

Annual Report of Activities

October 1, 2016 to November 20, 2017

American River Group (ARG)

November 2017

Acronyms and Abbreviations

ARG	American River Group
BiOp	Biological Opinion
cfs	Cubic Feet Per Second
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CDFW	California Department of Fish & Wildlife
FMS	Flow Management Standard
LAR	Lower American River
MRR	Minimum Required Release
NMFS	National Marine Fisheries Service
Reclamation	U.S. Bureau of Reclamation
RM	River Mile
RPA	Reasonable and Prudent Alternative
RTDOT	Real-Time Drought Operations Management Team
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	Thousand Acre-Feet
TCD	Temperature Control Device
USFWS	U.S. Fish & Wildlife Service

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Chapter 1 – Background

1.1 American River Geographic Orientation

The American River is the second largest tributary to the Sacramento River located in California's Central Valley. The North, Middle, and South forks of the American River originate in the Sierra Nevada range and then flow into Folsom Reservoir, approximately 25 miles east of the City of Sacramento, California. Folsom Dam and Reservoir as well as Nimbus Dam and Lake Natoma are features of the Central Valley Project (CVP) operated by the U.S. Bureau of Reclamation (Reclamation). The lower American River (LAR) reach begins at Nimbus Dam, approximately river mile (RM) 23, and continues downstream until its confluence with the Sacramento River. Figure 1 illustrates the LAR and surrounding features.

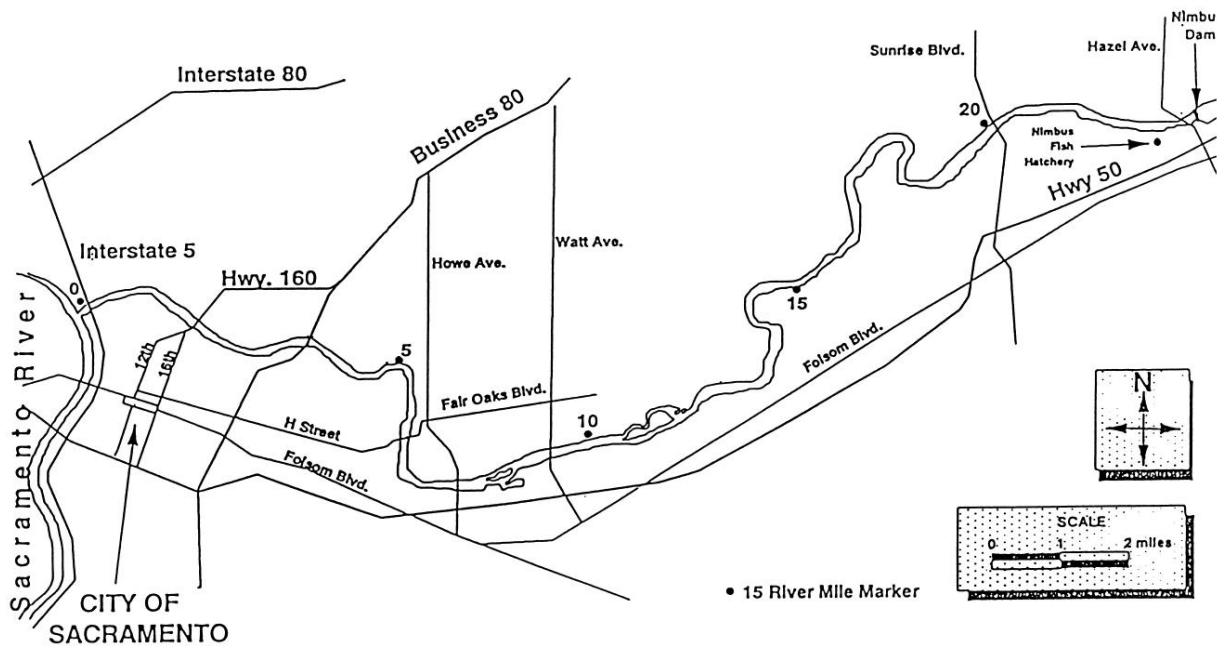


Figure 1. The lower American River between Nimbus Dam and the Sacramento River.

1.2 Lower American River Historical Background

The LAR is a significant resource of considerable interest and provides water supply to urban and agricultural uses, flood control, fish and wildlife protection, recreational opportunities, hydroelectric power generation, and protects conditions in the Sacramento-San Joaquin Delta. The regulating facilities of the Folsom/Nimbus Dam complex include Folsom Dam, Reservoir and Powerplant, Nimbus Dam and Powerplant, and Lake Natoma. Releases from Folsom Dam are re-regulated approximately seven miles downstream by Nimbus Dam. Nimbus Dam creates Lake Natoma, which serves as a forebay for the diversions to the Folsom South Canal. Additional facilities include the Nimbus Fish Hatchery, at Nimbus Dam, owned by Reclamation and operated by the California Department of Fish and Wildlife (CDFW).

Reclamation operates Folsom/Nimbus Dam under a state water right permit and fish protection requirements that were adopted in 1958 as the State Water Resources Control Board (SWRCB) Decision 893 (D-893). This decision allows flows at the mouth of the American River to fall as low as 250 cubic feet per second (cfs) from January through mid-September, with a minimum of 500 cfs required between mid-September through December 31. However, many recognize D-893 flows do not provide comprehensive habitat protection. Since 1958, additional SWRCB Decisions, Congressional Acts (i.e. Central Valley Project Improvement Act (CVPIA)), and a Federal Biological Opinion (BiOp) Reasonable and Prudent Alternative (RPA) (NMFS 2009 BiOp, Appendix 2D and 2011 RPA amendment), have changed the regulatory landscape for the State and Federal Water Projects.

The Water Forum, comprised of local American River stakeholders, has successfully joined together water purveyors, environmentalists, agriculturalists, business leaders, along with city and county governments in Sacramento, El Dorado and Placer counties in an agreement to secure Sacramento region water supply through the year 2030. The Water Forum has promoted operational changes with coequal objectives: “to provide a reliable supply for planned development to the year 2030, and to preserve the Sacramento region’s environmental crown jewel, the lower American River”. The Water Forum, in cooperation with Reclamation, National Marine Fisheries Service (NMFS), United States Fish and Wildlife Service (USFWS), and CDFW developed a draft Flow Management Standard (FMS) for the LAR to potentially improve the conditions of aquatic resources in the LAR. The FMS design is to improve habitat conditions for fall-run Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*Oncorhynchus mykiss*) fish in the LAR by enhancing minimum flows and water temperature, establishing a formal management process, and facilitating coordinated monitoring, and evaluation and reporting (Water Forum 2006).

The FMS was included in the NMFS 2009 BiOp on the Long-Term Operations of the CVP and State Water Project (SWP) RPA (Appendix 2D and 2011 RPA amendment). The FMS flow criteria have been tracked since 2006 and implemented, per the NMFS 2009 BiOp RPA action, since 2009. Reclamation continues to work with the Water Forum, NMFS, CDFW, USFWS, and other interested parties to integrate a revised flow management standard for the LAR into CVP operations and associated water rights.

The FMS is designed to integrate temperature performance capability for management of the downstream habitat. The NMFS 2009 BiOp also adopted components of the FMS temperature management process.

Because water temperature control operations in the LAR are affected by many factors and operational tradeoffs, ideal downstream temperature targets are sometimes infeasible (particularly with multiple years of below normal or dry conditions). The factors include available cold water resources, Nimbus release schedules, annual hydrology/snow pack, Folsom power penstock shutter management flexibility, Folsom Dam Urban Water Supply Temperature Control Device (TCD) management, power generation, and Nimbus Fish Hatchery operations and maintenance. Two structural devices provide downstream temperature management: (1) the Folsom Shuttters and (2) the TCD. These devices control the desired downstream temperature by selecting the elevation where the water is withdrawn from the reservoir. In addition to accessing cooler water using the shutter elevations, a blending operation can also be employed where shutters at differing elevations are mixed or blended for temperature management. Lastly, when temperature operations exhaust the reservoir's coldwater pool past the lowest shutter locations prior to the fall, Reclamation has the ability to bypass the Folsom Shuttters (power generation) to release the coolest water from the river outlets, the lowest elevation outfall in Folsom Dam, to maintain targeted temperatures in the LAR.

Reclamation established a working group to coordinate fishery and operational requirements for the LAR, known as the American River Group (ARG), in 1996. Reclamation is the lead coordinator of the ARG, bringing together those who have either a legislated or resources-specific interest in the operation of Folsom Dam and Reservoir, and the LAR. Agencies with trust responsibilities for the water resources in the LAR and the surrounding areas participate. Members of the public and other agencies may attend ARG meetings and are encouraged to comment on matters under consideration by the ARG. The ARG convenes monthly or more frequently, if needed, with the purpose of providing fishery updates and reports to help inform management decisions regarding temperatures and flows necessary to sustain fish resources in the LAR.

Chapter 2 –Reasonable and Prudent Alternative (RPA) Actions (NMFS 2009 BiOp)

2.1 Summary of RPA Actions

On June 4, 2009, NMFS issued its BiOp and Conference Opinion on the Long-Term Operations of the CVP and SWP that included RPA actions for the LAR. The ARG was included amongst the four Fisheries and Operations Technical Teams whose function is to make recommendations for adjusting operations to meet contractual obligations for water delivery and to minimize adverse effects on listed anadromous fish species (see Section 11.2.1.1, NMFS 2009 BiOp).

There are several RPA actions that discuss minimal flow requirements and temperature objectives for the LAR: Action II.1.; "Lower American River Flow Management", Action II.2; "Lower American River Temperature Management", and Action II.4; "Minimize Flow Fluctuation Effects" (NMFS 2009 BiOp, Appendix 2D, and 2011 RPA amendment). The objectives of these RPA actions are to provide minimum flows for all stages of steelhead and to maintain suitable temperatures to support over-summer rearing of juvenile steelhead. A Temperature Management Plan is prepared for NMFS' consideration in May of each year that takes into consideration actions under Reclamation's authority using iterative modeling techniques (i.e. The iterative Coldwater Pool Management model-see NMFS 2009 BiOp, Appendix 2D). Since 2009 Reclamation and NMFS continue to work together to address all of the elements of the RPA actions.

Chapter 3 – Summary of ARG Discussions

The following agenda items were discussed at monthly ARG meetings from October 2016 through September 2017. Meeting notes and supplemental ARG documents were made available.

3.1 Monthly Discussion Topics

- **Lower American River Fisheries Monitoring**
 - The status of current fisheries monitoring activities provided by Reclamation, NMFS, USFWS, and CDFW, as well as planned future fisheries monitoring activities.
- **Water Operations and Water Quality**
 - Flows measured at Nimbus Dam, temperatures at Watt Avenue. See Chapter 4.
- **NMFS BiOp RPA Actions – American River Division:**
 - **RPA Action II.1 – Lower American River Flow Management**

Goal: Implementation of flow schedule specified in the FMS, which is summarized in Appendix 2-D of the NMFS 2009 BiOp.

Discussion: Reclamation convenes the ARG to make recommendations for management within the constraints of the FMS.
 - **RPA Action II.2 – Lower American River Temperature Management**

Goal: Maintain suitable temperatures to support over-summer rearing of juvenile steelhead in the LAR.

Discussion: Reclamation convenes the ARG to make recommendations regarding cold water management alternatives to improve water temperature conditions for fish, including potential power bypasses.
 - **RPA Action II.4 – Minimize Flow Fluctuation Effects**

Goal: Reduce stranding and isolation of juvenile steelhead through ramping protocols.

Discussion: Reclamation convenes the ARG to make recommendations regarding ramping protocols and monitoring activities to effectively adjust releases from Nimbus to reduce the risk of stranding and isolation of steelhead.

3.2 Other Discussion Topics

- **Central Valley Project Improvement Act**
 - **LAR Gravel Augmentation Program**

Restore and replenish spawning and rearing habitat that was lost due to the construction and operation of the CVP. Spawning and rearing habitat restoration projects on the LAR are part of a continuing program under the CVPIA. The project planned for completion

in 2017 was delayed due to a new permitting requirement but, is anticipated to be completed in 2018. There were significant changes to the bathymetry of the LAR, particularly the restoration sites, due to the high flows that were experienced. Fortunately, a LiDAR survey of the entire reach is scheduled for the Fall of 2017.

○ **LAR fall-run Chinook Carcass Survey**

Estimate the escapement of fall-run Chinook salmon in a 13.1-mile section of the LAR from Nimbus Hatchery weir downstream to the Watt Avenue Bridge. The objectives of the surveys are to: 1) estimate the population size of returning Chinook salmon spawning in a 13.1-mile section of the LAR; 2) determine the general age and sex of returning Chinook salmon; 3) determine pre-spawning mortality; and 4) determine the ratio of returning hatchery-reared, coded-wire tagged salmon. The 2016/17 preliminary escapement estimate of fall-run Chinook salmon is approximately 10,484. The survey began on October 17th and ran for twelve weeks and ended two weeks early (the week of January 5th) due to high flows. There were no surveys occurring the tenth or eleventh week due to high flows. High, turbid flows encountered during survey periods after week 8 limited the effectiveness of field staff in identifying salmon carcasses and flushed many carcasses downstream likely resulting in a lower in-river escapement estimate. Peak carcass detection occurred during the seventh week (Nov. 28-Dec. 1) with 1,088 carcasses processed). Adult/grilse ratios and pre-spawning mortalities were within the normal limits, although, the proportion of ad-clipped fish seemed to be low, less than 20 percent.

Chapter 4 – Water Operations Summary

General Water Year Conditions and Operations

Water year 2017 had the highest Northern California 8 station index precipitation on record. All of California received record, or near record precipitation and snowfall across the state. American River operations were dominated by flood control and storage management operations from late December through June, 2017

Hydrologic Conditions – American River

Watershed runoff in California is typically driven by winter precipitation and spring snow-melt runoff and quantified as a late spring through summer inflow volume (April through July volume, in addition to a water year total volume). The American River watershed spring/summer forecasted inflow volume is fundamental in operational planning; this is product updated routinely by the Department of Water Resources (DWR) and the National Weather Service-California Nevada River Forecast Center (CNRFC), where uncertainty is represented by percent runoff exceedances. The initial April – July 90% (conservative volume) unimpaired runoff exceedance forecast volume (February) was estimated at 1,240 TAF, or 103% of the average (4.615 MAF was projected for the water year. The actual full natural flow volume April –July in 2017, was 2,302 TAF and 192% of the average (final water year volume was 7.389 MAF). The following table provides data and characteristics of water year 2017 (Table 1). Because operational planning is significantly influenced by future forecasts, these uncertainties and eventually modified decisions are translated into the performance and efficiency of the system-wide operation.

Table 1. 2017 Water Year Northern Sierra precipitation, American River Basin snowpack, and Sacramento Valley Index statistics by month.

Water year 2017 Month	Northern Sierra 8-Station Precipitation (Cumulative water year in inches through month)	Northern Sierra 8-Station percentage of historic monthly average (for month)	American River Basin Snowpack (percent of April 1 average)	Sacramento Valley Index (40-30-30 Index 50% Exceedence)
November	18.0	85	NA	NA
December	29.6	138	NA	8.6
January	53.2	262	51	8.9
February	76.6	292	117	11.4
March	83.5	100	171	13.9
April	93.1	246	162	13.9
May	93.6	23	138	14.9

(DWR 2016)

Operations – Lower American River

Operational decisions on the LAR are influenced by local and CVP and SWP system-wide multi-purpose objectives including those that are planned and uncertain. Many factors contribute to operational actions including, but not limited to: flood protection, forecasted inflows, facility maintenance schedules, physical/mechanical facility limitations, upstream operations, minimum in-stream flow criteria, downstream Delta regulatory requirements, Delta exports, power generation, recreation, fish hatchery accommodations, temperature management capabilities, and others. In addition, uncertain or unplanned events can also influence real-time operation decisions (e.g. additional flow reduction for debris removal prior to fish weir and picket installation for the Nimbus Fish Hatchery in 2013). Planned operational targets are regularly updated late winter through early summer (depending on hydrologic conditions) on Reclamation’s website (<http://www.usbr.gov/mp/cvo/>) (Reclamation 2017).

Key decisions that influenced 2017 LAR operations:

- Minimum flow rate/FMS: A record precipitation year resulted in releases that were significantly higher than the MRR for a majority of the water year. Flood control operations dominated the winter/spring releases through June. Summer releases were held at 4,000 cfs to allow sufficient storage drawdown for the fall flood control season.
- Cold Water Pool (CWP): The historical conditions of the CWP volume is recorded in Table 2 for comparison.

- Cold Water Pool Protection: Flood control release actions preferred spill through the Folsom main spillway radial gates (the warmer upper elevations of the reservoir) whenever possible (e.g. elevation high enough to release through the main spillway gates) to preserve the development of the cold water pool at lower elevations.
- Temperature Management Plan: At the end of April the Iterative Cold-Water Pool Management Model (iCPMM) results indicated a feasible maximum mean daily temperature target at Watt Avenue Bridge of 65°F. Monthly modeling updates continued to indicate a feasible maximum mean daily temperature target at Watt Avenue of 65°F. The model also indicated the potential for a November temperature target of 58°F at Watt Ave.
- Cold Water Bypass: Reclamation has not had to implement cold water bypass this year as of this writing.

Table 2. Historical Folsom Reservoir Cold Water Pool dynamics.

Historical Conditions (2001-2016)						
Year	End of May		All Upper Shuttters Lowered by	End of September		Watt Avenue Target (°F)
	Storage (TAF)	CWP Volume < 58°F (TAF)		Storage (TAF)	CWP Volume < 60°F (TAF)	
2001	696	275	30 Mar	368	30	65-71
2002	822	455	04 Mar	510	50	65-69
2003	962	640	02 Apr	658	135	65-67
2004	635	300	05 Mar	376	30	69
2005	959	705	15 Mar	652	140	65
2006	928	670	29 Mar	639	125	65
2007	787	355	21 Mar	323	30	68
2008	617	250	None Lowered	270	25	69-70
2009	933	550	12 Mar	412	60	67
2010	905	580	14 Apr	624	130	66
2011	880 (960-July)	590	28 Mar	740	180	65
2012	926	536	29 Mar	450	60	65-66
2013	734	277	15 Apr	361	50	69
2014	548	200	None Lowered	345	35	70
2015	576	256	None Lowered	174	39	75
2016	826	421	23 Mar	306	27	68
2017	937	558	2 June	664	85	65

4.1 RPA Action II.1 – Lower American River Flow Management

RPA Action II.1 is designed to provide minimum flow for all steelhead life stages, as specified by the FMS. These Minimum Release Requirements (MRR) are total releases measured at Nimbus Dam and are dependent on upstream storage and hydrologic conditions. The prescribed flows are minimums only and do not preclude Reclamation from making higher releases. Storage and flood control conditions are illustrated in Figure 2 which also includes inflow and releases October 2016 through November 2017.

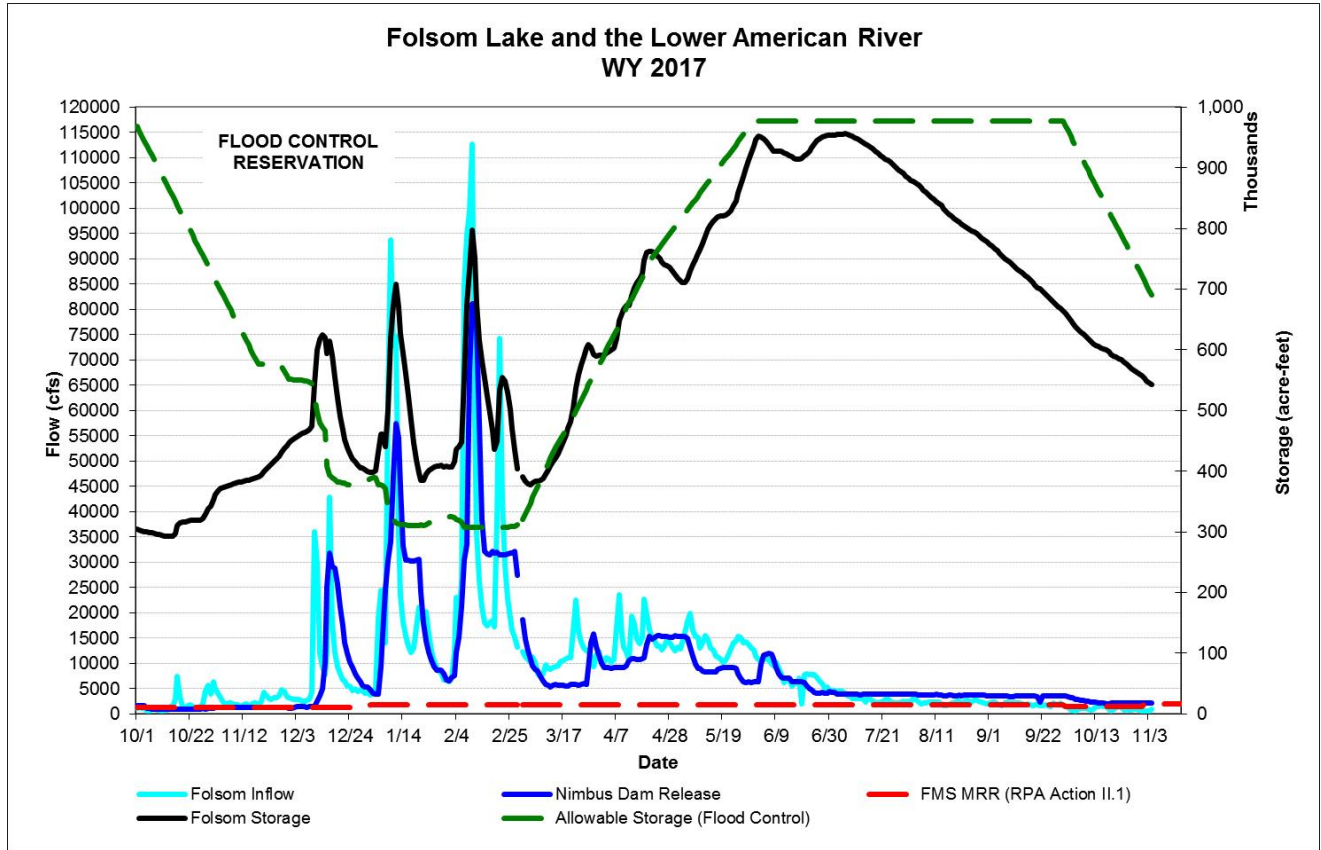


Figure 2. Summary of Folsom Reservoir Storage and Lower American River Flows¹

The Nimbus Dam releases to the LAR and the MRR prescribed by the FMS for water year 2017 are shown on Figure 3. In addition, the primary reasons for release changes to the LAR are identified on the figure. Strong winter and spring storm events resulted in flood control management and storage management operations for the months of December through June. This was followed by summer releases of 4,000 cfs through the end of September. This was necessary to bring Folsom storage down to a safe level heading into the fall flood control season. Folsom storage at the end of September was 664 taf, a significant improvement from WY 2016. The ARG agreed on fall releases of 2,000 cfs for October

¹ FMS MRR (RPA Action II.1) Conference/Off-Ramp Drought Operations were effective beginning March 2015 and terminated January 2016.

and November for spawning. The iCPMM model indicated a temperature target of 58°F. As of this writing, temperatures at the American River at Hazel gage have reached 58.5°F.

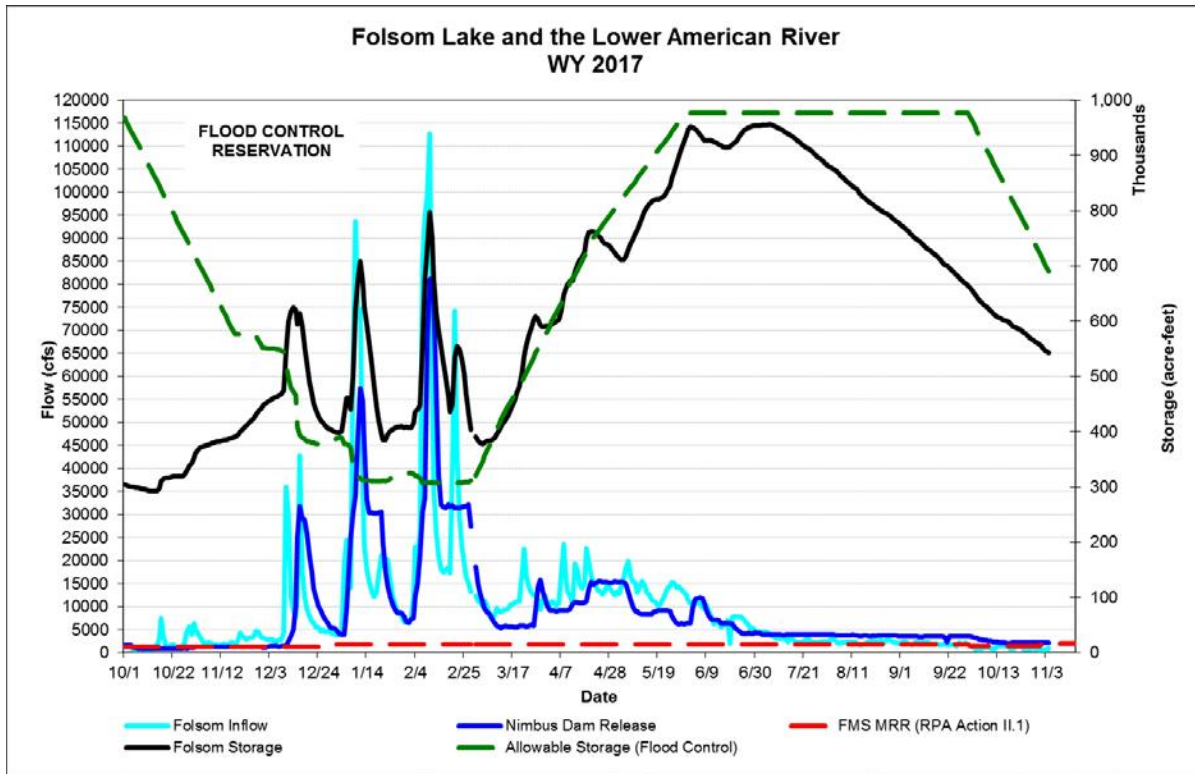


Figure 3. Summary of Lower American River Releases at Nimbus Dam

Table 3 contains a summary of operational release changes from Nimbus Dam. Flow management adjustments included flood control, storage conservation.

Table 3. Release Changes at Nimbus Dam

Start Date	End Date	Release	To (cfs)	Comment
10/5/2016	10/5/2016	Decrease	1,000	Storage conservation
11/1/2016	11/1/2016	Increase	1,250	Spawing flow
12/11/2016	12/11/2016	Increase	3,500	Storage management/flood control
12/13/2016	12/13/2016	Increase	6,000	Storage management/flood control
12/14/2016	12/14/2016	Increase	8,000	Storage management/flood control
12/14/2016	12/14/2016	Increase	10,000	Storage management/flood control
12/14/2016	12/14/2016	Increase	15,000	Storage management/flood control
12/15/2016	12/15/2016	Increase	35,000	Storage management/flood control
12/16/2016	12/16/2016	Decrease	30,000	Storage management/flood control
12/19/2016	12/19/2016	Decrease	25,000	Storage management/flood control
12/20/2016	12/20/2016	Decrease	20,000	Storage management/flood control
12/21/2016	12/29/2016	Decrease	5,000	Ramp down storage management/flood control
12/31/2016	1/2/2017	Decrease	3,500	Ramp down storage management/flood control
1/5/2017	1/5/2017	Increase	7,000	Storage management/flood control
1/5/2017	1/5/2017	Increase	15,000	Storage management/flood control
1/7/2017	1/7/2017	Increase	30,000	Storage management/flood control
1/9/2017	1/9/2017	Increase	35,000	Storage management/flood control
1/9/2017	1/9/2017	HOLD	35,000	Insufficient head on spillway gates to increase releases further at this time. Additional release increases will be made as reservoir storage allows.
1/9/2017	1/9/2017	Increase	40,000	Storage management/flood control
1/10/2017	1/10/2017	Increase	50,000	Storage management/flood control
1/10/2017	1/10/2017	Increase	60,000	Storage management/flood control
1/12/2017	1/12/2017	Decrease	50,000	Storage management/flood control
1/13/2017	1/13/2017	Decrease	40,000	Storage management/flood control
1/21/2017	1/27/2017	Decrease	8,000	Storage management
1/30/2017	1/31/2017	Decrease	6,400	Storage management
2/2/2017	2/2/2017	Increase	7,250	Storage management
2/4/2017	2/4/2017	Increase	15,000	Storage management
2/6/2017	2/6/2017	Increase	30,000	Flood control
2/8/2017	2/8/2017	Increase	40,000	Flood control
2/8/2017	2/9/2017	Increase	55,000	Flood control
2/9/2017	2/9/2017	Increase	65,000	Flood control
2/9/2017	2/9/2017	Increase	70,000	Flood control
2/9/2017	2/9/2017	Increase	80,000	Flood control
2/12/2017	2/12/2017	Decrease	70,000	Flood control
2/12/2017	2/13/2017	Decrease	55,000	Flood control
2/13/2017	2/13/2017	Decrease	45,000	Flood control/storage management
2/14/2017	2/14/2017	Decrease	40,000	Storage management
2/14/2017	2/14/2017	Decrease	30,000	Storage management
2/28/2017	2/28/2017	Decrease	20,000	Inflow management
3/1/2017	3/6/2017	Decrease	8,000	Storage management

3/7/2017	3/8/2017	Decrease	6,400	Inflow management
3/9/2017	3/10/2017	Decrease	5,000	Inflow management
3/27/2017	3/28/2017	Increase	15,000	Inflow management
3/29/2017	4/1/2017	Decrease	8,500	Storage management
4/11/2017	4/11/2017	Increase	10,000	Storage management
4/19/2017	4/19/2017	Increase	15,000	Storage management
5/5/2017	5/8/2017	Decrease	8,500	Storage management
5/17/2017	5/17/2017	Increase	9,500	Storage management
5/24/2017	5/26/2017	Decrease	6,400	Reduce flows for Memorial Day weekend
6/3/2017	6/3/2017	Increase	12,000	Storage management
6/7/2017	6/10/2017	Decrease	7,300	Storage management
6/14/2017	6/14/2017	Decrease	6,400	Storage management
6/20/2017	6/20/2017	Decrease	5,650	Storage management
6/21/2017	6/21/2017	Decrease	5,000	Storage management
6/22/2017	6/24/2017	Decrease	4,000	Storage management
7/2/2017	7/3/2017	Decrease	3,500	Storage management
9/20/2017	9/21/2017	Decrease/Increase	"1000/3500	Fish picket installation on fish weir
10/1/2017	10/4/2017	Decrease	3,000	Reducing flows for fall spawning
10/5/2017	10/14/2017	Decrease	2,000	Reducing flows for fall spawning

4.2 Action II.2 - Lower American River Temperature Management

RPA Action II.2 is designed to provide suitable temperatures to support over-summer rearing of juvenile steelhead in the LAR from May 15th through October 31st. Figure 4 is a summary of Reclamation's temperature operations, from October 2016 through November 2017, at the Watt Avenue Bridge (~RM 9) temperature compliance point. Each year available water resources and conditions are assessed to develop a temperature management Plan. The iCPMM model tool is used to generate temperature modeling results which are one component that guides the decision making for the Temperature Management Plan. Model runs incorporate the latest operation's forecast (inflow, outflow and storage) and iteratively selects a temperature target based on available resources and a pre-assumed habitat balance between steelhead and fall-run Chinook. The selected plan requires NMFS approval, with input from members of the ARG. The plan is reviewed for potential updates every month based on the latest hydrology and cold-water pool conditions. NMFS must concur on proposed deviations from the plan that may reduce the likelihood that the temperature objective will be met.

Reclamation submitted a Temperature Management Plan to NMFS on May 23, 2017 with the expectation that Folsom Reservoir storage conditions would fill to full capacity in the spring. The initial Plan in May included an iCPMM temperature model run with the objective to achieve a maximum temperature (mean daily) target at Watt Avenue Bridge of 65°F. While Reclamation never received an official approval of this year's temperature plan, at the ARG meeting the agencies were in agreement with the proposed operations plan.

Monthly modeling updates continued to prescribe a temperature target of 65°F through the summer months. Between May 15th and October 31st no days exceeded the daily average temperature target.

The FMS temperature management strategy and RPA acknowledge resource needs for the protection of Fall-run Chinook salmon spawning. The goal is to achieve cooler temperatures by November 1st, depending on the availability of remaining cold-water-pool resources. The onset of seasonal fall cooling in most years occurs about the same time Folsom Lake becomes isothermal, near mid-November. As a result, many years continue active temperature management after RPA Action II.2's October 31st date. This is typically accomplished by releasing water from Folsom Dam's lower river outlet gates and at a cost to power generation. As of this writing, by-pass operations have not yet been needed for November cooling. It may need to be utilized in the coming days however.

This year marks a significant improvement in the ability to record nearly a complete cycle of the temperature management period. Prior Annual Reviews documented spring and summer actions well but were truncated ahead of the most difficult and critical period for temperature management in the fall. As a result of recent drought periods and heightened sensitivity of thermal influences on life stages, prudent efforts to accomplish critical review and efficacy of temperature management decision making for targeted species would capture the entire active selective withdraw period (lake stratification through de-stratification, typically April through the end of November or early December). Within season temperature targets, locations, metrics, and release decisions can significantly influence fall temperature performance. Water year 2017 was fortunate to have frequent hydrologic events, reservoir refills, and strong snow-melt runoff yielding relatively unchallenging temperature management operations.

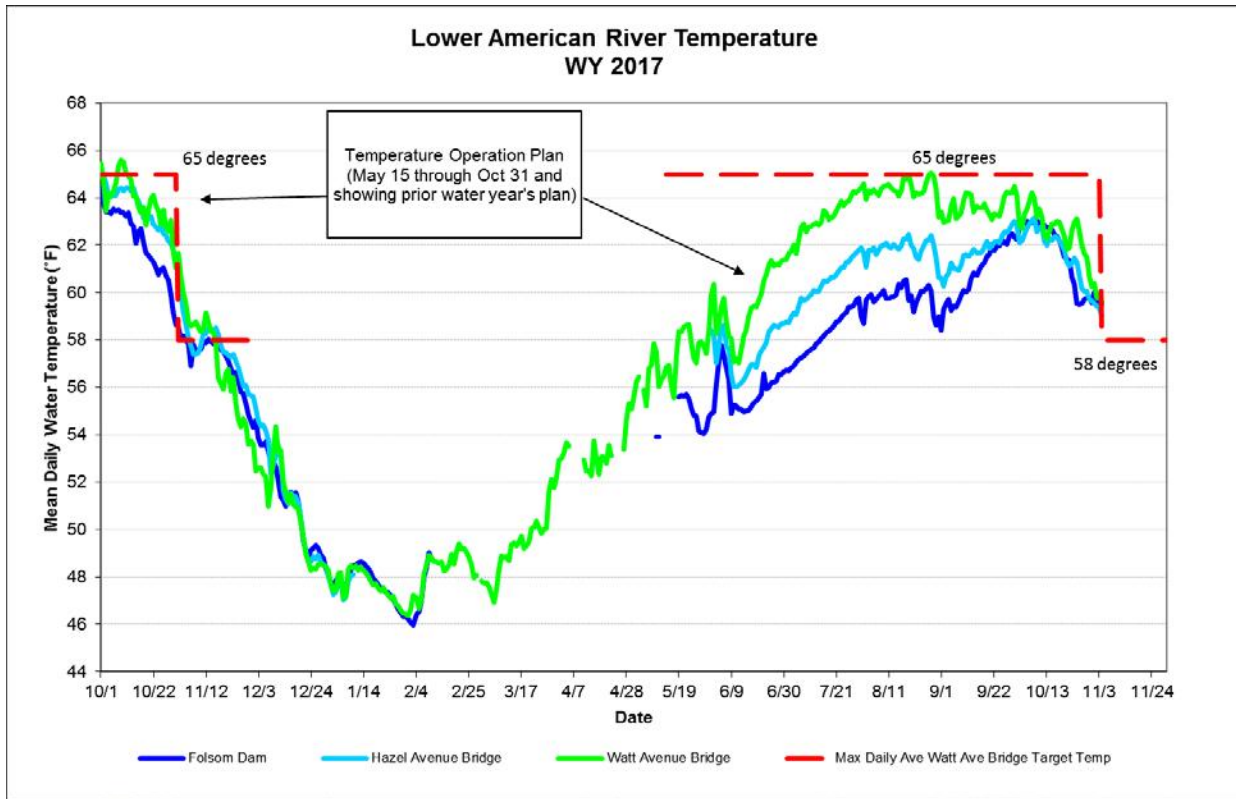


Figure 4. Summary of Temperature in the Lower American River

Table 4 is a list of Folsom Dam temperature shutter and power penstock blending operations taken to meet downstream temperature requirements.

Table 4. Folsom Dam Temperature Shutter and Bypass Operation

Date	Operation																												
10/3/2016	Beginning 10/3/2016, and until further notice, please remove all Unit blending priority preferences.																												
10/28/2016 to 11/02/2016	<p>Please bypass the following schedule through the lower-tier River Outlets:</p> <table border="1" data-bbox="526 495 1159 705"> <thead> <tr> <th>Date</th> <th>Time</th> <th>From (cfs)</th> <th>To (cfs)</th> </tr> </thead> <tbody> <tr> <td>10-28-2016</td> <td>0800</td> <td>0</td> <td>50</td> </tr> <tr> <td>10-29-2016</td> <td>0800</td> <td>50</td> <td>150</td> </tr> <tr> <td>10-30-2016</td> <td>0800</td> <td>150</td> <td>250</td> </tr> <tr> <td>10-31-2016</td> <td>0800</td> <td>250</td> <td>350</td> </tr> <tr> <td>11-01-2016</td> <td>0800</td> <td>350</td> <td>450</td> </tr> <tr> <td>11-02-2016</td> <td>0800</td> <td>450</td> <td>500</td> </tr> </tbody> </table> <p>Comment: Temperature operation supporting Fall Run Chinook spawning. Total release to the lower American River below Nimbus Dam remains unchanged.</p>	Date	Time	From (cfs)	To (cfs)	10-28-2016	0800	0	50	10-29-2016	0800	50	150	10-30-2016	0800	150	250	10-31-2016	0800	250	350	11-01-2016	0800	350	450	11-02-2016	0800	450	500
Date	Time	From (cfs)	To (cfs)																										
10-28-2016	0800	0	50																										
10-29-2016	0800	50	150																										
10-30-2016	0800	150	250																										
10-31-2016	0800	250	350																										
11-01-2016	0800	350	450																										
11-02-2016	0800	450	500																										
11/24/2016	At 0800 on Thursday Nov 24, 2016 please discontinue the power bypass releases. Route all releases through the powerplant. Total release to the river will continue to be 1250 cfs at Nimbus. Comment: Cold water pool exhausted.																												
4/13/2017	<p>On Thursday, 04/13/2017, lower the bottom and middle shutters on units 1 and 2.</p> <p>Folsom shutter status after changes: Top Shutters: Units 1, 2, & 3 - raised Middle Shutters: Units 1, 2 lowered unit 3 - raised Bottom Shutters: Units 1, 2 lowered unit 3 - raised</p> <p>Comment: Temperature shutter elevation requirement</p>																												
7/31/2017	Beginning 07/31/2017, and until further notice, please operate Unit 1 at 20% to blend for temperature target at Watt Ave. management																												
10/29/2015	Bypass the following schedule through the lower-tier River Outlets from 0 cfs to 50 cfs																												
10/30/2015	Bypass the following schedule through the lower-tier River Outlets from 50 cfs to 100 cfs																												
10/31/2015	Bypass the following schedule through the lower-tier River Outlets from 100 cfs to 150 cfs. Comment: Temperature operations supporting Fall Run Chinook spawning. Total release to the Lower American River below Nimbus Dam remains unchanged.																												
11/2/2015	Bypass the following schedule through the lower-tier River Outlets from 150 cfs to 200 cfs. Comment: Temperature operations supporting Fall Run Chinook spawning. Total release to the Lower American River below Nimbus Dam remains unchanged.																												

11/6/2015	Bypass the following schedule through the lower-tier River Outlets from 200 cfs to 300 cfs. Comment: Temperature operations supporting Fall Run Chinook spawning. Total release to the lower American River below Nimbus Dam remains unchanged.
12/4/2015	Terminate the bypass through the lower tier river outlets from 300 cfs to 0 cfs. Comment: Temperature operation supporting Fall Run Chinook spawning completed due to isothermal reservoir conditions.
2/9/2016	Work initiated the first week of February and completed Tuesday, 2/9/2016, the Bottom and Middle set of temperature shutters were lowered on Units 1 and 2, and the Middle set of temperature shutters were lowered on Unit 3.
2/22/2016	Preference spill through the Folsom Main Spillway Radial Gates if releases are greater than available penstock capacity.
3/23/2016	Work completed Wednesday, 3/23/2016, the Top set of temperature shutters were lowered on Units 1, 2, and 3.
7/31/2016	Raise the upper temperature shutters on Folsom Penstock Units 1, 2, and 3. Comment: Temperature management and head constraints on the upper shutters.
8/1/2017	Beginning 08/01/2017, and until further notice, please operate Unit 1 at 10% to blend for temperature target at Watt Ave.
8/5/2017	Beginning 08/05/2017, and until further notice, please operate Unit 1 at 20% to blend for temperature target at Watt Ave.
8/10/2017	Operate Unit 1 at about 45%, to blend for temperature target at Watt Ave.
8/10/2016	Beginning 08/10/2017, and until further notice, please operate Unit 1 at 35% to blend for temperature target at Watt Ave.
8/16/2017	Beginning 08/16/2017, and until further notice, please operate Unit 1 at 35%, unit 2 at 25%, and unit 3 at 40% to blend for temperature target at Watt Ave.
8/18/2017	Beginning 08/18/2017, and until further notice, please operate Unit 1 at 60% to blend for temperature target at Watt Ave.
8/22/2017	Beginning 08/22/2017, and until further notice, please operate Units 1 and 2 at a combined percentage of 65% and unit 3 at 35% to blend for temperature target at Watt Ave.
8/28/2017	Beginning 08/28/2017, and until further notice, please operate Units 1 and 2 at a combined percentage of 80% and unit 3 at 20% to blend for temperature target at Watt Ave.
8/29/2017	On 08/29/2017 please raise the upper temperature shutter on Unit 3 and the Middle shutter on Unit 2. Configuration after changes: Upper shutters - all up Middle shutters - unit 2 up, units 1 and 3 down Lower shutters - all down Comment: Water temperature management
8/29/2017	Beginning 08/29/2017 as soon as the temperature shutter changes are complete, and until further notice, please operate Unit 2 at 15% to blend for temperature target at Watt Ave.

9/29/2017	Please raise the middle shutters on Unit 1 at the earliest opportunity. If at all possible this needs to be done today. Comment: temperature control at Watt Ave.
9/29/2017	Beginning 09/29/2017 and until further notice, please operate Units 1 at 15% and Unit 2 at 20% to blend for temperature target at Watt Ave.
9/29/2017	This order documents that the following change was made on 09/29/2017 please raise the Middle shutter on Unit 1. Configuration after changes: Upper shutters - all up Middle shutters - units 1 and 2 up, unit 3 down Lower shutters - all down Comment: Water temperature management
10/19/2017	Beginning 10/19/2017 and until further notice, please operate Unit 1 at 100% and Unit 2 at 0% to blend for temperature objective at Fair Oaks Ave. Comment: Water temperature management to encourage spawning of Coleman Hatchery tagged fish at Nimbus Hatchery during remaining days of October.
10/20/2017	please raise the Middle shutter on Unit 3 as early as possible on Friday October 20, 2017. Configuration after changes: Upper shutters - all up Middle shutters - all up Lower shutters - all down Comment: Water temperature management
10/20/2017	Beginning 10/20/2017 (after completion of the removal of the middle shutter on unit 3) and until further notice, please remove penstock priorities. Both units will be configured identically. Comment: Water temperature management to encourage spawning of Coleman Hatchery tagged fish at Nimbus Hatchery during remaining days of October.
10/23/2017	Beginning 10/23/2017 and until further notice, please run unit 1 at 30% and unit 3 at 70%. Comment: Targeting 60 degrees at Hazel Ave to encourage spawning of Coleman Hatchery tagged fish at Nimbus Hatchery during remaining days of October.
10/23/2017	please raise the lower shutter on Unit 1 as early as possible on Monday October 23, 2017. Configuration after changes: Upper shutters - all up Middle shutters - all up Lower shutters - Unit 1 up, Units 2 and 3 down Comment: Water temperature management
10/26/2017	Beginning 10/26/2017 and until further notice, please run Unit 1 at 70%. Comment: Targeting 60 degrees at Hazel Ave to encourage spawning of Coleman Hatchery tagged fish at Nimbus Hatchery during remaining days of October.

11/2/2017	please raise the lower shutter on Unit 2 on Thursday November 2, 2017. Configuration after changes: Upper shutters - all up Middle shutters - all up Lower shutters - Unit 1 and 2 up, Unit 3 out of operation Comment: Water temperature management
11/2/2017	Beginning 11/02/2017 remove unit priorities. Comment: All units are in the same shutter configuration.

4.3 Action II.4 - Minimize Flow Fluctuation Effects

The goal of RPA Action II.4 (NMFS 2009 BiOp) is to reduce stranding and isolation of juvenile steelhead through ramping protocols, from January 1 through May 31; and to minimize the occurrence of flows exceeding 4,000 cfs throughout the year, except as necessary for flood control or in response to high inflow events. Owing to a steady series of precipitation events over the American River Basin, and steady high inflows into Folsom Reservoir, releases to the Lower American River were above 4,000 cfs from January 5, 2017 through June 22, 2017.

Ramping protocols as specified under RPA II.4 were met from January 1 through May 31. Expedited ramping to install the Nimbus Fish Hatchery weir and picket infrastructure occurred on September 20, 2017 consistent with prior year operations.

Chapter 5 – Lower American River Monitoring

The monitoring activities described below are currently being implemented on the LAR and include actions which are either a requirement in the NMFS 2009 BiOp, assist Reclamation in meeting the NMFS 2009 BiOp RPA requirements, provide supplemental information, or are a CVPIA requirement.

5.1 RPA Monitoring Activities

5.1.1 Steelhead Spawning Surveys

NMFS RPA Actions II.1 – Lower American River Flow Management and II.4 - Minimize Flow Fluctuation Effects

Reclamation contracted with Cramer Fish Sciences to conduct bi-weekly steelhead redd surveys from Nimbus Dam to Watt Avenue with the addition of Paradise Beach every other survey period, covering 18 river miles. The surveys began January 4th, 2017, and extended through April 19th, 2017. From March 8th to April 6th, 2017, A total of 10 new, clear steelhead redds were observed between March 8th and April 6th, 2017. Additional observations included seven Chinook Salmon redds and four Pacific Lamprey redds. Figure 5 shows the 2017 steelhead redd locations (following DFA analysis) and their corresponding dates. Surveyed redds were recorded from a cataraft, raft or on foot and plotted using GPS and biometric equipment. Updates were sent to NMFS bi-weekly to summarize the findings of the steelhead spawning survey.

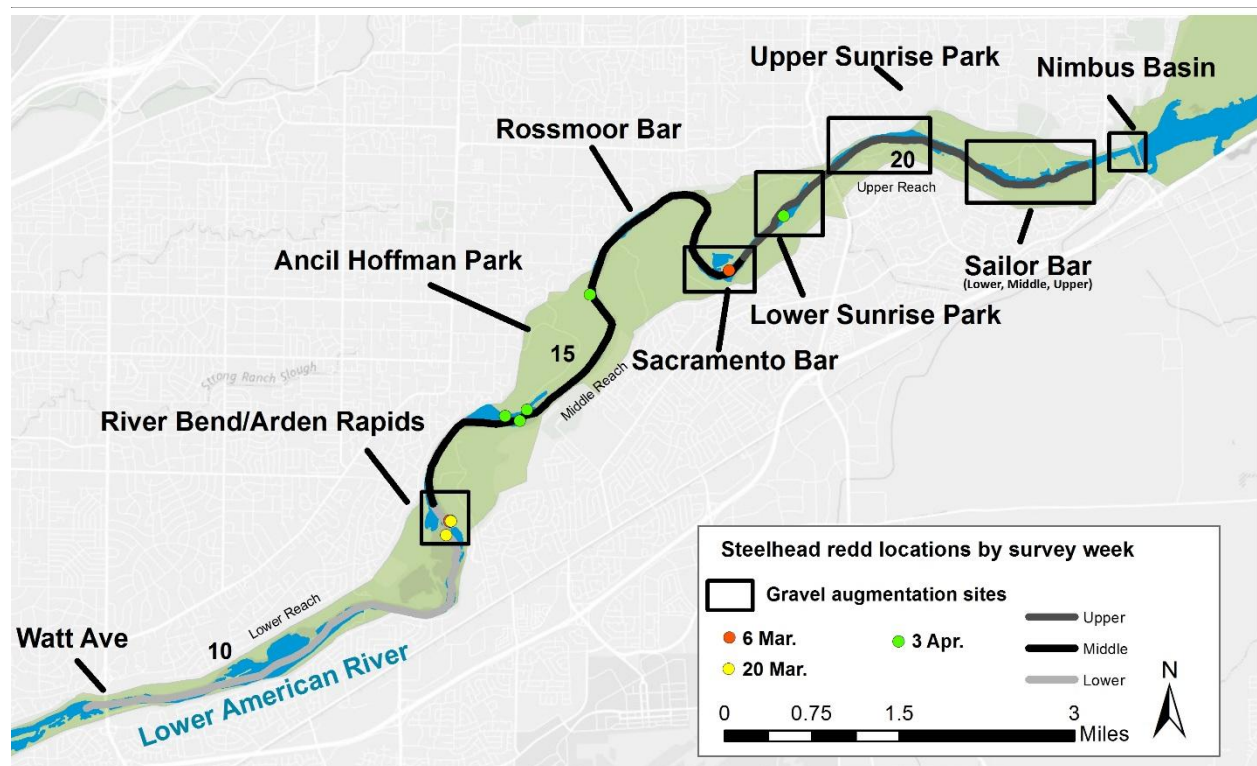


Figure 5. American River Steelhead redd distribution and timing in 2017.

5.1.2 Manual Temperature Profiles

RPA Action II.2 – Lower American River Temperature Management

Twice per month from May through November, Reclamation collects temperature profile data in Folsom Reservoir to assist in meeting RPA Action II.2 – Temperature Management. The temperature profile data are used to model downstream temperatures through the operation season so Reclamation can plan temperature shutter operations to meet the downstream temperature compliance point at Watt Avenue Bridge. Manual temperature profiles are taken at six locations in Folsom Reservoir (see Chapter 4, Section 4.2).

5.1.3 Isolation Pool Monitoring

RPA Action II.4 – Minimize Flow Fluctuation Effects

Reclamation monitors flow fluctuations in the LAR to assess and reduce stranding and isolation of steelhead when ramping down flows and fluctuating flows above and below a threshold where elevations changes could lead to isolation of redds, fry and/or juvenile steelhead. Flow fluctuations in the LAR have been documented to result in steelhead redd dewatering and isolation, fry stranding, and fry and juvenile isolation. Habitat evaluations have identified several locations where isolation of salmonids and other fish species have been observed in the past coinciding with the reduction or fluctuation of flows.

Six stranding surveys were performed from January to June. A total of 463 stranded juvenile salmonids were observed during these surveys, 22 of which were confirmed as steelhead, across a total of 35 pools covering an estimated area of 15,762 m². All stranded steelhead were observed during May and June. Figure 6 shows the locations of all identified stranding pools. Bi-weekly updates were sent to NMFS describing isolation pool observations that coincided with steelhead spawning surveys.

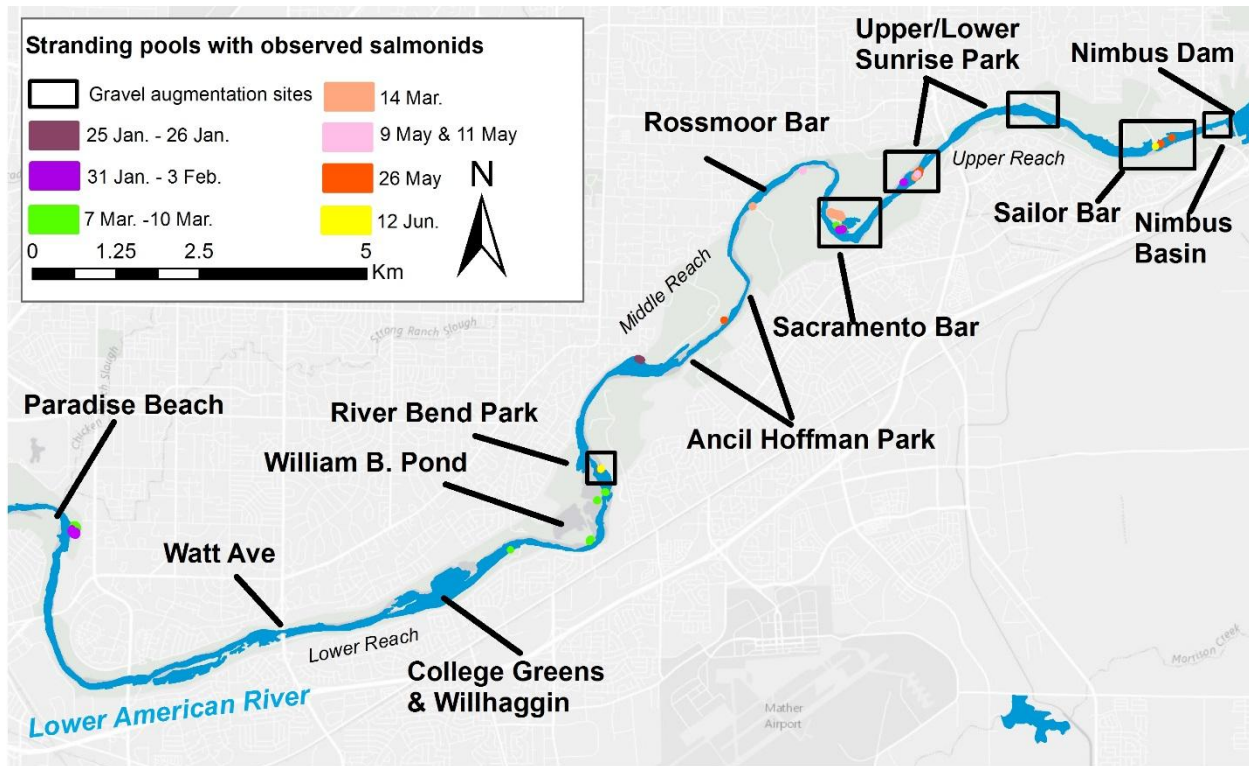


Figure 6. Locations of stranding areas on the Lower American identified January 25th and 26th, January 31st - February 3rd, March 7th -10th, March 14th, May 9th and 11th, May 26th, and June 12th, 2017.

References

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- NMFS. 2009. *Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project.*
- NMFS. 2011. *2011 Amendments to the National Marine Fisheries Service Operations Criteria and Plan Reasonable and Prudent Alternatives.*
- Reclamation, 2016. Central Valley Operations Office: Operations Analysis and Accounting: Water Operations Analysis (Monthly PDF). <http://www.usbr.gov/mp/cvo/>
- SWRCB, 2016. *State Water Resources Control Board Order WR 2015-0043. In the Matter of Specified License and Permits of the Department of Water Resources and the U.S. Bureau of Reclamation for the State Water Project and the Central Valley Project regarding the Executive Director's February 3, 2015 Order and Subsequent Modifications to that Order.*
- Water Forum. 2006. *Draft: Lower American River Flow Management Standard.*