation and coarse sediment supply should continue to be a priority. Many note the importance and associated cost of maintaining these project areas well into the future, given that sediment washes away over time and dams prevent natural replenishment.

*Rearing Habitat:* Interviewees indicate the value of diverse rearing habitat where fish can hide from predators and strong flow. Beneficial rearing habitat includes complex edge with nooks and crannies and overhanging vegetation. Several people describe in-stream large woody debris as valuable aquatic habitat. One person noted that “for boater safety, woody debris have been scoured clean.” Instead, current practice centers on implementing boater-friendly alternatives such as adding wood to side channels and stream margins. Several interviewees spoke to the importance of balancing fish habitat needs with recreation interests in such a way that does not compromise fish populations. Another person suggests that root wads provide valuable cover for juveniles, adding that predation from non-native species is a significant issue.

*Ephemeral and Perennial Rearing Habitat:* Several interviewees are particularly interested in the benefits of side channels and floodplains, which serve as ephemeral rearing habitat with fewer predators, yet note that dam operations lead to significant loss of floodplain habitat. As one interviewee explained, floodplains are particularly useful for juvenile fish, which currently have low survival rates. In natural river systems, flows increase with spring snowmelt, thereby inundating floodplains and drowning terrestrial bugs, which become a valuable food source. “This hydrological process is essential, but in the managed system the snow melt instead fills the reservoir.” Another interviewee pointed to the challenge of ensuring quality fish habitat in the context of climate change

and an inverted hydrograph, suggesting that, "Because so much floodplain habitat is lost, we should instead focus on perennial rearing habitat that will function even when the river is at lower flows, such as side channels and complex edge." One interviewee championed habitat and flows that support "the portfolio effect," whereby fish of varying sizes migrate to sea, rather than solely big fish; though large fish have a better chance of returning, their success depends on ocean conditions.

*Possible Actions:*

- Utilize the lower American River Decision Support Model (DSM) to drive restoration projects, both location and focus
- Restore wetland / slough habitat
- Increase diversity with large rocks and wood

**Most interviewees urge for removal of riprap and minimizing bank protection.** Many described the important geomorphic process of river banks building and eroding over time and expressed concern that riprap and bank armament shuts down this natural process. One interviewee said, "Unless there is infrastructure there to protect, we should minimize bank protection." Others said that removing riprap and replacing it with an outer layer of natural vegetation will help to restore aquatic, riparian, and wetland habitat and support a river that is "as naturally functioning as we can make it, which leads to beneficial recreational uses as well as fisheries uses."

*Possible Actions:*

- Itemize unsuccessful bank protection projects
- Improve revetments for fish
- Remove riprap and replace with fish friendly bank protection
- Minimize all bank protection projects opting to encourage natural channel migration

**Interviewees envision new approaches to managing floodplains and levees.** One person described a "tug of war between flood control and floodplain habitat" on the Lower American River, particularly given that the river flows through a dense urban city. Some interviewees are concerned that levees restrict natural floodplain habitat and flood processes and emphasize the importance of restoring floodplain connectivity and enhancing floodplain productivity. Several interviewees spoke to the benefits of implementing levee setbacks so that the river channel is less constricted, while one interviewee expressed concern that levee setbacks may increase fish transit time and increase risk of predation. This same interviewee noted that the U.S. Army Corps of Engineers is currently poised to rethink its approach to levee management. One person observed that levees are typically denuded, whereas large trees provide numerous ecosystem functions, including shade, valuable habitat for birds, bugs that fall into the river, and eventually woody debris for the river. One person suggests looking at natural infrastructure so that "this doesn't have to be an either/or issue; we can restore flood plain habitat in areas where we are not worried about flood inundation risk and then take pressure off places where we are worried about flooding, and we can provide protection without ripraping everywhere." Another interviewee suggested that groups working on the Lower American River connect with researchers studying approaches to flood management and stay abreast of the latest flood control technology.

*Possible Actions:*

- Work with USACE and SAFCA to develop fish friendly bank protection designs
- Use monitoring to adaptively manage bank protection projects
- Minimize bank armoring

**Most interviewees do not view stranding as a significant issue.** Interviewees note that while there are significant benefits to activating flood plains, one cost is the potential to leave fish stranded when waters recede; yet many interviewees note that stranding has little population impact to fish and thus should be considered a minor issue. One interviewee commented that stranding has a greater impact in the context of low population levels than it does when production levels are high and adequate numbers of fish are reaching the ocean. Another interviewee explained that the natural hydrograph strands fish and that this is acceptable, given the benefits associated with the natural hydrograph and ephemeral fish habitat.

**There are a range of perspectives on the influence of hatcheries on the Lower American River, though interviewees share the goal of increasing natural wild anadromous fish production.** One interviewee explained that dams on the Lower American River cut off high-elevation habitat, thereby requiring habitat below the dams to fulfill all roles of habitat, noting that "this is hard and forces our reliability on hatcheries right now, but everyone's goal is to maintain if not increase wild production." Currently, hatchery production is high relative to wild river production, partly due to the requisite cool temperatures and flows coming late in the year; yet many interviewees envision moving toward a greater balance between "vibrant in-river populations complemented by hatchery production." Several interviewees warn that the non-local strain of steelhead at the Lower American River hatchery detract from this goal of natural production and identify hatchery influence as a significant problem for fall run populations in particular. Numerous participants recommend improving the genetic stock of fish on the river via wild fish upstream of the dam. At least one interviewee sees opportunity to control hatchery fish populations via harvest; this interviewee suggests separating hatchery and wild fish via a weir where hatchery fish can be fished or removed. While out of scope of the FISH Plan, at least two interviewees commented that getting fish back into their historic habitat via fish passage upstream and downstream of Folsom Dam could provide significant benefits to wild fish populations. Two interviewees recommend studying the relationship between hatchery production and wild anadromous fish production. One person advises that the Lower American River Hatchery follow the Central Valley Hatchery Review Committee's report on how best to manage hatcheries.

*Possible Actions:*

- Modify fish ladder
- Evaluate hatchery production and stocking

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*"We're in a race to preserve, protect, restore and recover populations of wild fish because of their genetic vigor. There are dangers of becoming over-dependent on hatchery production."*

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**Design projects for resilience, as climate change will exacerbate flooding, drought and fires.** Some interviewees advise that climate change will bring warmer temperatures and reduced snowpack, along with increased frequency and severity of floods, drought and fires. Interviewees suggest designing projects that account for these new patterns; this includes utilizing the right vegetation at the right elevation.

*Possible Actions:*

- Use current climate change modeling to design restoration projects for resilience.

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*"We need to build resilience into the project designs. That's the best we can do locally; the rest is more global."*

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**It is critical to weave rigorous monitoring, evaluation and adaptive management throughout all projects.** While stakeholders hold varying perspectives on the success of monitoring and evaluation efforts to date, nearly all agree that monitoring, evaluation and adaptive management should be core components of project design from the outset. As one interviewee described, "We need effective monitoring to determine project efficacy over time and feed into an adaptive management plan." At least half of interviewees envision a monitoring approach that is "sustained, robust and long-term," and some hope that agencies will commit long-term funds to support a robust monitoring and evaluation program. One interviewee noted that Chapter 7 of the 2001 FISH Plan outlines a comprehensive monitoring approach; yet from this interviewee's perspective, monitoring on the Lower American River to-date has been implemented "piecemeal, sporadically and less rigorously than it should." An interviewee described three gaps in the current monitoring process: (i) Geographic monitoring gap: There is a biological question of when fish move from one part of the river to another. "While there is a way to count fish that pass through the river at a midpoint near Watt Avenue, we probably need another fish counting method lower in the river so we can estimate the survival of fish as they move faster through a steeply-sloped section of stream compared to a slower-moving, flat section of stream." (ii) Temporal monitoring gap: "Monitoring should be conducted for a longer part of the year, but monitoring is expensive." (iii) Gap in data availability: "We need to do a better job of making monitoring data publicly available." This includes improved data quality assurance/quality control and then publishing the data in raw form so that it is available for widespread analysis. At least two interviewees point to the need for a better analytic overview and more robust quality assurance/quality control processes.

Some interviewees see great value in utilizing data to justify project need and suggest that the FISH Plan should quantify success by setting clear, measurable goals, which would in turn help the FISH Group identify actions needed in order to attain those quantifiable goals. "Without this, how do we know that we need to restore habitat on the Lower American River to begin with?" asked one interviewee. At least two interviewees expressed that it is "useful to quantify how much salmon and steelhead habitat is needed compared to where we are now, in order to prioritize restoration activities." Interviewees also note that the decision support model developed for the American River should play a central role in determining actions for the FISH Plan; some would find it very helpful to have a structured process and clear objectives from which to

make management decisions. Several interviewees see value in a collaborative, transparent adaptive management approach that will help the FISH Group assess what actions are working well and modify its approach accordingly.

*Possible Actions:*

- Continue adaptive management monitoring and update DSM
- Continuous temperature monitoring in Folsom Lake to aid with temperature modeling

**"Water quality is not a top issue, but important to monitor."** Most interviewees are unaware of any significant issues with contaminants in the Lower American River, outside of "typical urban issues" of fertilizer and pesticide runoff and effects of homelessness (see below). One interviewee believes that the water quality is fine outside of runoff from the first storm of the year; possible solutions include designing parking lots with a lower elevation in the middle and implementing design approaches that allow water to infiltrate rather than run off. However, one interviewee commented that because the river is surrounded by a major metropolitan area, contaminants are "not the top issue, but in the top four."

*Possible Actions:*

- Engage with Regional Water Board to stay up to date on monitoring information
- Add biofilters to runoff inflow to catch first flush pollutants

**Interviewees are concerned by the ecological impacts of homelessness on the American River Parkway.** One person described homelessness along the American River Parkway as "a social problem with ecological impacts." Several interviewees expressed concern that homeless encampments negatively affect water quality, including through increased prevalence of E. Coli, jeopardize restoration sites in the vicinity and increase the occurrence of fires.

*Possible Actions:*

- Support local legislation addressing homelessness
- Advocate for public bathrooms to decrease E. coli spikes

**A challenging regulatory environment creates unique management barriers.** Given the risks, liability and high population densities in the Sacramento area, proposed restoration actions are frequently slowed by permitting issues. Numerous interviewees named the U.S. Army Corps of Engineers' 408 permitting process as a particularly frustrating barrier to project implementation.

*Possible Actions:*

- Create long-term permitting plans

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*"Most agencies are not set up for restoration permits. Permitting for restoration projects is challenging and getting worse and more expensive."*

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## About the Consensus Building Institute

Founded in 1993, the Consensus Building Institute improves the way that community and organizational leaders collaborate to make decisions, achieve agreements, and manage multi-party conflicts and planning efforts. A nationally and internationally recognized not-for-profit organization, CBI provides collaborative problem solving, mediation and high-skilled facilitation for state and federal agencies, non-profits, communities, and international development agencies around the world. CBI senior staff are affiliated with the MIT-Hard Public Disputes Program and the MIT Department of Urban Studies and Planning. Learn more about CBI at: [www.cbi.org](http://www.cbi.org)

Julia Rose Golomb is an Associate at CBI, with eight years of experience as a mediator, facilitator, and negotiations coach, and a rich background in domestic and international environmental management issues. She facilitates and mediates environmental planning and public policy disputes. Her primary practice areas include food and agriculture, climate mitigation and adaptation, water, energy, land use and transportation planning. Ms. Golomb holds a Masters in Environmental Management from Yale University. You can learn more about Julia at cbi.org and reach Julia at 415-580-2768 or [jgolomb@cbi.org](mailto:jgolomb@cbi.org).

## Appendix A: List of Persons Interviewed

*Interviews alphabetized by last name of interviewee.<sup>1</sup>*

1. Shane Abeare, U.S. Fish and Wildlife Service
2. Cesar Blanco, U.S. Fish and Wildlife Service
3. Paul Bratovich, HDR Inc.
4. Paul Cadrett, U.S. Fish and Wildlife Service
5. Tom Gohring, Sacramento Water Forum
6. Ruth Goodfield, National Oceanic and Atmospheric Administration Restoration Center
7. Chris Hammersmark, CBEC
8. John Hannon, U.S. Bureau of Reclamation
9. Mary Maret, Sacramento County Parks
10. Joe Merz, Cramer Fish Sciences
11. Tanya Sheya, California Department of Fish and Wildlife
12. Felix Smith, Local Stakeholder, Save the American River Association
13. Gary Sprague, National Marine Fisheries Service
14. Rob Titus, California Department of Fish and Wildlife
15. Chuck Watson, WRC-Environmental
16. Rod Wittler, U.S. Bureau of Reclamation
17. Julie Zimmerman, The Nature Conservancy

## Appendix B: Interview Protocol

### Lower American River FISH Plan Update

Confidentiality: *CBI Facilitators will use what we discuss to report back findings without attributing it to interviewee personally; anything that interviewee wishes to stay confidential will remain between the facilitator and interviewee.*

#### Background

Please tell us about your history of involvement and interests related to the Lower American River.

#### Lower American River and Planning

When you look ahead 10, 25, or 50 years from now, how would you like to be able to describe the Lower American River?

How would you characterize the restoration activities that have taken place on the Lower American River during the past decade?

Currently, what are the greatest management challenges related to the Lower American River?

What key issues or concerns would you like to see the plan address?

#### Action Categories

- LAR Flow / Temperature Regime
- In-Stream, Riparian and Floodplain Habitat and Physical Processes
  - a. Natural Floodplain & Flood Processes
  - b. Coarse Sediment Supply
  - c. Aquatic, Riparian and Wetland Habitat
  - d. Levees and Bank Protection
- Management, Artificial Propagation and Harvest of Fish
  - a. Artificial Propagation of Fish
  - b. Stranding
  - c. Harvest of Fish and Wildlife
- Other Management and Restoration Actions
  - a. Other Potential Management Actions
  - b. Other Potential Restoration Actions
  - c. Contaminants
- Monitoring and Evaluation Components

Of the above action categories, which are most important and why?

Of the above categories, which are least important and why?

Of the above categories, which are the most challenging and why?

#### Conclusion

Is there anything else that you haven't mentioned? What advice would you offer or what else would you recommend as the Water Forum looks to prioritize FISH Plan objectives and projects?

This conversation has focused on general needs and priorities of the lower American River. If you have more specific or technically detailed thoughts that you'd like to have reflected in the FISH Plan update, including specific input on particular actions, I can arrange for a Water Forum or cbec staffer to contact you. Would you like me to pass along that request? Everything else that you've shared will still be confidential.

Who else, if anyone, would you recommend that I interview on these issues?