San Joaquin River Restoration Program

Restoration Administrator's 2025 Report to Settling Parties

Prepared by

Tom Johnson

Restoration Administrator

June 2026

1 Introduction 3
2 Overview of 2025 Hydrology, Friant Operations, and Restoration Flows 3
3 Program Milestones and Accomplishments during 2025 5
4 Progress toward Achieving Settlement Paragraph 11, 13, and 14 Requirements during 20257
5 Program Challenges and Recommendations 11
5.1 Federal Government Staffing and Funding Challenges 11
5.2 Program Funding Challenges 12
5.3 MOU with the State 12
5.4 Extension of the Settlement 13
5.5 Projects and Improvements in Furtherance of the Restoration Goal 13
5.6 Continuing Challenges, as identified in Previous Annual Reports 14
6 Specific RA and TAC Activities Completed During 2025 17
7 Priority RA/TAC Tasks for 2025 19
8 2024 RA and TAC Expenditures 21

<u>Appendices:</u>

A. URF Revenue
B. 2024 - 2025 Flow Accounting
C. Unimpaired Runoff History
D. Restoration Allocations
E. 2025 Hydroclimate and Outcomes
F. Projects and Improvements in Furtherance of the Restoration Goal

1 Introduction

This Restoration Administrator's Report on the status of the San Joaquin River Restoration Program (Program or SJRRP) is prepared in accordance with the Stipulation of Settlement filed September 13, 2006, in the case of *NRDC, et al., v. Kirk Rodgers, et al*. Pursuant to the Stipulation of Settlement (Settlement), the Restoration Administrator (RA) , with the assistance of the Technical Advisory Committee (TAC) will prepare an annual report which shall include a summary of settlement implementation activities of the previous year, findings of research and data collection, any additional recommended measures to achieve the Restoration Goal of the Settlement, a summary of progress and impediments in meeting targets established pursuant to Settlement Paragraph 11 (Paragraph 11), and a summary of expenditures from the Account.

2 Overview of 2025 Hydrology and Friant Dam Operations

The 2025 Water Year (October 1, 2024 – September 30, 2025) started out dry, with precipitation and runoff below average, then slowly climbed by the time of the last Restoration Flow Allocation (Allocation) on May 18, 2025.

The 2025 Water Year unimpaired runoff inflow to Millerton Lake was 1,346 thousand acre-feet. While November precipitation in the San Joaquin watershed was above normal, all other months through January were below normal. January was exceedingly dry, with near-record lack of precipitation, second only to January 2022 which received zero precipitation.

Although the 2025 water year began with strong gradient in precipitation from north to south, later storms were biased toward the Southern Sierra Nevada. The result being most of California had near-normal precipitation. Since peak snowpack occurred the first week in April for most locations, snowmelt was rapid.

The 2025 hydroclimate– precipitation, snow accumulation and depletion, temperature, and resulting runoff - had the following notable characteristics:

- Nearly half of the total precipitation fell in three storm events
- Snowpack was slightly below average, with high elevations (above 8,000') trending above median and the mid-elevations (5,000' to 8,000') trending below median.
- Despite near-median snowpack, melt rates in 2025 were higher than historic norms and likewise runoff was faster than historic norms. It is partly a result of the temperature at which the snow fell (storms were generally warmer in 2025), the reflectivity of the snow, and the heat added to the snow (from sunlight and air temperature). Rapid snowmelt produces a slightly higher runoff efficiency (i.e. greater volume of water across the water year) but often cannot be captured effectively in reservoirs if the reservoir has limited storage.

The following graphics show the major events and flows for water year 2025. Figure 1 shows the water year trend plot for 2025, and Figure 2 shows Millerton Lake inflows and outflows.

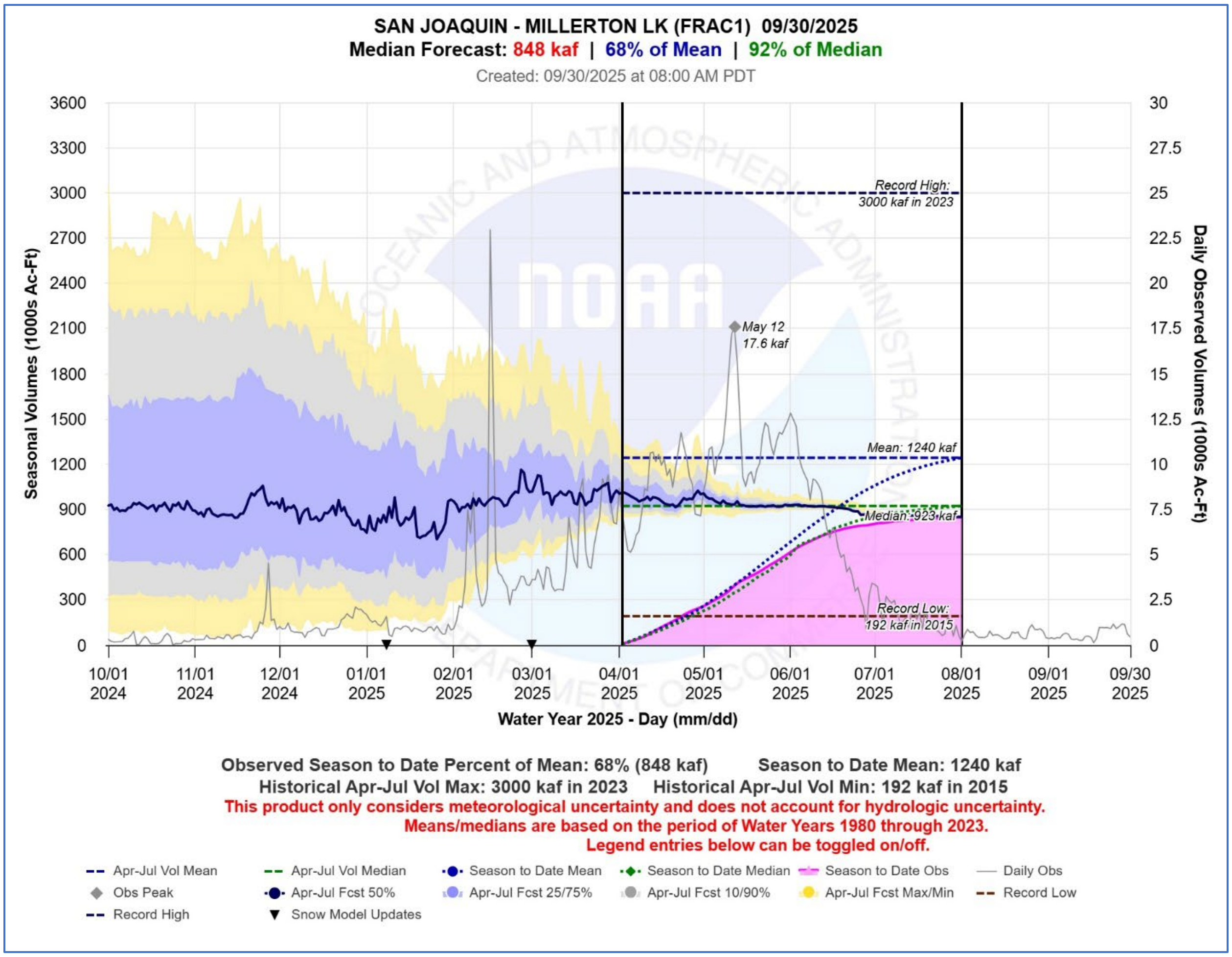


Figure 1. Water Year 2025 Trend Plot from the California Nevada River Forecast Center (CNRFC)[1]

[1] https://www.cnrfc.noaa.gov/ensembleProduct.php?id=FRAC1&prodID=7&year=2025

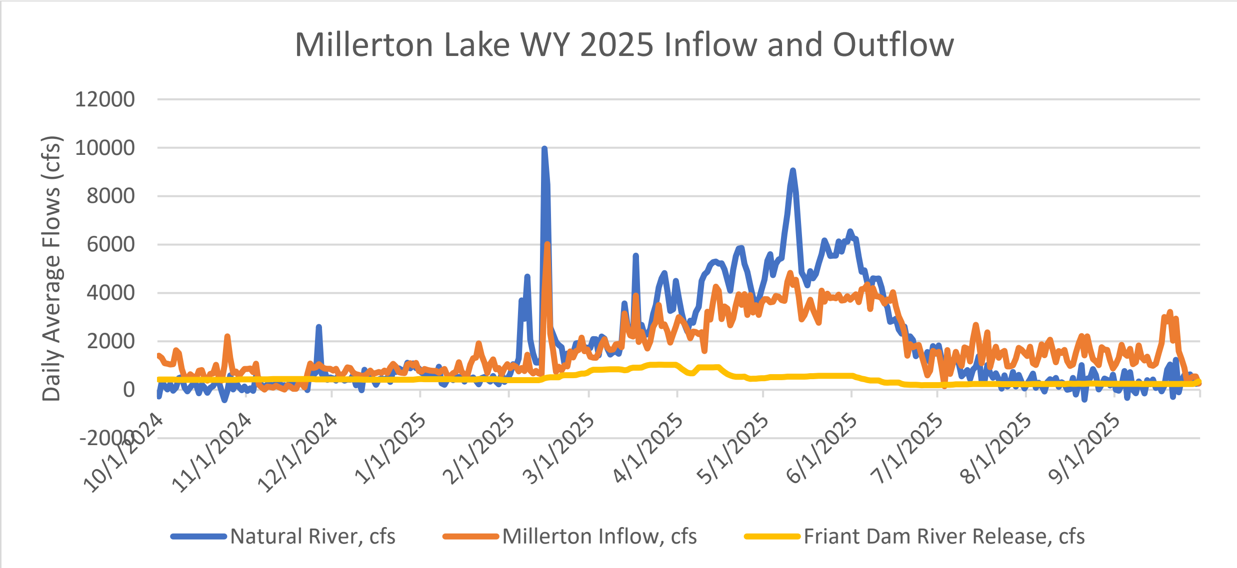


Figure 2. Millerton Lake Computed Natural River Flows, Computed Inflow, and Measured Outflow. [2]

3 Program Milestones and Accomplishments during 2025

This Section provides an overview of specific Program milestones and accomplishments for 2025. Additional detail on Settlement Paragraphs 11 (channel improvements), 13 (Restoration Flows), and 14 (Salmonid reintroduction) efforts follow in Section 4.

The final 2025 Restoration Allocation was for the Settlement-defined Normal-Dry water year type, with an allocation of 269.355 TAF (measured at Gravelly Ford). Typically, this volume of Restoration Flow would be sufficient to release high spring flows plus shift some flows to the summer months to maintain river connectivity through the summer months, as long as such a shift was allowed by a Water Supply Test[3]. Due to high reservoir levels, it was not apparent that any Restoration Flow would be able to be shifted to summer until late May.

Milestones and accomplishments included:

- Restoration Flow releases within existing channel capacity were accomplished without noteworthy events.

- Between April and June, a total of 448 Spring-Run Chinook salmon returned to the lower reaches of the Restoration Area and were captured in Program fyke nets. Of these 448 salmon, 394 of the salmon were successfully transferred to Reach 1 of the Restoration Area and released near Scout Island, by far the largest observed return since inception of the

[2] QA/QC data from the San Joaquin River Restoration Program Daily Operations spreadsheet, Ver. 41s, February 20, 2026.

[3] A Water Supply Test (WST) is defined in the Restoration Flow Guidelines and describes a quantitative and qualitative process to determine whether a shift in Restoration Flows will cause an impact to Friant contractor water supply.

Program. Although not specifically a Program milestone, an additional 1,000+ SR Chinook returned to the Tuolumne River

- The Program continued work on the major Paragraph 11(a) projects, including advancing design and analysis of the Mendota Pool Compact Bypass and Arroyo Canal/Sack Dam bypass projects. The construction solicitation for the "Arroyo Canal Fish Screen and Sack Dam Bypass Project" was released in late 2024, and a contractor was announced in July of 2025. The 11(a) projects progress is described further in Section 4 below.

- The Bureau of Reclamation's (Reclamation) Upper San Joaquin Watershed Forecasting Discussion Group provided periodic runoff forecasts throughout the winter and spring, integrating disparate indicators of snowpack, runoff efficiency, and forecasted runoff. This information was used to inform Allocations through the winter, spring and early summer. The Forecasting Group provided technical briefings through the monthly Upper San Joaquin Watershed Forecasting Discussion Group.

- The National Marine Fisheries Service (NMFS) completed and released a 2025 Technical Memorandum[4] on January 15, 2025, that outlined the spring-run Chinook salmon release and monitoring plans for 2025, plus methods for identifying spring-run Chinook salmon outside of the San Joaquin River. The 2025 Technical Memorandum includes an Appendix A which provides an overview of fish releases, rotary screw trap monitoring, telemetry monitoring, and adult broodstock releases in the San Joaquin River from late fall 2024 through fall 2025.

- Work on the California Department of Fish and Wildlife's Salmon Conservation and Research Facility (SCARF) was completed in 2025, with testing and commissioning underway in early 2025. Although a number of construction-related challenges have continued to plague the SCARF, including problems with the water supply line to the facility, most broodstock were successfully transferred to the new facility in 2025, and all 2026 production is to occur at the SCARF. The Interim SCARF (iSCARF), located adjacent to where the SCARF was constructed, has been producing juveniles for the Program for several years. The iSCARF and will now be re-purposed and can be used for various experiments in juvenile production.

- A 2025 Channel Capacity Report[5] (CCR) was published by the Channel Capacity Advisory Group (CCAG) to update estimates of then-existing channel capacities in the Restoration Area to ensure Restoration Flows would be kept below levels that would increase flood risk. Separate from channel capacity, flows in Reaches 3 and 4A are limited to avoid seepage impacts to adjacent lands. Channel capacities are applicable to Restoration Flows only and are usually much less than the flows the channels are designed to convey during flood

[4] https://www.fisheries.noaa.gov/s3/2025-01/sjrrp-2025-spring-run-tech-memo.pdf

[5] https://restoresjr.net/wp-content/uploads/2026/01/Channel-Capacity-Report_2026_Final_508.pdf

events. Channel capacities in 2025 remained unchanged from 2024 and are summarized in Table 1. Table 1 of the CCR is shown below.

Table 1.
2026 Then-existing Channel Capacity

Reach	Then-existing Channel Capacity (cfs)[1]	Method Used to Determine Then-existing Channel Capacity
Reach 2A	6,000[2]	Geotechnical Assessment
Reach 2B	1,210	In-channel
Reach 3	2,860[3]	In-channel
Reach 4A	2,840	Geotechnical Assessment and In-channel
Reach 4B1	Not Analyzed	--
Reach 4B2	4,300	Geotechnical Assessment
Reach 5	2,350	In-channel
Middle Eastside Bypass	2,600	Geotechnical Assessment
Lower Eastside Bypass	2,890	In-channel
Mariposa Bypass	1,800	Geotechnical Assessment

1 Then-existing channel capacity shown in this table is based on levee stability only and does not consider Restoration Flow limitations related to agricultural seepage.
2 Capacity not assessed for flows greater than 6,000 cfs. Restoration Flows are limited due to agricultural seepage with Reach 2A thresholds being updated in Appendix H of the SMP and published in 2024.
3 Reach 3 flows are limited to approximately 895 cfs due to agricultural seepage.

Table 1. 2025 Then-existing Channel Capacity, showing In-channel (typically seepage) and Geotechnical Assessment (typically levee issues) flow limitations for Restoration Flows.

4 Progress toward Achieving Settlement Paragraph 11, 13, and 14 Requirements during 2025

This Section provides an overview of progress in 2025 towards meeting Paragraph 11, 13, and 14 requirements of the Settlement.

<u>Paragraph 11 – Channel Improvements</u>

- The NMFWS Biological Opinion for the Arroyo Canal/Sack Dam project was issued in March of 2025, authorizing construction of the Project with various conditions.
- The construction solicitation for the “Arroyo Canal Fish Screen and Sack Dam Bypass Project” was released in late 2024, and a contractor was announced in July of 2025. Site work consisting of clearing & grubbing commenced in October, and cofferdams around the first phase work site were installed in early November.

- A flow and operations protocol for the Arroyo/Sack Dam complex has yet to be negotiated between Reclamation and Henry Miller Reclamation District #2131 (HMRD), owner of the Arroyo/Sack Dam complex. Apparently, an MOU outlining principles for interim operations is in discussion or nearly completed between Reclamation and HMRD.

- The approach to commissioning and maintenance of the facilities at the Arroyo/Sack Dam complex have not been finalized.

- The Program has outlined concepts for phased implementation of the Reach 2B/Compact Bypass projects, the large suite of projects conceived to address the requirements of Paragraph 11(a)(1) and 11(a)(2) in the Settlement. As of December of 2025 and into early 2026, the schedule for implementation of the initial phases (1A, 1B and 2) of the Reach 2B Projects was uncertain:

    - Design review of the fish ladder associated with the 1A construction (Compact Bypass) resulted in the need for some redesign, with unknown schedule implications of 6 months to a year or more delay.

    - Substantial Federal staffing cutbacks in early 2026 have severely reduced staffing at the Reclamations California-Great Basin regional offices, in the SJRRP, and in Reclamation's Technical Service Center (TSC) design group.

    - Additional funding for Phase 1B to replace Aging Infrastructure under the Infrastructure Investment and Jobs Act is not likely to be forthcoming.

    - Implementation of Phases 1A and 1B, originally envisioned for 2027 and 2028, are now further delayed.

Paragraph 13 – Restoration Flows

The final Runoff Forecast for Water Year 2025 based on the 50% exceedance forecast was released on May 18, 2025, and was 1,346 TAF. The corresponding Restoration Flow Allocation for Restoration Year (RY) 2025 (March 1, 2025 – February 28, 2026) was 269.355 TAF as measured at Gravelly Ford (GRF) based on the 50% exceedance forecast. The Allocation also specified certain contractual and operational constraints on Restoration Flow releases for 2025.

The final Restoration Flow release limitation accounting for 2025 was:

Year	Year Type	Final Restorati on Allocation (TAF)	URFs Removed from Allocation (TAF)	URF Exchange Returns (TAF)	Buffer Flows Utilized (TAF)	Restorati on Flows Passing Gravelly Ford (TAF) [A7]	Restorati on Allocation Utilization (TAF)	Ending Balance (TAF)
2025	Normal-Dry	269.355	87.696	0	0	182.245	269.941	-0.495

The Program completed realty actions to relieve seepage constraints in Reach 3 and 4 of the Restoration Area. New limits of 900 cfs (all sources, Restoration Flows and consumptive deliveries) in Reach 3, and 700+ cfs in Reach 4 are substantial and welcome improvements for Restoration Flow releases and aquatic resources. Unfortunately, any additional substantial realty actions to further relieve seepage constraints are likely many years in the future, after completion of the Arroyo/Sack Dam complex, and Phases 1A, 1B and 2 of the 2B/Compact Bypass projects.

The RA monitors river flows and coordinates closely with the SJRRP's Flow Coordinator to ensure Flow Recommendations are followed closely. Additional progress on Paragraph 13 requirements included:

- In collaboration with Friant Water Authority and Reclamation, the RA and TAC continued their engagement with the California Department of Water Resources' (DWR) management of the Sustainable Groundwater Management Act (SGMA) as well Groundwater Sustainability Agencies (GSAs) adjacent to the San Joaquin River who were required to develop more technically sound SGMA stream depletion management criteria through an analysis of interconnected surface water and groundwater (ISWs). Specific tasks completed in 2025 and that will be continued in 2026 included:

  a) Reviewing updates to Groundwater Sustainability Plans (GSPs) from GSAs that border the San Joaquin River.

  b) Engagement in the assessment of ISWs by the six GSAs in the Kings and Madera subbasins. DWR required the SJR-adjacent Kings GSAs to engage with the Program on an analysis of ISWs prior to developing sustainable management criteria for the depletion of ISWs. The GSAs entered into a collaboration and information sharing Memorandum of Understanding (MOU) in early 2025 with the Bureau of Reclamation, Friant Water Authority, and the RA. Technical and Policy meetings occurred throughout 2025. The MOU participants are generally awaiting the publishing of ISW analysis guidance by the State prior to undertaking more detailed analysis.

Paragraph 14 – Reintroduction of Salmonids

Pending completion of the Paragraph 11 modifications, the Program is undertaking interim measures to continue the process of salmon reintroduction, build fish stocks, and to continue to collect valuable monitoring data to further inform future management actions. Specifically, in 2025:

- There was anticipation that the seasonal return of San Joaquin River origin spring-run Chinook Salmon might be higher than the past several years, due to the combination of a wet year and extended flood flow releases in January through June of 2023, and closure of the ocean salmon fishery for the past three years. Assisted adult CV spring-run Chinook salmon migration (trap & haul) from Reach 5 to Reach 1 was implemented from mid-March 2025 to June 5, 2025. In total, 448 adult spring-run Chinook salmon were captured, and 394 were tagged, and released in Reach 1A. This was the largest single-year return since the inception of the SJRRP[6].
- During the same time period, an unknown number of spring-run Chinook salmon returned to the Tuolumne River. In 2025, there was no formal counting system in place to assess precise dates and numbers of returning fish (this has been rectified for 2026); however multiple drone surveys conducted in May 2025 identified as many as 1,100 fish schooling in the Upper Tuolumne River below LaGrange Dam. Subsequent genetic analysis demonstrated that most of these fish were born in the iSCARF, released in the Restoration Area in 2022 or 2023, successfully moved to the ocean to mature, and returned.
- The SCARF opened for commissioning and early operations in 2025. The path to operations for this facility has been long and tortured, with design and permitting in 2012, followed by bid and contracting, partial construction, failures by the contractor, pause in construction, redesign and securing additional funding, re-bidding and eventually completed construction. The SCARF is still not fully functional, as the water supply for the facility can only deliver a portion of the design flow. However, the SCARF is able to produce 25 to 35% of its design production of juveniles and is currently producing and releasing fish to the San Joaquin River.
- The Program completed several Young-of-Year and Juvenile Spring-run Chinook salmon releases into Reaches 1 and 5, as well as the release of mature fish into Reach 1. The details of those releases are best documented in the *NMFS "2026 Technical Memorandum Regarding the Accounting of San Joaquin River Spring-run Chinook Salmon at the Central Valley Project and State Water Project Sacramento-San Joaquin Delta Fish Collection Facilities"*[7]. Many of the juvenile fish successfully migrated downstream to and through the Sacramento/San Joaquin Delta, as evidenced by capture of some of the released fish at various monitoring locations in the Delta.

---

[6] https://restoresjr.net/story/record-breaker-salmon-return-in-droves-for-2025/

[7] https://www.fisheries.noaa.gov/s3/2025-01/sjrrp-2025-spring-run-tech-memo.pdf

- Juvenile Young-of-Year spring-run Chinook Salmon Releases - From February – May 2025, three groups of juvenile spring-run Chinook salmon were released to the San Joaquin River. Two groups totaling 146,609 were released in Reaches 4 or 5 for movement out to the ocean. An additional 14,000 were released in Reach 1 as rotary screw trap efficiency test fish. All juveniles had coded wire tags and adipose fin clips. A total of 1,897 of the juveniles were subsequently observed at the Central Valley Project (CVP) or State Water Project (SWP) San Joaquin Delta Fish Collection Facilities.
- Yearling Releases – in December 2024, a total of 5,201 yearling spring-run Chinook salmon were released into Reach 1 of the San Joaquin River[7]; 16 were observed at the Central Valley Project (CVP) or State Water Project (SWP) San Joaquin Delta Fish Collection Facilities.
- Trap and haul of adult fall-run Chinook salmon did not occur in fall 2024 and the beginning of 2025 nor in the fall of 2025, and the Hills Ferry Barrier was in place to encourage fall-run Chinook salmon migration into the Merced River and prevent upstream migration into the Restoration Area.

5 Program Challenges and Recommendations

The biggest challenges facing the program in 2025 included staffing, funding, and the very continuation of the Program beyond 2026.

5.1 Federal Government Staffing and Funding Challenges

In 2025, Federal Executive Branch changes and executive orders had a substantial impact on Program staffing. Federal staff numbers were reduced across Reclamation's Great Basin Region, including both the South-Central California Area Office (SCCAO) and the SJRRP office. NMFS and United States Fish and Wildlife Service staff assigned to support the Program also experienced cutbacks.

Program staff numbers have been cut by about 50%, and overall regional staffing numbers by a similar amount. TSC, responsible for design of forthcoming projects such as the Reach 2B Compact Bypass, has also seen substantial staff reductions due to retirements.

It is anticipated that immediate impacts will be a substantial and potentially severe slow-down in the pace of progress on Program implementation, potentially more challenges in coordinating river and reservoir operations, more delays in Paragraph 11 project implementation, and reduced quantity and quality of data available to the Program for Paragraph 11 project design and Restoration Flow operations. The full impact of these cutbacks is not fully known yet and will be addressed further in the 2026 Annual Report.

It is beyond the purview of the Restoration Administrator to recommend staffing levels for the Federal government. However, the Non-Federal Settling Parties should take note of

Reclamation's staffing challenges, and Reclamation's continued ability to implement the Program, in future discussions with Reclamation about the SJRRP.

5.2 Program Funding Challenges

It is unclear where future budgets for Reclamation will be, given the goal of 'downsizing' the federal government, and how the current administration will prioritize funding obligations for the Program. It appears that the SJRRP budget for the next fiscal year (FY 2027) will be consistent with the past few years - sufficient for ongoing operations but without major funding for capital projects.

In addition, it appears that the State budget for operations of the SCARF in 2027 and construction of the East Side Bypass Rock Ramp are included in the state FY2027 budget.

Although 2027 is funded, long-term, secure funding sources for implementation of the next phases of SJRRP projects and long-term continued operations of the SCARF are not secured. It is beyond the purview of the Restoration Administrator to recommend State and Federal budget levels. However, the Non-Federal Settling Parties should take note of State and Reclamation budgets as they apply to discussions around implementation of the SJRRP.

5.3 MOU with the State of California

The SJRRP parties have a Memorandum of Understanding (MOU) with the State of California[8] executed in September of 2006 in which the State commits to assist with the implementation of the SJRRP and provide both in-kind and direct funding up to certain levels. The MOU expires on December 31, 2026, and should be renewed to secure future State support and funding for the Program. Per the Program, a new draft of the MOU is being considered by the Federal and State parties. In addition to a general extension, it is recommended that the MOU include more specific commitments by the State to directly align with the objectives of the SJRRP in the next decade[9]:

1. Funding of the SCARF operations: the 2027 budget includes funding for the first few years of SCARF operations; however, ***bringing the SCARF up to full operational capacity should be a priority, and funding for SCARF operations should be made permanent.***
2. Funding for the Eastside Bypass Control Structure Rock Ramp: the State's 2027 budget includes funding for construction of the rock ramp. ***Completion of the Rock Ramp by early 2029 should be achieved, or the Eastside Bypass will be a barrier to fisheries migration after the completion of the Sack Dam bypass upstream.***
3. Investigate and resolve fish passage at the Chowchilla Bifurcation Structure: DWR is investigating passage solutions for the river side of the Chowchilla Bifurcation

[8] https://restoresjr.net/2816___mou-final-as-filed-091306/

[9] See Appendix F. "Projects and Improvements in Furtherance of the Restoration Goal" for context on these specific recommendations for the State MOU.

Structure. DWR appears to have funding to select a preferred design, and proceed to perhaps 20 – 35% design. ***Funding for additional design, and for implementation of the first phase of the project should be furnished by the State in the next 5 years***, or there is a real risk that the Chowchilla Bifurcation Structure will be a barrier to fish passage after Reclamation completes the Reach 2B projects.

4. <u>Resolve the rubble weir in Reach 4,</u> which is currently a passage barrier for several months of the year at some flow levels (*this is mentioned in concept in the Settlement at Para. 11(a), but not mentioned specifically and has not received priority to resolve and is not currently on a path to implementation).* Either Reclamation or DWR could take the lead on this project; however, ***failure to remedy this minor barrier could result in a fish passage barrier that undermines hundreds of millions of dollars of Reclamation fish passage improvements upstream.***
5. <u>Resolve fish passage barriers in the Eastside Bypass:</u> During flood flows, most if not all juvenile and adult salmonids will move through the Restoration Area via the flood bypass system. Drop Structure #2, and the highly eroded road crossings at Roads 18 ½ and 21 in the Eastside Bypass, are all likely partial fish passage barriers (passage barriers at some flood flows) to upstream migration. Although not mentioned in the Settlement, the Bypass floodway will convey major quantities of water, and fish, during all future operations of the SJRRP. Since the floodway can activate in 20% or more of all water years, resolving passage in this corridor is crucial for the success of the Restoration Goal. ***DWR is the logical entity to modify these barriers that are located in the floodway; funding should be secured for completing those relatively modest modifications in the next 5 to 10 years.***

5.4 Possible Revision of the Settlement

The Settlement was executed in 2006, and includes a "reopener" clause that allows for petitioning for material changes to the Restoration Flows after December 31, 2025. The Non-Federal Settling Parties and Reclamation were in discussions in 2025 for possible revision of key provisions of the Settlement. Reportedly, those discussions were successful and a revision of some terms of the Settlement will be filed with the Court. No other details are publicly available at this time.

The RA and TAC roles are described in the Settlement and those positions sunset in 2026. The Non-Federal Settling Parties and Reclamation will need to agree to the extension of those roles beyond 2026. The funding source for the RA and TAC is currently a grant from the DWR, which sunsets in mid-2027. The TAC is funded sufficiently to carry on tasks until the end of 2026 or beginning of 2027 and will then run out of funding. The RA is funded sufficiently to continue working into 2027. In 2027, the RA will produce the spring Restoration Flow recommendations, produce the 2026 Annual Report, and produce a final report as required by the Grant agreement. There is currently no funding plan secured for the RA and TAC beyond early to mid-2027.

5.5 Projects and Improvements in Furtherance of the Restoration Goal

The Settlement includes a number of specific improvements to be completed by Reclamation (Paragraph 11A, 11B, and 12 of the Settlement). Since the execution of this Settlement in 2006 and the passage of the Settlement Act in 2009, more than 15 years of implementation, monitoring, experimentation, and testing has provided general validation of the concepts for implementation of the Settlement. However, in a number of instances, it would appear that alternative priorities than what are laid out in the Settlement could improve success in achieving the Restoration Goal.

Specifically, Appendix F to this report includes the Restoration Administrator's suggestions on projects and improvements that could improve success in achieving the Restoration Goal. Many of these suggestions are simply modifications, or changes in priority, for projects that are already specified in the Settlement. A handful of suggestions include projects that were not included in the Settlement, but the implementation of which will be important, if not crucial, to the successful achievement of the Restoration Goal.

5.6 Continuing Challenges, as identified in Previous Annual Reports

In Annual Reports going back several years, a number of key challenges continue to persist s:

From the 2014 RA Annual Report, Stakeholder Challenges:

Reclamation staff spends tremendous time and resources interacting with stakeholders, across almost all facets of the Program. The Restoration Program is essentially a public program (implemented by state and federal agencies), that will impact thousands of square miles, hundreds of thousands of people, and will have substantial economic implications for affected stakeholders. It is not clear that the original Settlement Agreement envisioned the level of resources that would be necessary to fully integrate a wide diversity of stakeholders into almost every single Program decision.

It is not clear that the original Settlement Agreement, nor early year Program scheduling and budgeting efforts grasped the true extent of stakeholder involvement, and the extensive resources that would need to be dedicated to that stakeholder involvement as the project transitioned from early planning phases to implementation phases. It is possible that stakeholder scrutiny, and required stakeholder interaction, could continue to increase as the Program enters into large-scale construction projects.

From the 2015 RA Annual Report, Seepage Impacts:

The Program will need to procure, mitigate, or secure thousands of acres of land in fee, via easement, or as some sort of mitigation. Mitigation for seepage impacts (up to 20,000 + acres assessed, easement procured and/or otherwise mitigated), land for construction (10,000 acres plus, depending on alignments, in fee or for construction access), and land for mitigation (potentially several thousand acres for agricultural lands preservation and giant garter snake habitat mitigation). In total, land payments to secure fee title, easements, or to address mitigation obligations will total hundreds of millions of dollars. The federal process for valuing and securing land or easements is exacting and slow; the vast area to be addressed in some way by the Program will make this a formidable challenge for the duration of the Program.

From the 2017 RA Annual Report, Schedule and Budget Concerns:

Implementation of the Funding Constrained Framework within the budget and schedule agreed to by the Settling Parties and stakeholders will require relentless focus on schedule and budget efficiency by the Program, as well as anticipation of challenges, continuous marshalling of support from elected officials as well as other departments within Reclamation, and constant communications with a bevy of stakeholders.

Also from the 2017 RA Annual Report, Program Staff Levels:

Program staff attrition is a constant challenge. The Program attracts highly capable staff and is a highly challenging work assignment. For a variety of reasons (moving on, and usually up) Program staff have ample opportunities to find other positions. The Program does not particularly plan for vacancies (e.g. all key staff find, recruit and train their prime lieutenant); thus, turnover of key staff is always a disruption to progress of the Program.

From the 2023 RA Annual Report, *Third Party Impacts*:

The Settlement parties recognized that federal authorization was required for several aspects of Settlement implementation and worked with congressional delegations to craft the "San Joaquin River Restoration Settlement Act". The Act directed the Secretary of the Interior to design and construct facilities and to acquire property as described in the Settlement and also authorized funds to be appropriated for implementation. Importantly, though, the Act also addressed concerns from various stakeholders about impacts of the Settlement (characterized as "third party impacts").

During Congressional hearings while considering the Act, several stakeholders who were not party to the Settlement voiced concerns about potential impacts. As a result, the Act contains several provisions intended to safeguard the interests of these stakeholders, including:

a) Requiring reintroduction of Spring-Run Chinook pursuant to Section 10(j) of the Endangered Species Act;
b) Avoiding any material adverse impacts to third parties from groundwater seepage from interim flows;
c) Avoiding any impact on contract water allocations for CVP long-term contractors other than the Friant Division contractors, and
d) Mitigating impacts (of implementation of the Settlement) on adjacent and downstream water users and landowners (third parties).

The Act was signed into law in 2009; however, the 2006 Settlement was not revisited to accommodate the additional obligations that Congress had placed upon the Program. In addition to design, compliance with state and federal environmental requirements, land acquisition and water rights proceedings that would be expected to underpin Settlement implementation, the Act also required a 10(j) designation, consultation with virtually any stakeholder who might seek to claim a third-party impact, and a substantially protracted implementation schedule as a result. Reclamation has adopted a very cautious approach to identifying potential third-party impacts and has sought to mitigate those potential impacts in advance, rather than identifying impacts during the course of implementation and then working to mitigate as needed. As will be described in more detail below, this cautious approach has resulted in substantial delay and increased cost in implementing Paragraph 11 and 13 actions in the Settlement. Reclamation did not seek eminent *domain for required real estate until more than 15 years after the Settlement was executed, choosing instead to enter lengthy purchase or easement negotiations for most parcels acquired. In particular, extensive measures to avoid any seepage impacts whatsoever to landowners near or adjacent to the river (despite those same parcels suffering greater seepage or inundation impacts from repeated flood control release occasions), has severely limited the ability to release Restoration Flows.*

Many of the potential third party impacts were identified during the hearings on the Settlement[10]*, or in a subsequent Congressional Research Services report*[11] *at CRS 17-18 A list of potential third-party concerns regarding implementation of the Settlement identified during the hearing included:*

- *potential flooding and loss of crops and property in areas without adequate river channels;*
- *possible operational constraints related to the protection of reintroduced salmon under the Endangered Species Act (ESA; 16 U.S.C. §§ 1531-1543);*
- *potential impacts on existing salmon populations in San Joaquin tributaries and associated water uses;*
- *potential effects on surface and groundwater supplies, and water rights; and*
- *adequate program funding for Settlement implementation and other non-San Joaquin restoration projects (e.g., Trinity River restoration).*

Most of these anticipated impacts either never occurred, or were mitigated (for example, avoiding ESA impacts to third parties by designation of reintroduced spring-run Chinook salmon as a Nonessential Experimental Population). There were some potentially substantive impacts that Reclamation worked diligently to avoid or mitigate; however, more recently various relatively trivial operational details and design decisions are being elevated to the level of third-party impacts (e.g., who has control of a particular gate or level setting, even for facilities owned by Reclamation). This raises concern about stakeholders maneuvering to either ensure implementation of the Program to the benefit of specific stakeholders, or to extract financial or other concessions from the Program.

Unless Reclamation can develop a more refined and narrow definition of "third party impacts", or unless Congress can update the Settlement Act to reflect current circumstances, the delays precipitated by the Settlement Act will continue.

From the 2024 RA Annual Report, Reservoir Spills During Average Hydrology Conditions:

Spring runoff reservoir operations planning needs to be cognizant of Restoration Flow needs and cold pool management. Prior to the impacts. Pre-Settlement, Millerton Reservoir could be managed aggressively (run high, close to the flood pool) and simply spilled if and when the flood pool was encroached. However, since most flood control releases must be made from the low-level outlets (unless the reservoir is full enough to have water on the spill gates, which only occurs

[10] *Oversight Hearing on The San Joaquin River Restoration Settlement Act,* before the Water and Power Subcommittee of the Committee on Resources, U.S. House of Representatives, (Sept. 21, 2006).

[11] https://www.everycrsreport.com/files/20071109_RL34237_420ea9fd41b580b48b39a329d283351ba7203b9a.pdf

late in the spring runoff cycle), "forced" spill due to running the reservoir high in the spring will cause impacts to Restoration Flows as described below in this Report.

Additional specifics around operations that lead to these conditions are included in the 2024 Annual Report. Address potential improvements in spring runoff reservoir operations in the Restoration Flow Guidelines Group, with the goal of identifying coordination protocols, operating rules, or other mechanisms to reduce risk of reservoir operations impacting Friant Division contractor water supply or Restoration Flows.

6 Specific RA and TAC Activities Completed During 2025

The RA and TAC completed a variety of tasks during 2025 to support and contribute to Program implementation efforts as required by the Settlement. In addition to specific tasks assigned by the Settlement, the RA and TAC have broad latitude pursuant to the Settlement to consult with State and Federal representatives "on matters including, but not limited to, pre-permitting and pre-ESA consultation activities, sharing of information, and technical assistance during initial project development, planning, design, and implementation phases, and monitoring."[12] The following summarizes major RA and TAC activities conducted in 2025:

- The RA provided Restoration Flow Recommendations (Recommendations) throughout 2025, including coordination with Reclamation for the management of the Unreleased Restoration Flows (URF's).
- In support of the Recommendations, flow and river condition monitoring by the RA, TAC members, and Program staff was nearly continuous. Additionally, one or two weekly flow and operations coordination calls hosted by the Program were attended by the RA and one or more TAC members. Additional meetings, calls, discussions, and flow scenario evaluations (including extensive flow and temperature modeling efforts) were undertaken by the RA and TAC to evaluate potential release scenarios in advance of each recommendation, particularly in January (first Recommendation), and in April and May (during the critical management of Millerton Lake).
- RA and TAC members worked on several water temperature monitoring, analysis, or modeling efforts, particularly revisiting, updating and improving the CE-QUAL Millerton Lake water temperature modeling tool.
- The RA and TAC continued to work on initiatives to improve understanding of flow losses, diversions, flow accretions, gauging and accounting of flows on the San Joaquin River, including Restoration Flows.
- The RA and TAC closely tracked the biological monitoring conducted by Program staff, including the release of adult spring-run Chinook salmon in Reach 1A

[12] Stipulation of Settlement, Exhibit D Paragraph C.9

downstream of Friant Dam, redd monitoring and rotary screw trapping efforts, and other data collection activities.

- The RA and TAC reviewed Program monitoring data and discussed the results of the field monitoring studies with the Implementing Agencies. In particular, the RA and TAC tracked flow, water temperature, and salmonid movement/migration data to inform current and future flow release decisions.
- The RA and the TAC were involved in numerous meetings and discussions regarding various Program initiatives, including:
  - Arroyo Canal/Sack Dam improvements and construction planning;
  - Reach 2B/Compact Bypass phasing and design work, including review and comments on the proposed construction sequence for the Compact Bypass facilities;
  - Monitoring seepage well status with regards to permissible Restoration Flows;
  - Input on fishery monitoring activities in response to flow release operations;
  - Weekly flow management conference calls; and,
  - Participation in the Upper San Joaquin Watershed Forecasting Discussion group.
- The RA and individual members of the TAC organized and led the following initiatives working with the Program, non-Federal Settling Parties, and Implementing Agencies:
  - Various field trips to the San Joaquin River to observe biological study work and operations; and,
  - Coordination with Program staff and Implementing Agency staff on improved data management approaches and systems.

Monthly TAC meetings Convened by the RA: Monthly coordination calls involving TAC members were convened to address restoration issues, updates on meetings recently attended by TAC members, and general program updates. These meetings (conference calls) were useful in improving coordination among TAC members. There were no in-person TAC meetings in 2025.

RA Weekly Telephone Conferences with the Program Manager and Key Staff: The RA met via telephone weekly for an hour or more with the Program Manager and key senior Program and Implementing Agency staff throughout 2025 to discuss upcoming events, program schedule, emerging issues, coordination of efforts and other matters.

RA and TAC Member Participation in Regular Water Quality, Monitoring, and Flow Scheduling Conference Calls: The Program holds weekly conference calls involving the Implementing Agencies, Settling Parties, and RA/TAC to address water quality, flow monitoring, and flow scheduling issues. These meetings contributed to improving communication between the various Program participants on a range of flow scheduling and monitoring needs and activities.

7 Priority RA/TAC Tasks for 2026

Due to limited RA and TAC funding for 2026, the expanse of projects to be undertaken will be limited compared to some past years. The following list includes proposed 2026 RA/TAC priority tasks (including both tasks as required by the Settlement and focus areas that the RA and TAC feel are important to achieve Restoration Program goals). Given anticipated funding constraints for the RA and TAC for the next two years, the level of engagement and number of priority tasks is reduced from previous years.

Routine or Required Tasks

- Participate in December – June runoff forecasting meetings/calls.
- Develop Recommendations, which include modeling, gaming, and temperature assessment of flow scenarios, plus outreach to participants including TAC and the Program's Fish Management Work Group (FMWG) as required based on hydrologic conditions and Allocations received from Reclamation.
- Produce RA Annual Report.
- Conduct regular TAC calls.

Priority Tasks to Continue

- Continue participating in Restoration Flow Guidelines (RFG) meetings, which focus on working on the resolution of RFG issues. This will also include the Reach 3 "rules and accounting" initiative that the Program is leading.
- Support implementation of the Arroyo/Sack Dam project when opportunities are present.
- Comment on designs for Reach 2B and Compact Bypass when design updates are available from the Program.
- Continue refining and applying the CE-QUAL water temperature model for Millerton Lake.
- The RA and two TAC members will participate in the *"Millerton Lake Outflow Temperature Management and San Joaquin River Flow Connectivity Special Study"*, convened by the Friant Water Authority and funded by Reclamation. The purpose of the study is to better understand and investigate potential operations and infrastructure that could improve *both* temperature conditions for salmon while *also* improving river flow connectivity in the San Joaquin River below Millerton Lake (the SJR Restoration Area). A Small Working Group of technical experts, including the RA and TAC members, will advise FWA and the Special Study consultant team throughout the duration of the study, scheduled for May 2026 – June 2027.

Lower Priority/Defer to 2026 or beyond, depending on funding.

- Continued initiatives for the Water Rules group work.
- Update the Spring-Run Chinook Salmon Reintroduction Recommendation to incorporate lessons learned from Restoration Flow operations, juvenile and adult release and return data, water temperature monitoring results, and in light of current Program construction status, channel flow capacity, SCARF, etc.

- Lead a “Lessons Learned” process with a focus on Restoration Flows and water temperatures, and how to improve progress towards the Restoration Goal. This would include assessing or gaming alternative reservoir release options for fisheries benefits and/or preserving the Millerton Lake cold water pool.
- Participate in development of guidelines for third-party restoration or habitat projects on the San Joaquin River.
- Participate in the assessment of productivity limiting factors in the San Joaquin River.
- Complete the 2021 Dry River retrospective (waiting on FMWG for feedback and comments), possibly with additional insights from 2022 through 2025 operations.

8 2024 RA and TAC Expenditures

Table 2 summarizes calendar year 2025 expenditures as provided by National Fish and Wildlife Foundation (NFWF), the administrator of the grant that funds operations of the RA and TAC.

Table 2. Summary of RA and TAC Expenditures, 2025.

Restoration Administrator & Technical Advisory Committee Expenditures - 2025	
Organization	**2025 Expenditure Totals**
Tom Johnson	$123,811.32
Bill Luce Consulting	$7,684.30
Hanson Environmental Inc.	$1,030.00
McBain Associates/Applied River Sciences	$39,136.75
The Bay Institute / Friends of the River	$26,208.57
Trout Unlimited, Inc.	$0.00
FlowWest, LLC	$18,225.00
	$216,095.94
Restoration Administrator & Technical Advisory Committee Hours - 2025	
Organization	**2025 Hour Totals**
Tom Johnson	522.00
Bill Luce Consulting	37.00
Hanson Environmental Inc.	5.00
McBain Associates/Applied River Sciences	224.00
The Bay Institute / Friends of the River	185.50
Trout Unlimited, Inc.	0.00
FlowWest, LLC	81.00
	1054.50
NFWF Fee - 2025	$0.00
Task Order Expenditures & Hours - 2025	
Organization	
McBain Associates/Applied River Sciences	$1,625.75
Total Expenditures: RA, TAC, Task Orders, & Admin	***$217,721.69***

APPENDICIES

Appendix A: URF Revenues

Appendix B: 2024 Flow Accounting

Appendix C: History of Millerton Unimpaired Runoff

Appendix D: Final Restoration Allocations

Appendix E: 2024 Hydroclimate and Outcomes

Appendix F: Projects and Improvements in Furtherance of the Restoration Goal

Appendix A: Summary of 2013-2025 URF Volumes, Revenues, and Exchanges

Appendix E: Unreleased Restoration Flow History

Table E1. URF Distributions (TAF)

Restoration Year	Gross Volume of URF Sales to Class 1	Gross Volume of URF Sales to Class 2	Net Volume of URF Sales to Class 1	Net Volume of URF Sales to Class 2	Gross Volume of URF put into Exchanges	Net Volume of URF put into Exchanges	Gross Volume of URFs Spilled	Gross Total URF
2013	—	—	—	—	12.694	12.694	—	12.694
2014	11.219	—	11.219	—	—	—	0.206	11.425
2015	—	—	—	—	—	—	—	0
2016	70.860	56.959	67.317	54.111	18.947	18.000	—	146.766
2017	5.474	364.967	5.200	346.716	2.491	2.366	—	372.932
2018	65.249	40.000	61.986	38.000	19.543	18.565	—	124.792
2019	—	326.954	—	310.607	16.298	15.482	22.509	365.761
2020	43.500	—	41.325	—	20.002	19.697	—	63.502
2021	—	—	—	—	—	—	—	0
2022	75.178	—	71.419	—	26.951	25.603	—	102.128
2023	—	372.048	—	353.446	—	—	—	372.049
2024	—	150.474	—	142.950	—	—	—	150.474
2025	42.100	37.894	39.995	35.999	7.702	7.321	—	87.696
2026	—	—	—	—	—	—	—	—
Total	**313.58**	**1349.296**	**298.461**	**1281.829**	**124.628**	**119.728**	**22.715**	**1810.219**

2026: URF actions are not completed for this year

Table E2. Expected URF Revenue for the Restoration Fund

Restoration Year	Revenue Expected from URF Sales	Revenue Expected from URF Exchanges	Total Expected URF Revenue
2013	—	—	—
2014	$3,470,650	—	$3,470,650
2015	—	—	—
2016	$9,686,790	—	$9,686,790
2017	$6,990,680	—	$6,990,680
2018	$6,123,858	$494,504	$6,618,362
2019	$6,393,286	$306,680	$6,699,966
2020	$8,922,481	$1,251,630	$10,174,111
2021	—	$525,000	$525,000
2022	$13,488,907	$1,909,267	$15,398,173
2023	$8,129,258	—	$8,129,258
2024	$3,287,850	$188,870	$3,476,720
2025	$7,103,145	—	$7,103,145
2026	—	—	—
Total	**$73,596,905**	**$4,675,951**	**$78,272,855**

Table E3. URF Exchanges Returned to the Program

Restoration Year	Volume Returned (TAF)	Notes
2013	0	—
2014	11.425	From 2013 URF Exchange with FID, used for 2014 sales
2015	0	—
2016	0	—
2017	5.474	Returned from San Luis Reservoir, 5.200 net URF sold
2018	2.129	Returned from 2018 DEID exchange
2019	9.000	Returned to SLR from 2019 AEWSD and LTRID exchange, transferred to CVO for San Luis Unit supply
2020	0.487	Returned from FID from 2019 exchange
2021	10.425	Returned from multi-party 2020 exchange
2022	3.500	From 2016 URF Exchange with AEWSD
2023	10.167	3.500 AEWSD, 2.000 FID, 4.667 OCID
2024	8.700	3.500 AEWSD, 0.822 DEID, 0.378 SWID, 3.000 OCID
2025	0	—
2026	*Pending*	
Total	**61.307**	

Appendix B: Previous Year (2025) Flow Accounting

Table B1. Annual Restoration Flow Accounting and Unreleased Restoration Flows, and Holding Contracts, for the period February 2025 through February 2026. The Restoration Allocation had a year-end balance of -0.495 TAF.

<table>
<tr><th rowspan="2">Gravelly Ford 5 cfs Requirement (TAF)</th><th rowspan="2">Other Flows Passing GRF (TAF)</th><th rowspan="2">URF Sold or Exch</th><th colspan="7">Released Restoration Flow Volumes (TAF)</th></tr>
<tr><th>Continuity Flow</th><th>Spring Flexible Flow</th><th>Fall Flexible Flow</th><th>Riparian Recruitment Flow</th><th>Buffer Flow</th><th>Flexible Buffer Flow</th><th>URF Returned</th></tr>
<tr><td rowspan="5">146.210 [A1]</td><td rowspan="5">1.569</td><td rowspan="4">87.696</td><td>119.208</td><td>63.037</td><td>6.942</td><td>0</td><td>0</td><td>0</td><td rowspan="3">0</td></tr>
<tr><td colspan="4">182.245 (Base Restoration Flows)</td><td colspan="2">0 (all Buffer Flows)</td></tr>
<tr><td colspan="6">182.245 (Restoration Flows affecting Friant water supply)</td></tr>
<tr><td colspan="7">182.245 (Restoration Flows released to river)</td></tr>
<tr><td colspan="5">269.941 (Restoration Allocation used)</td><td colspan="3"></td></tr>
<tr><td colspan="2"></td><td></td><td colspan="7">355.515 (Friant Dam releases — excludes removed URFs, Restoration Flows advanced info February, and excludes contributions from tributary inflows)</td></tr>
</table>

A1. Calculations of the 5 cfs requirement are sensitive to gauge error at GRF or imprecision in Friant Dam release.

Table B2. Monthly Restoration Flow Accounting and Unreleased Restoration Flows, and Holding Contracts, for the period February 2025 through February 2026. The final Restoration Allocation was 269.355 TAF. URF Sales removed from the Allocation totaled 87.696 TAF. Additionally, Unreleased Restoration Flow exchange returns of 0 TAF were released to the San Joaquin River, and 0 TAF of Buffer Flows. A total of 0 TAF was advanced into February 2025.

Flow Period	Gravelly Ford 5 cfs Requirement (TAF)	Other Flows Passing GRF (TAF)	URF Sold or Exch	Released Restoration Flow Volumes (TAF)							Combined Released Restoration Flow
				Continuity Flow	Spring Flexible Flow	Fall Flexible Flow	Riparian Recruitment Flow	Buffer Flow	Flexible Buffer Flow	URF Returned	
Feb 1–Feb 28	–	–	–	–	0	–	–	–	–	–	0
Mar 1–Mar 31	9.471	0	0	13.527	31.375	–	–	0	–	0	44.902
Apr 1–Apr 30	11.665	0	10.527	11.901	21.834	–	–	0	–	0	33.735
May 1–May 31	13.434	0	31.573	9.927	9.828	–		0		0	19.755
Jun 1–Jun 30	12.863	0	12.632	7.585	–	–	0	0		0	7.585
Jul 1–Jul 31	13.258	0	5.812	0	–	–		0	0	0	0
Aug 1–Aug 31	14.358	0	17.153	0	–	–	–	0		0	0
Sep 1–Sep 30	13.335	0	9.999	0.833	–	0	–	0		0	0.833
Oct 1–Oct 31	15.870	0	0	12.857	–	1.220	–	0		0	12.857
Nov 1–Nov 30	12.986	0.169	0	15.225	–	1.755	–	0	0	0	15.225
Dec 1–Dec 31	11.070	0	0	18.198	–	3.967	–	0		0	18.198
Jan 1–Jan 31	10.681	0	0	15.007	–	–	–	0	–	0	15.007
Feb 1–Feb 28	7.283	1.400	0	14.148	–	–	–	0	–	0	14.148

Appendix C: 1873-2025 History of Millerton Unimpaired Runoff

Appendix C: History of Millerton Unimpaired Runoff

Table C. Water Year Totals in Thousand Acre-Feet

Water Year [A2]	Unimpaired Runoff [A3]	SJRRP Water Year Type [A4]
1873	1063.6	Normal-Dry
1874	1743.0	Normal-Wet
1875	837.0	Dry
1876	2493.0	Normal-Wet
1877	758.0	Dry
1888	2218.0	Normal-Wet
1889	1452.2	Normal-Wet
1890	3117.0	Wet
1891	2626.5	Wet
1892	1670.4	Normal-Wet
1893	1286.7	Normal-Dry
1894	3207.8	Wet
1895	1175.5	Normal-Dry
1896	3905.0	Wet
1897	1412.0	Normal-Dry
1898	906.0	Dry
1899	1517.0	Normal-Wet
1900	1337.1	Normal-Dry
1901	2988.8	Wet
1902	1704.0	Normal-Wet
1903	1727.0	Normal-Wet
1904	2062.0	Normal-Wet
1905	1795.4	Normal-Wet
1906	4367.8	Wet
1907	3113.9	Wet
1908	1163.4	Normal-Dry
1909	2900.7	Wet
1910	2041.5	Normal-Wet
1911	3586.0	Wet
1912	1043.9	Normal-Dry
1913	879.4	Dry
1914	2883.4	Wet
1915	1966.3	Normal-Wet
1916	2760.5	Wet
1917	1936.2	Normal-Wet
1918	1466.8	Normal-Wet
1919	1297.5	Normal-Dry
1920	1322.5	Normal-Dry
1921	1604.4	Normal-Wet
1922	2355.1	Normal-Wet
1923	1654.3	Normal-Wet
1924	444.1	Critical-High
1925	1438.7	Normal-Dry
1926	1161.4	Normal-Dry
1927	2001.3	Normal-Wet
1928	1153.7	Normal-Dry
1929	862.4	Dry
1930	859.1	Dry
1931	480.2	Critical-High
1932	2047.4	Normal-Wet
1933	1111.4	Normal-Dry
1934	691.5	Dry
1935	1923.2	Normal-Wet
1936	1853.3	Normal-Wet
1937	2208.0	Normal-Wet
1938	3688.4	Wet
1939	920.8	Dry
1940	1880.6	Normal-Wet
1941	2652.5	Wet
1942	2254.0	Normal-Wet
1943	2053.7	Normal-Wet
1944	1264.4	Normal-Dry
1945	2134.633	Normal-Wet
1946	1727.115	Normal-Wet
1947	1121.564	Normal-Dry
1948	1201.390	Normal-Dry
1949	1167.008	Normal-Dry
1950	1317.457	Normal-Dry
1951	1827.254	Normal-Wet
1952	2840.854	Wet
1953	1226.830	Normal-Dry
1954	1313.993	Normal-Dry
1955	1161.161	Normal-Dry
1956	2959.812	Wet
1957	1326.573	Normal-Dry
1958	2631.392	Wet
1959	949.456	Normal-Dry
1960	826.021	Dry
1961	647.428	Critical-High
1962	1924.066	Normal-Wet
1963	1945.266	Normal-Wet
1964	922.351	Dry
1965	2271.191	Normal-Wet
1966	1298.792	Normal-Dry
1967	3233.097	Wet
1968	861.894	Dry
1969	4040.864	Wet
1970	1445.837	Normal-Dry
1971	1416.812	Normal-Dry
1972	1039.249	Normal-Dry
1973	2047.585	Normal-Wet
1974	2190.308	Normal-Wet
1975	1795.922	Normal-Wet
1976	629.234	Critical-High
1977	361.253	Critical-Low
1978	3402.805	Wet
1979	1829.988	Normal-Wet
1980	2973.169	Wet
1981	1067.757	Normal-Dry
1982	3317.171	Wet
1983	4643.090	Wet
1984	2042.750	Normal-Wet
1985	1135.975	Normal-Dry
1986	3031.600	Wet
1987	756.853	Dry
1988	862.124	Dry
1989	939.168	Normal-Dry
1990	742.824	Dry
1991	1027.209	Normal-Dry
1992	807.759	Dry
1993	2672.322	Wet
1994	824.097	Dry
1995	3876.370	Wet
1996	2200.707	Normal-Wet
1997	2817.670	Wet
1998	3160.759	Wet
1999	1527.040	Normal-Wet
2000	1735.653	Normal-Wet
2001	1065.318	Normal-Dry
2002	1171.457	Normal-Dry
2003	1449.954	Normal-Dry
2004	1130.823	Normal-Dry
2005	2826.872	Wet
2006	3180.816	Wet
2007	684.333	Dry
2008	1116.790	Normal-Dry
2009	1455.379	Normal-Wet
2010	2028.706	Normal-Wet
2011	3304.824	Wet
2012	831.582	Dry
2013	856.626	Dry
2014	509.579	Critical-High
2015	327.410	Critical-Low
2016	1300.613	Normal-Dry
2017	4395.400	Wet
2018	1348.980	Normal-Dry
2019	2734.772	Wet
2020	886.025	Dry
2021	521.853	Critical-High
2022	1059.492	Normal-Dry
2023	4506.923	Wet
2024	1757.111	Normal-Wet
2025	1280.766	Normal-Dry

A2. Water year is from Oct 1 through Sept 30, for example the 2010 water year began Oct 1, 2009. Unimpaired Runoff is based on Reclamation calculations, and hypothetical water year types are shown here; actual Restoration water year types are based on the final allocation, which may sometimes differ slightly from the calculated water year total.

A3. Also known as "Natural River" or "Unimpaired Runoff into Millerton"–This is the total runoff that would flow into Millerton Lake if there were no dams or diversions upstream. There was a lower level of precision prior to 1945. Friant Dam uses 1.9835 conversion from cfs to AF.

A4. The six SJRRP Water Year Types are based on Unimpaired Runoff and are not updated as climatology changes as per the Settlement. Critical-Low= <400 TAF, Critical-High=400-669.999 TAF, Dry= 670-929.999 TAF, Normal-Dry 930-1,449.999, Normal-Wet 1,450-2,500, Wet>2,500.

Appendix D: 2009-2024 Final Restoration Allocations and 2014-2025 Restoration Flow Releases

Appendix D: Final Restoration Allocations and Errors

Table D1. History of Restoration Allocations

Year	Type	Date of Final Allocation Issuance [A6]	Unimpaired Runoff Forecast in Final Allocation (TAF)	Final Restoration Allocation (TAF)	Observed Unimpaired Runoff on September 30 (TAF)	Unimpaired Runoff Forecast Error	Allocation Error
2009	Interim Flows			261.5	1,455.379	—	—
2010	Interim Flows			98.2	2,028.706	—	—
2011	Interim Flows			152.4	3,304.824	—	—
2012	Interim Flows			183	831.582	—	—
2013	Interim Flows			65.5	856.626	—	—
2014	Restoration Flows	Mar 3	518	0 [A5]	509.579	+8.421 (+1.6%)	0 [A5]
2015	Restoration Flows	Sep 28	327	0	327.410	-0.410 (-0.1%)	0
2016	Restoration Flows	Sep 30	1,300.986	263.295	1,300.986	0 (0%)	0
2017	Restoration Flows	Jul 10	4,444	556.542	4,395.400	+48.600 (+1.1%)	0
2018	Restoration Flows	May 22	1,427	280.258	1,348.979	+78.021 (+5.8%)	+10.503
2019	Restoration Flows	May 20	2,690	556.542	2,734.772	-44.772 (-1.6%)	0
2020	Restoration Flows	June 19	880	202.197	886.025	-6.025 (-0.7%)	-1.345
2021	Restoration Flows	June 25	529	70.919	521.853	+7.147 (+1.4%)	0
2022	Restoration Flows	May 13	1,072	232.470	1,059.492	+12.508 (+1.2%)	+1.684
2023	Restoration Flows	May 18	4,664	557.038	4,506.923	+157.077 (+3.5%)	0
2024	Restoration Flows	May 17	1,776	329.026	1,757.111	+18.889 (+1.1%)	+2.646
2025	Restoration Flows	May 18	1,346	269.355	1280.766	+65.234 (+5.1%)	+8.602

A5. No water was provided under this Critical-High designation due to necessity for Friant Dam to release flows for the Exchange Contract.

A6. In 2018 with the completion of Version 2.0 of the Restoration Flows Guidelines, the date of final Restoration Allocation issuance was advanced from September 30 to May (or June under dry hydrologic conditions). This results in greater Unimpaired Runoff Forecast error, and sometimes in greater Allocation Error.

Table D2. History of Restoration Flow Releases

Year	Year Type	Final Restoration Allocation (TAF)	URFs Removed from Allocation (TAF)	URF Exchange Returns (TAF)	Buffer Flows Utilized (TAF)	Restoration Flows Passing Gravelly Ford (TAF) [A7]	Restoration Allocation Utilization (TAF)	Release Error (TAF)
2014	Critical-High	0	0	0	0	0	0	0
2015	Critical-Low	0	0	0	0	0	0	0
2016	Normal-Dry	263.295	*pending*	*pending*	*pending*	*pending*	*pending*	*pending*
2017	Wet	556.542	367.458	0	0	*pending*	*pending*	*pending*
2018	Normal-Dry	280.258	124.791	2.129	0	157.596	280.258	0
2019	Wet	556.542	365.760	0	0	190.666	556.426	-0.116
2020	Dry	202.197	63.502	0.487	0.605	139.517	201.927	-0.270
2021	Critical-High	70.919	0	10.425	0.902	82.247	70.919	0
2022	Normal-Dry	232.470	101.076	3.500	0	135.094	232.670	+0.200
2023	Wet	557.038	373.944	10.167	0	193.263	557.040	+0.002
2024	Normal-Wet	329.026	150.473	8.700	4.447	191.542	328.868	-0.158
2025	Normal-Dry	269.355	87.696	0	0	*pending*	*pending*	*pending*

A7. Restoration Flows passing Gravelly Ford includes flood management releases which were accounted for as meeting the Restoration Flow Schedule at Gravelly Ford.

Appendix E: 2025 Restoration Allocation History, Hydroclimate, Forecasting Challenges, and Millerton Storage and Operations

This Appendix documents the Restoration Allocation History in 2025 and provides additional detail on the 2025 water year (October 2024 through September 2025) hydroclimate and the resulting challenges in forecasting runoff.[13] Additionally it provides an overview of Millerton Lake reservoir operations.[14]

Restoration Allocation History

The progression of the Restoration Allocation from the initial allocation on January 22, 2025, to the final allocation on May 18, 2025, is shown in Table 1. The methods and data used to develop the forecasts and allocations are described in the Restoration Allocations that the Program issued on the dates shown in in Table 1. The Restoration Flow Guidelines Version 2.1 provide guidance for the development of the Forecasts and Restoration Allocation.

Table 1: 2025 Restoration flow allocation history

Allocation Type	Issue Date	Forecast Blending Applied	Unimpaired Runoff Forecast (at forecast exceedance)	Year Type	Restoration Allocation at Gravelly Ford	Restoration Flows and URFs Released
Initial	January 22, 2025	10/90	727 TAF (@ 75%)	Dry	168.055 TAF	0 TAF (through 1/21/2025)
Updated	February 14, 2025	40/60	1,049 TAF (@ 75%)	Normal-Dry	229.374 TAF	0 TAF (through 2/14/2025)
Updated	March 17, 2025	50/50 (-50 / -75 / -100 / -125 / -150)	1,191 TAF (@ 75%)	Normal-Dry	248.489 TAF	21.610 TAF (through 3/16/2025)
Updated	April 14, 2025	10/90 (-20 / -40 / -60 / -80 / -120)	1,367 TAF (@ 50%)	Normal-Dry	272.182 TAF	64.596 TAF (through 4/14/2025)
Final	May 18, 2025	60/40 (-35 / -40 / -45 / -45 / -45)	1,346 TAF (@ 50%)	Normal-Dry	269.355 TAF	88.201 TAF (through 5/16/2025)

[13] Table 1, Figure 1, and hydroclimate and forecasting key points are derived from San Joaquin River Restoration Program (Program) and Millerton Joint Forecasting Team documents.

[14] Figure 2 is from the US Army Corps of Engineers https://www.spk-wc.usace.army.mil/plots/california.html?name=frt&year=2025&interval=d&tab=plot&window=wy&gl=true

Hydroclimate

The 2025 water year (October 2024 through September 2025) unimpaired runoff inflow to Millerton Lake of 1,281 thousand acre-feet (TAF) was 70% of average. This 2025 Normal-Dry Restoration year (the 2025 Restoration Year is March 2025 through February 2026, although Allocations commence in January 2025) followed the 2024 Normal-Wet Restoration year (SJR runoff 96% of average).

The San Joaquin River watershed above Friant Dam received 84% of average precipitation in 2025. Weak La Niña conditions turned neutral by April. The only wetter-than-average months in the winter season were November, February, and March.

The 2025 hydroclimate–precipitation, snow accumulation and depletion, temperature, and resulting runoff—had the following notable characteristics.

- Two-thirds of total precipitation fell in February and March
- Temperatures were average and the snowline of about 7,000' was higher than in recent years
- A dozen Atmospheric Rivers (AR) hit the Upper San Joaquin River out of 50 that made landfall on the U.S. west coast. A Category 3 AR caused a February 13 peak unimpaired flow of 10,000 cfs
- Peak Snow Water Equivalent (SWE) of about 1 MAF occurred on March 18
- Peak unimpaired snowmelt runoff of 9,100 cfs occurred on May 11

Runoff Forecasting

Figure 1 plots the seasonal progression of the forecasts of the unimpaired runoff at Millerton Lake issued by California Department of Water Resources (DWR) and the National Weather Service (NWS) via the California Nevada River Forecast Center (CNRFC).

Snowpack modeling and runoff forecasting characteristics in 2025:

- DWR reported several improvements in the California Cooperative Snow Surveys that occur at 26 locations in the San Joaquin Basin
- Four Airborne Snow Observatory (ASO) LiDAR surveys of the watershed occurred in 2025 (the 9th year for this survey)
- Reclamation's Water Budget Model using runoff efficiency curves, tuned over the past 8 years with ASO data, performed well after the second ASO survey (within 5%). A minimum of three ASO flights was previously thought to be needed to obtain an accurate curve. Reclamation has identified several improvements that would increase accuracy.
- Historic snow course analogs remain a useful tool.
- Effects from the 2020 Creek Fire (e.g. higher runoff efficiency) continue to wane.
- Reclamation blends the NWS and DWR forecasts and applies corrective offsets
- Reclamation conducted a retrospective analysis that showed its blending had quite good performance compared to other models, however in May it had the highest % error since beginning this effort in 2017
- Results from multiple tools and models can be compared on DWR's Snow Products Comparison Dashboard at snow.water.ca.gov.

The following were challenges in 2025:

- Four snow pillows were offline: Volcanic Knob, Agnew Pass, Chilkoot Meadow, and Devil's Postpile. Others had low data quality, limiting available data.
- Snowpack models remained divergent all winter
- Reclamation's forecasting team's offsets were always in the correct direction, but they never before had to offset so many times to compensate for DWR and CNRFC overestimates
- Snowmelt began early (late March)
- Forecasts overestimated precipitation in April and May because forecasted storms did not materialize
- Actual April-May Natural River was higher than DWR and lower than CNRFC
- Accurate monthly natural river data was crucial in May in deciding whether to initiate flood management actions

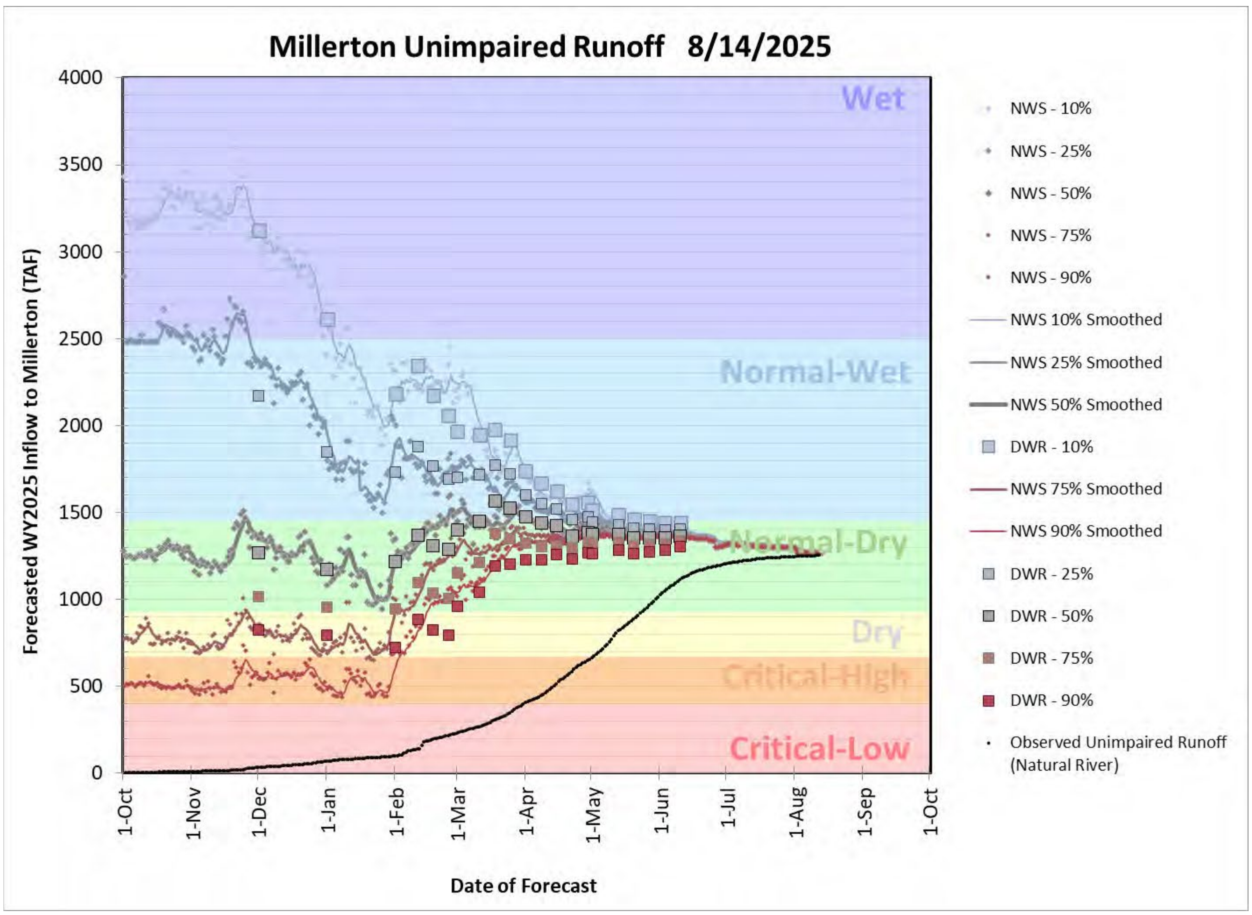


Figure 1. Plot of 2025 water year forecasts, including both NWS ensemble streamflow prediction forecasts and DWR forecasts. Reclamation's Consensus Forecast blends NWS and DWR forecasts and gives weight to emerging models and information.

Millerton Lake Reservoir Operations

Figure 2 plots (from top to bottom) the 2025 time series of:

a) Precipitation at Friant Dam.

b) Reservoir storage volume (blue line) in relation to the allowable conservation storage (top of grey shaded area). Storage was above conservation pool limits April 1-11 and May 29-June 3.

c) Inflow (green line). During snowmelt runoff, inflow peaked at 4,830 cfs on May 11. The wintertime peak was 6,020 cfs on February 15.

d) Outflow (orange line). Sum of river releases (for Holding Contracts, Restoration Flows, and flood management) and canal releases (Madera and Friant-Kern canals).

There were no flood management releases in Water Year 2025.

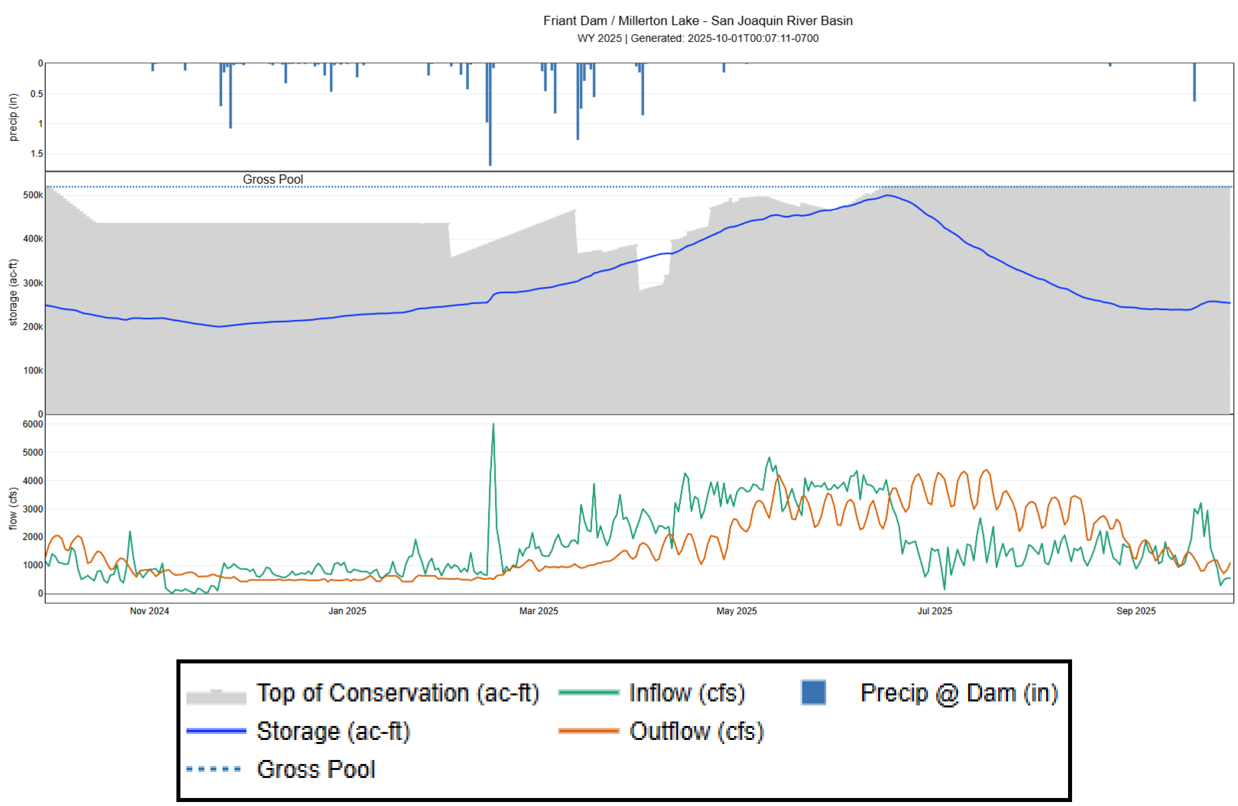


Figure 2. 2025 Water Year Millerton Lake Storage and Operations

Appendix F: Recommended Projects and Improvements in Furtherance of the Restoration Goal

Projects and Improvements in Furtherance of the Restoration Goal

The following lists represent a snapshot of projects and improvements to implement the Restoration Goal. Several projects are underway, some are concept-level only, some have not been started nor have a path forward. All suggestions are solely the recommendations of the Restoration Administrator as of June 2025.

There are several sections below:

1. Projects and improvements that are underway – recommend allowing these to proceed apace.
2. Projects and improvements that are nominally underway, but may need a different approach or an additional approach to funding
3. Projects and improvements that should be implemented to further the Restoration Goal.
4. Projects and improvements that can be postponed to a future phase of work (i.e., not as vital to the Restoration Goal).
5. Potential Secondary Projects

All projects and improvements are categorized thusly:

A. Most important/necessary/urgent: Sufficient flow, appropriate temperature, unimpeded volitional passage, full implementation of the SCARF.
B. Secondary import: Additional habitat, and better understanding of productivity drivers and limiting factors
C. Tertiary: Balance of commitments in the Settlement.

<u>It is recommended that all of the projects and improvements in Sections 1, 2 and 3 be implemented within 10 years at most.</u>

1. **Projects Improvements Underway,** allow to proceed apace (although continuous support for budgets, staff and resources is likely necessary):

   Projects Underway (in construction this fall):

   1. Sack Dam Bypass/Arroyo Canal Fish Screen – BOR in lead

   Projects Underway (Partly designed, funding likely):

   1. Compact Bypass Control Structure, fish ladder, and Compact Bypass (Phase "1A" per current BOR planning) – BOR in lead

2. **Projects Improvements Nominally Underway,** may need a different approach, or source of funding:

   Projects in Planning (Partial or Concept design, awaiting funding):

   1. Rock Ramp at Eastside Bypasa Control Structure. This has been in the works for 8 or 10 years, still a couple of years at best from construction. This needs true support from the state in the form of funding, or perhaps a stick - e.g., this will be a barrier to returning Chinook under some flow conditions within a couple of years. DWR in lead
   2. Columbia Canal Siphon & Ancillary Facilities ("Phase 1B" per current BOR planning). This project may have funding (pending costs for the Arroyo complex, potential Aging Infrastructure funding, and annual appropriations). Different options for more efficient design and implementation should be considered, such as outsourcing design or construction. BOR in lead.

3. **Projects and improvements that can be postponed to a future phase of work**

In the opinion of the Restoration Administrator, the following projects and improvements can be postponed until a future phase of work. In most instances, current progress on these elements has outstripped other components needed to achieve the Restoration Goal, and resources should be focused on 'catching up' in other areas.

Paragraph 11(a) specifies *"Modifications in channel capacity (incorporating new floodplain and related riparian habitat) to ensure conveyance of at least 4,500 cfs in Reach 2B between the Chowchilla Bifurcation Structure and the new Mendota Pool bypass channel"*. However, the current setback plan is massive in scope, will cost hundreds of millions of dollars in unidentified funding, and assumes that the State of California through DWR will commit to implementing the projects. The current Reach 2B capacity of 1,210 cfs is sufficient to pass all flows up to seepage limitations in Reach 3, 4A and 5 downstream, and will include modest floodplain and riparian habitat amounts when Mendota Dam is partitioned from the SJR.

<u>It is recommended that the 2B improvements beyond Reclamations "Phase 2" be deferred until after the completion of all of the projects Listed in Section 4 below.</u>

4. Projects and improvements that should be implemented to further the Restoration Goal

These projects are not in the Settlement, are mentioned in concept but not specifically in the Settlement or are in the Settlement but have not received priority in the past decade. All of these projects would have substantial benefit to the Restoration Goal, some are critical for Restoration Goal success.

1. A canal turnout to allow river temperature management *(not included in the Settlement)*
2. Resolve the rubble weir in Reach 4, which is currently a passage barrier for several months of the year at some flow levels (*this is mentioned in concept in the Settlement at Para. 11(a), but not mentioned specifically and has not received priority to resolve and is not currently on a path to implementation).*
3. Investigate and resolve passage at the Chowchilla Bifurcation *(included in the Settlement but has not received priority –not currently on a path to implementation).*
4. Partition the SJR from Mendota Pool *(included in the Settlement but in a future, unfunded phase – no date certain for implementation).*
5. Ensure flows of up to 700 cfs below Sack Dam *(included in the Settlement, and currently implemented under some circumstances)*
6. Resolve passage barriers in the Eastside Bypass – *(not included in the Settlement)*
7. Provide flexibility to shift Restoration Flows from February into March *(not included in Settlement but could be addressed in RFG's).*
8. Achieve full productivity from the SCARF *(the SCARF is not specifically in the Settlement but will be a valuable tool for the Restoration Goal).*

More details about each of these recommendations are provided below.

Additional Detail, Section 3 - Projects and improvements that should be implemented to further the Restoration Goal

Project: Install a turnout on the Madera or Friant-Kern Canal to allow river temperature management[1]
Rationale: Due to the size and configuration of Friant Dam and Millerton Lake, managing the limited store of cold water through the summer (from the end of cold-water inflow to the reservoir, typically April or early May, through the end of Spring Run Chinook salmon egg incubation in late November) is challenging. A second point of release from the reservoir at a different elevation than the River Outlet valve would allow for mixing flows from different thermal strata in the reservoir and preservation of the coldest water until later in the season. When Contractor demands on the canals permit (e.g., excess canal capacity is available for Restoration Program use), a portion of the total SJR release water can be released via the canals to the river to meet Holding Contract and Restoration Flow demands. With the proper measurement and control systems in place, the water releases to the SJR via the canal turnout can maintain river temperatures within an acceptable range without relying solely on released from the coldest water in the reservoir via the River Outlet valve.
Description/Action: Design and install a turnout in the Madera or Friant Kern Canal to allow release of water to the river immediately downstream of Friant Dam. Ideally sized at 300 cfs to 500 cfs, a turnout on the Madera Canal could drop flow into Cottonwood Creek or the SJR; a turnout from the Friant Kern Canal could transit through the BOR office/maintenance site then into the river.

Project: Resolve the Rubble Weir in Reach 4[2]
Rationale: at low Exhibit B flows (approximately 200 – 235 cfs at GRF, and approximately 100 cfs and less at the rubble weir), the weir is a partial or full barrier for migrating adult Chinook. This will be a major challenge for fall-run Chinook, as Exhibit B flows in October – December will be in this range.
Description/Action: The concrete rubble weir in Reach 4 backs up water for a pump that is only used occasionally. However, under some flow conditions, this is the most downstream passage barrier to Chinook in the Restoration Area. Work with landowner to remove/reorganize rubble weir: assist with permitting and/or hire landowner or contractor to field-fit a removal/rearrangement of concrete rubble to enable adult salmon passage for flows as low as 50 cfs.

[1] Conceptual Design Temp Turnout 5-2025
[2] Kelly Weir Flow Documentation

This minor barrier should be amenable to various low-cost solutions (e.g., simply removing with a backhoe and dump truck during dry conditions). Although resolution of this barrier is mentioned obliquely in the Settlement, no work has been done on advancing a solution for several years.

Project: Investigate and resolve passage at the Chowchilla Bifurcation[3]
Rationale: The potential for the river-side arm of the Chowchilla Bifurcation to pass migrating Chinook is unknown. Under some conditions, such as high debris load on the trash rack or partially closed gates during flood control releases, the Bifurcation is likely a total barrier. Under other conditions, such as a clean trash rack and flows under open-gate conditions, it is possible that there is partial or full passage. Empirical testing (e.g. using acoustically tagged fish) should be performed to assess the current status of passage under different flow conditions, and to inform design for passage enhancement as needed. Once current passage conditions are fully understood, physical passage enhancement or management options can be developed and implemented to facilitate passage at this facility.
Description/Action: the Chowchilla Bifurcation, SJR side, is a known passage barrier at some flow conditions, and a suspected partial barrier under other conditions. This needs to be investigated and resolved via physical improvements or management approaches. DWR is ostensibly in charge this project; however, although this is an improvement specifically called out in the Settlement, no substantial work on investigating or implementing a solution has occurred for a decade.

Project: Partition the SJR from Mendota Pool
Rationale: Under current Reclamation planning and phasing, Mendota Pool for improvements in Reach 2B, the partition of Mendota Pool from the river and allowing unimpeded bi-directional passage through the Compact Bypass would not occur until sometime well into the future, along with implementation of a construction project with a price tag north of $150M and no identified funding source. As a result, Mendota Pool will continue to stretch several miles up the SJR towards the Chowchilla Bifurcation, as predator habitat for juveniles. Upstream passage for adults would only be via a fish ladder, and downstream passage for juveniles would have unknown effectiveness via potential temporary barriers and juveniles required to move under a cracked open gate at the bottom of the channel several feet down. A simple stoplog wall or other approach should be investigated for implementation with an earlier phase of construction, meaning partition of the pool from the river would not be hostage to unknown funding for the more expansive project.

[3] Pilot Evaluation of Adult Chinook Salmon Passage

Description/Action: Partition the SJR from Mendota Pool in parallel with the Columbia Canal Siphon is project (currently Phase 1B of the Reach 2B Project).

Project: Ensure flows of up to 700 cfs below Sack Dam
Rationale: Current seepage limitations in Reach 3 limit total flows to 900~950 cfs, therefore if consumptive demand at Arroyo Canal exceeds about 200 cfs, Restoration Flows below Sack Dam must be curtailed. Increasing the seepage limit in Reach 3 to about 1200 cfs should resolve this problem. Reclamation's current design for the Compact Bypass limits flows to 500 cfs, which would be an effective limit of about 460 cfs below Sack Dam. Although in theory additional flows could continue to be released from Mendota Dam by the Mendota Dam operators, Reclamation would still need to rely on the uncertain operations of third parties to deliver Restoration Flows. Reclamation's design for Phase 1A of the Reach 2B project should be revisited, to allow a flow of at least 750 cfs through the Compact Bypass.
Description/Action: This potentially requires two elements: relieving seepage limitations in Reach 3 to allow 750 cfs of Restoration Flows in parallel with irrigation deliveries, plus relieving flow constraints on the Compact Bypass to allow flows of up to 750 cfs from immediately after the construction of the Bypass.

Project: Resolve passage barriers in the Chowchilla and Eastside Bypass[4,5]
Rationale: During flood control releases, the majority of SJR flows moves down the Chowchilla and Middle & Lower Eastside Bypass systems. In some conditions (e.g. when the Kings River flows at 4,000 cfs at the James Bypass), all SJR flows will move down the bypasses. Wet year/high outflow conditions and the associated boon to upstream and downstream anadromous migration will be vital for the success of the Restoration Goal; therefore, it is imperative that all potential routes for adult and juvenile immigration be optimized for passage under a wide range of flow conditions. There are at least three partial or full passage barriers on the Chowchilla and Middle Eastside Bypass flood channel during flood flows. The barriers may be passable at some flows and not passable at others. All of these barriers should be made passable under most, if not all, flood flow conditions. Although not specified as an improvement in the Settlement, these improvements would substantially benefit the Restoration Goal.

[4] Chowchilla Fish Passage Structures_f
[5] 2023June16_Site Visit Summary Eastside Bypass Fish Barriers

Description/Action: Drop Structure #2, and the highly eroded road crossings at Roads 18 ½ and 21 in the Eastside Bypass are all likely partial passage barriers (passage barriers at some flood flows). Resolution of the erosion under the bridges at Roads 18 ½ and 21 is likely needed for future bridge stability and should be completed by the County with appropriate consideration for fish passage. Similarly, Drop Structure #2 is a low barrier (approx. 4 ft tall), and a number of options for resolution (nature-like fish way swim around, small 4 bay fish ladder, or other solution) should be straightforward.

Project: Flexibly Shift Restoration Flows from February into March
Rationale: The RFG's do permit shifting Restoration Flows from March to February, but not February into March. This change would allow better smoothing from a Wet Restoration Year transitioning into a Dry or Critical-High Restoration Year.
Description/Action: A change in the Restoration Flow Guidelines (RFG's) to allow a shift of water from February to March would facilitate transitioning between very different water year types. On at least two occasions in the past decade, the first Restoration Allocation was for a Dry or Critical High water year type following a previous year Normal-Wet or Wet water year type. The Program made extraordinary efforts to facilitate a URF exchange from February into March to avoid the precipitous drop in Restoration Flows that would have otherwise occurred on March 1. A limited ability to shift water from February to March would resolve this problem. Examples of limitations could include: a shift of no more than 5 TAF, shift can only occur if the year type for the receiving Restoration Year is Dry, Critical High or Critical Low, and shift can only be from February to March.

Project: Achieve full productivity from the SCARF
Rationale: The SCARF was intended to be a key component of reintroduction of salmonids in the SJR, to both propagate and then foster a SJR-specific spring-run Chinook genome. In addition, the SCARF will help to jump start a foundation population for the SJR. CDFW has spent in excess of $42M to construct the facility but has not committed funds for long term staffing and operations. In addition, faults with the water supply line mean that only a small portion of the full hatchery flow is currently available, limiting production to approximately 25% of design capacity. Although DWR is investigating causes and potential solutions for the supply line limitation, the evaluation is proceeding slowly with no resolution in design or yet scheduled.
Description/Action: CDFW needs to dedicate funding to repair, then operate, the SCARF as intended.

Attachments and Additional Information

1. Conceptual Design Temp Turnout 5-2025
2. Kelly Weir Flow Documentation
3. Pilot Evaluation of Adult Chinook Salmon Passage at Chowchilla Bifurcation Using Acoustic Telemetry
4. Chowchilla Fish Passage Structures_f
5. 2023June16_Site Visit Summary Eastside Bypass Fish Barriers
6. Next Steps: Top Actions to improve Habitat and Productivity

1. **Conceptual Design Temp Turnout 5-2025**

Conceptual Design

Madera Canal Turnout for Water Temperature Control

May 2025

1. Introduction, Background & Concept Overview

The San Joaquin River watershed above Friant Dam has an average annual runoff of about 1,840 thousand acre-feet (TAF). Millerton Lake is small in comparison to the average runoff, with a total storage capacity of 520 TAF and an active storage capacity of about 400 TAF. As a result, in most non-dry years, several reservoir volumes pass through the reservoir.

Inflow water temperature varies throughout the year, with colder inflows in the winter and early spring and warmer temperatures in the summer and fall. Once colder-water inflows begin to warm in the spring (Figure 1), then inflows into Millerton Lake are warmer than the outflows from the Friant Dam River Outlet, and the reservoir is on a warming trajectory into the summer.

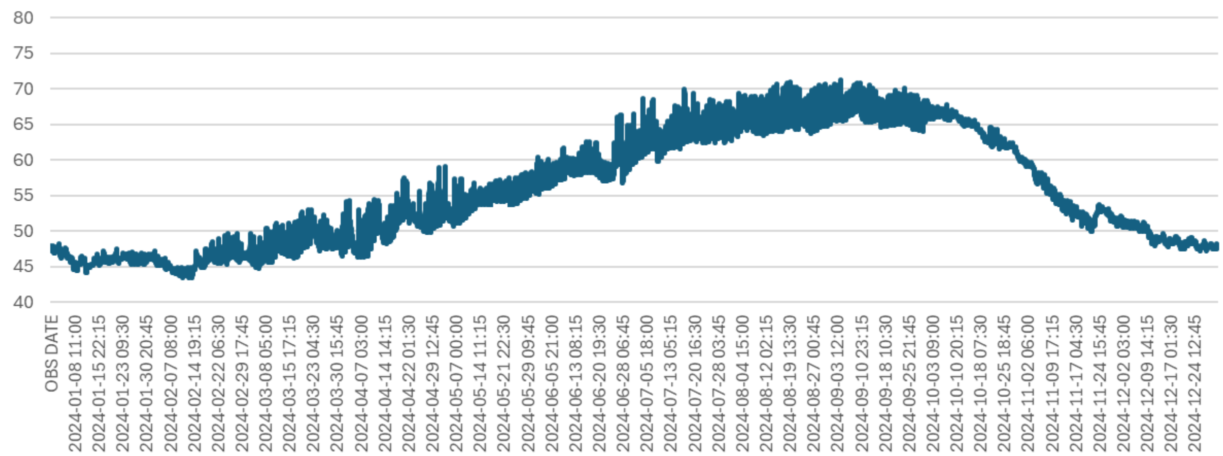


Figure 1. Millerton Lake Inflow Temperatures in 2024 as assumed by the SJA water temperature gage immediately downstream of Kerckhoff Reservoir, 20 miles upstream of Friant Dam and approximately 7 miles upstream of the head of Millerton Lake.

Millerton Lake stratifies dramatically through the year (typically beginning in May and June), with warmer water at the top and cooler water at the bottom, reflecting the combined effect of warming meteorological conditions, increasing inflow water temperatures, and withdrawal of cooler/deeper water from the reservoir from the Friant-Kern and Madera canals and the River Outlet (Figure 2).

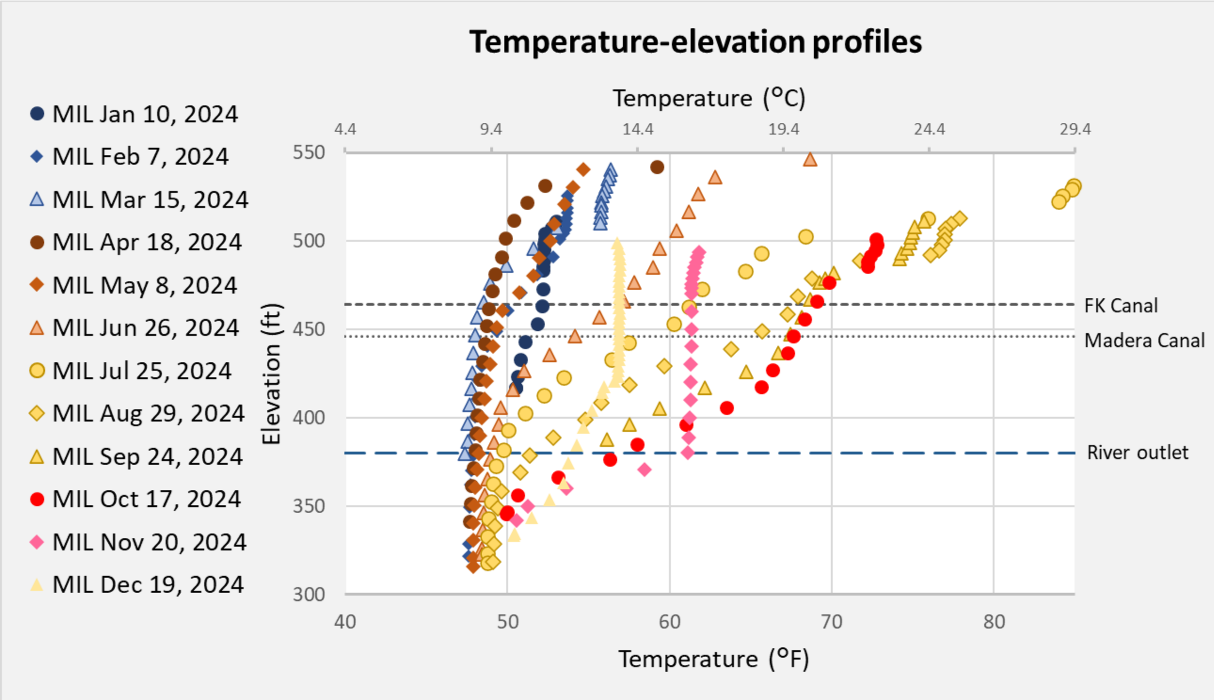


Figure 2. Monthly Vertical Reservoir Profile 2024.

The combined canal release capacity is high (up to 10 TAF/day at full canal capacity) relative to the active storage volume of the reservoir, which can release the entire active volume of the reservoir in about 40 days if inflows are low. As can be seen from Figure 2, after May and June, the reservoir starts to strongly stratify, with warmer water temperatures on top of the reservoir and cooler temperatures at the bottom.

Chinook salmon, a key target species for the San Joaquin River Restoration Program, are sensitive to water temperature. During adult spring-run Chinook Salmon migration and holding periods, salmon will move upstream to find areas of cooler water or thermal refugia. Once spawning commences in September, the salmon eggs are particularly sensitive to temperature from September through November. Operating the reservoir to maintain cold water releases through September, October, and November can be a challenge given the thermodynamics of Millerton Lake as described above. As shown in Figure 3, maintaining Friant Dam release water temperatures that avoid exceeding Critical thresholds for the egg incubation period is the most challenging for cold-water pool management in Millerton Lake.

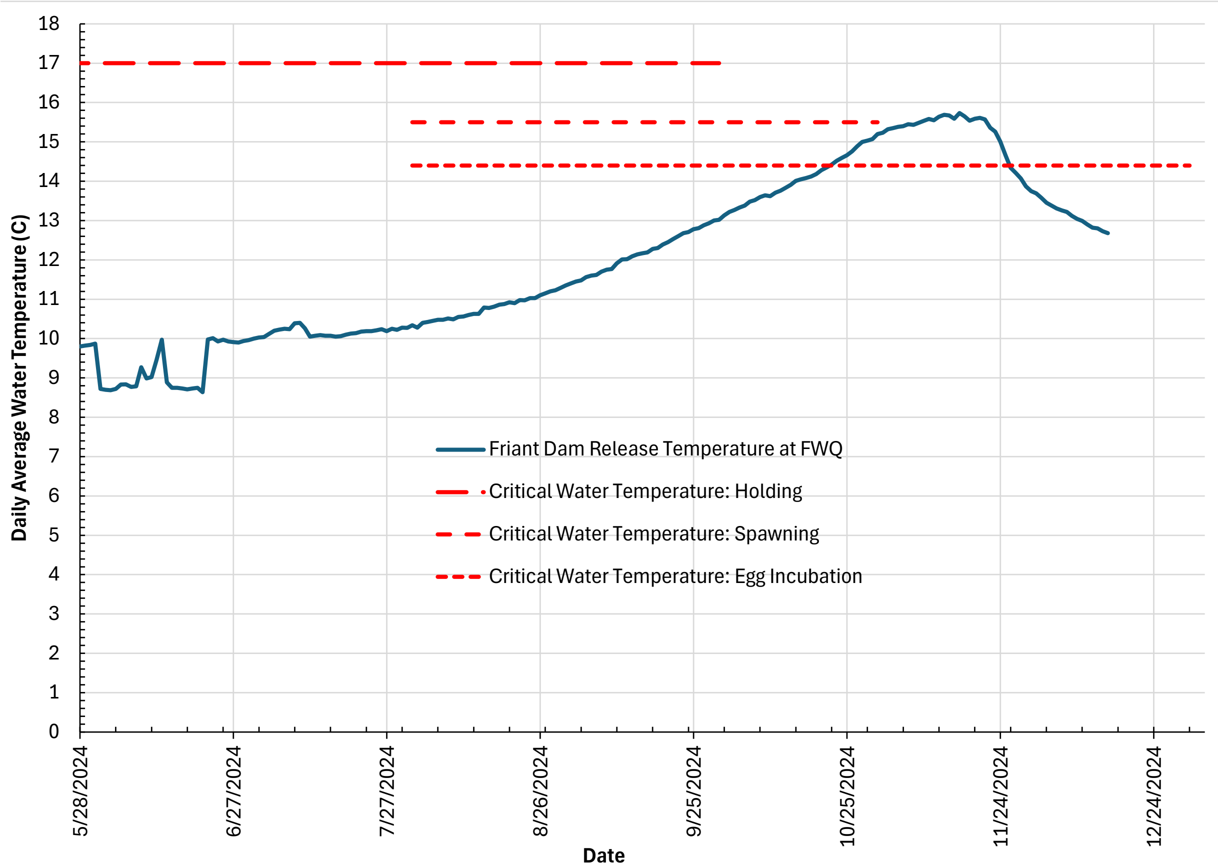


Figure 3. Daily average water temperatures released from Friant Dam in 2024 (FWQ), with lower Critical water temperature thresholds shown in Table 1.

Chinook Life Stage	***Reaches***	***Temperature Objectives***[3]	
Adult Migration	1 – 5	Optimal: Critical: Lethal:	≤ 59°F (13°C) 62.6 – 68 °F (17-20°C) > 68°F (20°C)
Adult Holding	1	Optimal: Critical: Lethal:	≤ 55°F (13°C) 62.6 – 68 °F (17-20°C) > 68°F (20°C)
Spawning	1	Optimal: Critical: Lethal:	≤ 57°F (13.9°C) 60 – 62.6 °F (15.5-17°C) > 62.6°F (17°C)
Incubation & Emergence	1	Optimal: Critical: Lethal:	≤ 55°F (13°C) 58 – 60 °F (14.4-15.6°C) > 60°F (15.6°C)
Late-season In-River & Floodplain Juvenile Rearing	1	Optimal: Critical: Lethal:	≤ 62.6°F (18 °C) late season – yearling; 55 – 68 °F (13-20°C), floodplain (unlimited food supply) 64.4 – 70°F (18-21.1°C) > 75°F (23.9°C), prolonged exposure

[1] Temperature objectives from Fisheries Management Plan, Chapter 3 and Exhibit A, Table 3-1 (SJRRP 2010)
[2] Temperature objectives from Fisheries Framework – Version 5.1, Chapter 2, Figure 9 (SJRRP 2017)
[3] Temperature objectives are 7-day Average of the Daily Maximum (7DADM)

Table 1. San Joaquin River Water Temperature Objectives from the 2010 Fisheries Management Plan.

The River Outlet on Friant Dam, the primary release point for Restoration Flows to the San Joaquin River, pulls water from the coldest part of the reservoir year-round (Figure 4). While this is a beneficial attribute in the fall (September – November) when the coolest possible water is needed in the river, it may not be ideal earlier in the summer when salmon are holding. Once Millerton Lake begins to stratify, Friant Dam releases warmer water to the Friant-Kern and Madera canals because the canal release elevations are higher elevation than the elevation of the River Outlet. Releasing water to the San Joaquin River exclusively through the River Outlet once the reservoir stratifies depletes the cold-water pool, which lowers the thermocline elevation in the reservoir, such that warmer water temperatures are released to the river in October and November despite cooling meteorological conditions (Figure 3 and 4).

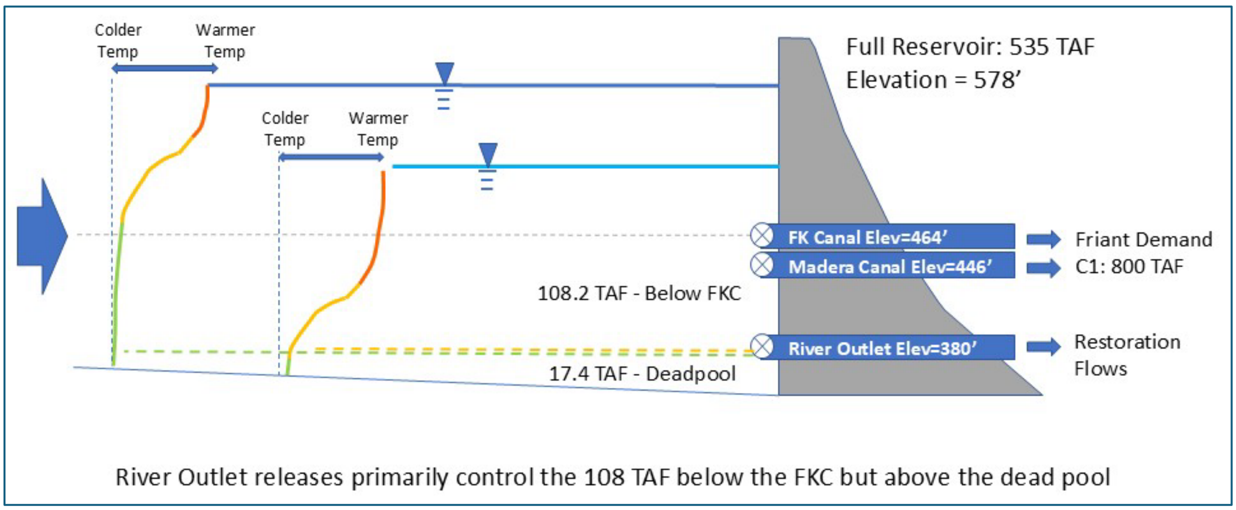


Figure 4. Millerton Reservoir Temperature Strata and Outlets.

If operators could release warmer surface water to the San Joaquin River from the upper elevations of the reservoir in the spring and early summer months when upper elevation water temperatures and meteorological conditions are cooler, the amount of water released from the River Outlet could be decreased, and the draw on the cold-water pool would be reduced. This spring and early summer release strategy could preserve cold-water pool through the summer, such that September, October, and November release temperatures could be lowered. One potential strategy (rather than building an expensive temperature control device) could be to deliver water to the San Joaquin River in the spring and early summer via the higher elevation Madera Canal. A turnout would need to be constructed on the Madera Canal above Cottonwood Creek, and a channel constructed from the turnout to Cottonwood Creek to allow the release of water to the San Joaquin River from a warmer thermal layer in the reservoir. With careful control and mixing, river temperatures can be maintained while the volume of the coldest water in the reservoir can be preserved for the critical fall months.

2. Conceptual Layout and Design

The Madera Canal Turnout concept envisions a turnout from the Madera Canal near Friant Dam, that would allow the release of water from the reservoir to the canal and then into the San Joaquin River or into Cottonwood Creek and then into the river. When Madera Canal capacity was available (e.g., canal flows for contractor deliveries is less than the canal capacity near Friant Dam), and if thermal conditions are beneficial, water would be turned out down a new Madera Canal Turnout instead of from the Friant Dam River Outlet. Real-time temperature monitoring below Friant Dam (e.g., the FWQ and SJF gauges) could ensure that the relative River Outlet/Madera Canal Turnout release maintained river temperatures in an acceptable temperature range for the holding, spawning, and egg incubation life stages as shown on Figure 3. Likely Madera Canal Turnout releases would be highest in March and April, less in May and June, and low or zero after early July.[1]

Figure 3. Potential Madera Canal Turnout Locations and routes to Cottonwood Creek.

Design and construction of the Madera Canal Turnout would be by Reclamation or Madera Canal contractors with Reclamation approval. Operations of the turnout could be by Reclamation, Madera Canal operators, or Friant Power Authority operators. Monitoring and emergency systems would be similar to existing Madera Canal systems, and SCADA and communications would be tied into existing Madera Canal or Reclamation systems.

[1] The biggest benefits may come once the reservoir starts to stratify (after May) rather than March and April. This will need gaming with the model to better figure this out

Additional automated streamflow gauge(s) will be required in the Madera Canal upstream of the turnout for flow and temperature measurement, and either in the canal below the turnout or in the turnout for turnout flow measurement and compliance with Water Board reporting requirements.

Madera Canal Turnout flows would be adjusted in concert with any changes to the release from the River Outlet.

3. Potential River Temperature Benefits – Initial CE-QUAL-W2 Reservoir Water Temperature Model Results

To illustrate possible benefits of a Madera Canal Turnout operational strategy on Millerton Lake cold-water pool and fall release temperatures, the CE-QUAL-W2 reservoir temperature model was run for actual 2022 releases under the following flow release proportioning scenario. The flows below would be released from the Madera Canal Turnout rather than the River Outlet (e.g., if total flow on a given day in April 2022 was 450 cfs, then 350 cfs would be released from the Madera Canal Turnout and 100 cfs would be released from the River Outlet).

- March to June: 350 cfs
- July: 150 cfs
- August: 100 cfs
- September to December: 0 cfs

Figure 5 illustrates that approximately 1 degree C of cooling could be obtained from September through mid-November with the Madera Canal Turnout operation described above, which would greatly reduce the duration of elevated water temperatures during the holding and spawning period. predicted water temperatures would still exceed lower-Critical thresholds for egg incubation, and additional gaming of release proportioning strategies and additional water years will be conducted with the CE-QUAL-W2 reservoir temperature model to improve overall release water temperature performance.

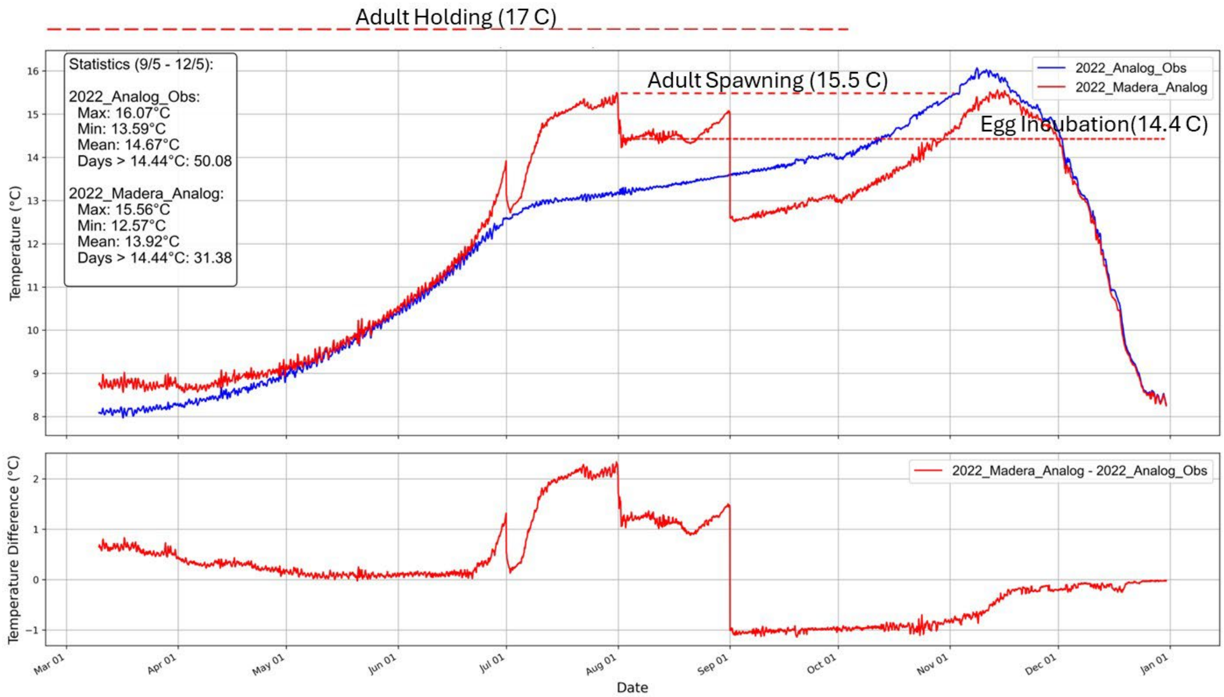
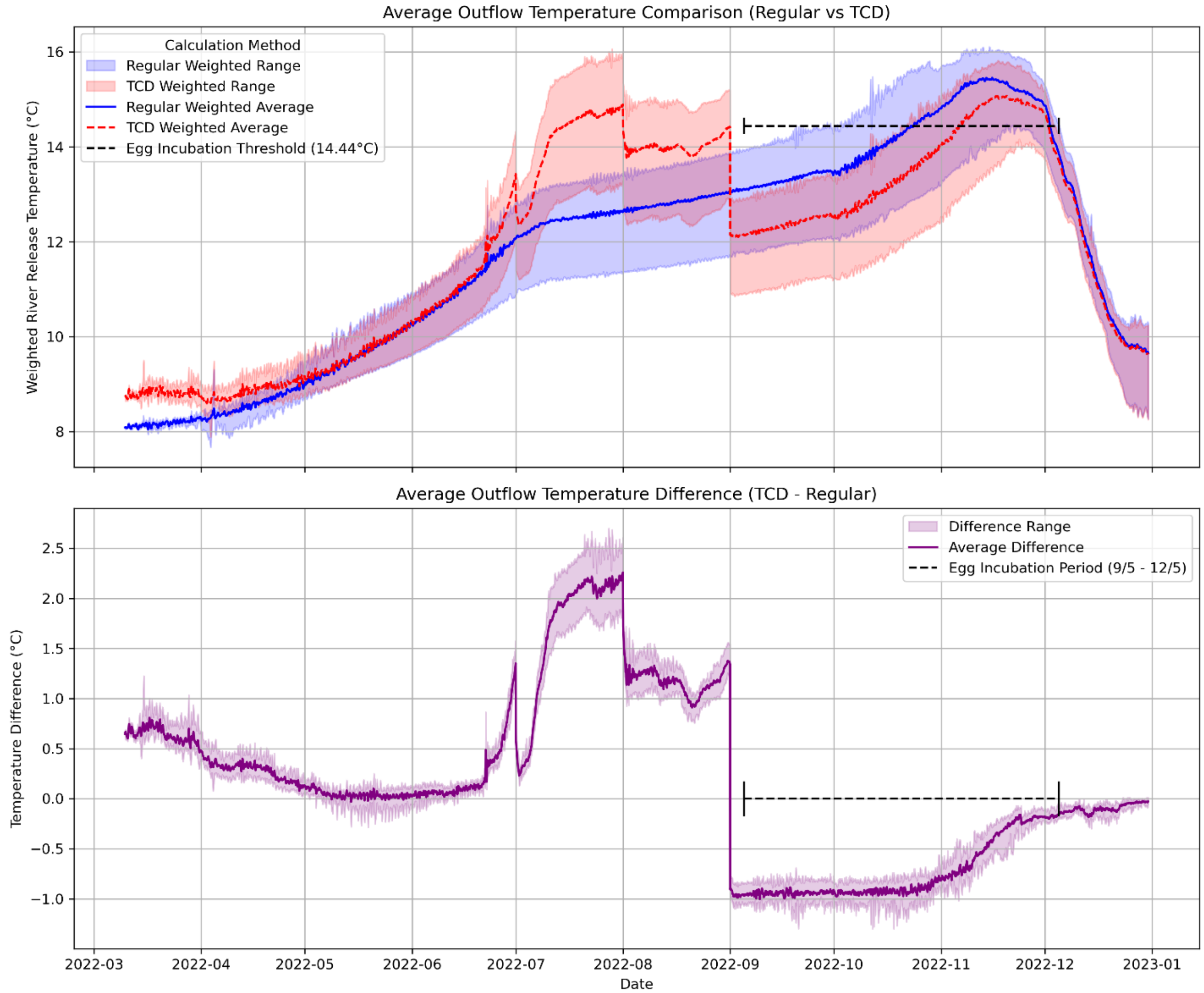


Figure 5. Initial CE-QUAL-W2 water temperature modeling results.


Average Outflow Temperature Comparison (Regular vs TCD)
Calculation Method
Regular Weighted Range
TCD Weighted Range
Regular Weighted Average
TCD Weighted Average
Egg Incubation Threshold (14.44°C)
Weighted River Release Temperature (°C)
Average Outflow Temperature Difference (TCD - Regular)
Difference Range
Average Difference
Egg Incubation Period (9/5 - 12/5)
Temperature Difference (°C)
2022-03
2022-04
2022-05
2022-06
2022-07
2022-08
2022-09
2022-10
2022-11
2022-12
2023-01
Date

2. Kelly Weir Flow Documentation

Photographs and Flow Estimates at the Rubble Weir in the Eastside Bypass

The SJRRP has collected a series of photographs of the Rubble Weir (a.k.a. Kelley Weir) in the Eastside Bypass (37.272332, -120.816539). These photographs were used to assess the potential for fish to pass the structure and to guide fisheries monitoring and flow recommendations.

The flow coordinator used the timestamp of the photographs to estimate actual flows at the structure as follows. The flow coordinator analyzed the QA/QC data published by DWR, the travel times between gauges, the hourly data, and the expectations of accretions to come up with an instantaneous estimate of when each photograph was taken.

The California Fish Passage Assessment Database (https://www.calfish.org/ProgramsData/HabitatandBarriers/CaliforniaFishPassageAssessmentDatabase.aspx) marks this structure with PAD ID number 758833. DWR's assessment states: "The structure is primarily composed of large concrete rubble. Passage is impeded and there is potential for stranding at flows below 200 cfs. The passage impediment is related to debris that appears to be in place for maintaining a certain water surface elevation for operation of equipment." Based on these photographs, the FMWG estimates fish *may be able* to get past this structure at flows as low as 115–125 cfs, though these flows do not provide suitable passage conditions.

Figure 1. Photograph Date 3.11.2020 17:02. QA/QC Data: EBM 87 cfs daily avg, SJS: 110 cfs daily avg, C. Moore estimate approx. 85 cfs instantaneous.

Figure 2. Photograph Date 3.12.2020 10:51. QA/QC: EBM: 87 cfs daily avg, SJS: 104 cfs daily avg. C. Moore estimate approx. 85 cfs instantaneous.

Figure 3. Photograph Date 3.10.2020 10:13. QA/QC data: EBM: 82 cfs daily avg, SJS: 122 cfs daily avg. C. Moore estimate approx. 90 cfs.

Figure 4. Photograph Date 3.17.2020 11:35. QA/QC: EBM: 76 cfs daily avg, SJS: 172 cfs daily average. C. Moore estimate 90 cfs instantaneous.

Figure 5. Photograph Date 3.08.2020 11:16. QA/QC Data: EBM 107 cfs daily avg, SJS: 161 cfs daily avg. C. Moore estimate approx. 115 cfs instantaneous.

Figure 6. Photograph Date 3.19.2020 11:31. QA/QC: EBM: 77 cfs daily avg, SJS: 239 cfs daily average. C. Moore estimate approx. 125 cfs instantaneous.

Figure 7. Photograph Date 01.06.2020 11:48. QA/QC: EBM: 177 cfs daily avg, SJS, 213 cfs daily avg. C. Moore estimate from multiple gauges approx. 195 cfs instantaneous.

Figure 8. Photograph Date 12.11.2019 11:03. QA/QC: EBM 129 cfs daily avg, SJS 376 cfs daily avg, C. Moore estimate approx. 250 cfs instantaneous.

Figure 9. Photograph Date 03.05.2018. QA/QC data: EBM 186 (daily average), SJS: 811 (daily average). Interpolated by multiple gauges (C. Moore pers com)- approx. 600 cfs (instantaneous estimate).

3. Pilot Evaluation of Adult Chinook Salmon Passage at Chowchilla Bifurcation Using Acoustic Telemetry

Pilot Evaluation of Adult Chinook Salmon Passage Using Acoustic Telemetry

Prepared for the Fishery Management Work Group
July 2024

SAN JOAQUIN RIVER
RESTORATION PROGRAM

1.1 Statement of Need

Passage impediments and flow diversions were major factors that led to the extirpation of spring-run Chinook Salmon (*Oncorhynchus tshawytscha*) from the upper San Joaquin River (Yoshiyama et al. 1998). The Restoration Goal of the San Joaquin River Restoration Program (SJRRP) is to restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence with the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish. Passage issues upstream of the Merced / San Joaquin River confluence remain and are a limiting factor to accomplishing the Restoration Goal. The Settlement prioritizes key improvements and segregates them into two Phases of implementation. Phase 1 improvements related to passage are making progress on their designs, but construction has not begun to date (paragraph 11(a) (1-10) of NRDC et al. v. Kirk Rodgers et al. 2006). Passage impediments in Phase 2 are lower in priority, but equally limiting in accomplishing the Restoration Goal (paragraph 11(b)(2) of NRDC et al. v. Kirk Rodgers et al. 2006). Specifically, the Chowchilla Bifurcation Structure (Latitude: 36.773979°; Longitude: -120.284490°) which serves as a flow diversion during flood conditions into the Chowchilla Bypass. Flows are diverted into the Chowchilla Bypass due to capacity limitations in the San Joaquin River below the bifurcation. The San Joaquin River side of the bifurcation structure (Latitude: 36.773295; Longitude: -120.285179) moderates flows into the San Joaquin River. Flows can be directed down the San Joaquin River or the Chowchilla Bypass (**Figure 1**). Upon completion of Phase 1 passage impediments the Chowchilla Bifurcation Structure (CBS) and/or the San Joaquin River Bifurcation Structure (SJRBS) will still prevent or delay adult upstream migration and juvenile downstream migration during certain flows, depending on where flows are diverted. And this will have a negative impact on restoring a population of spring-run Chinook Salmon to the river.

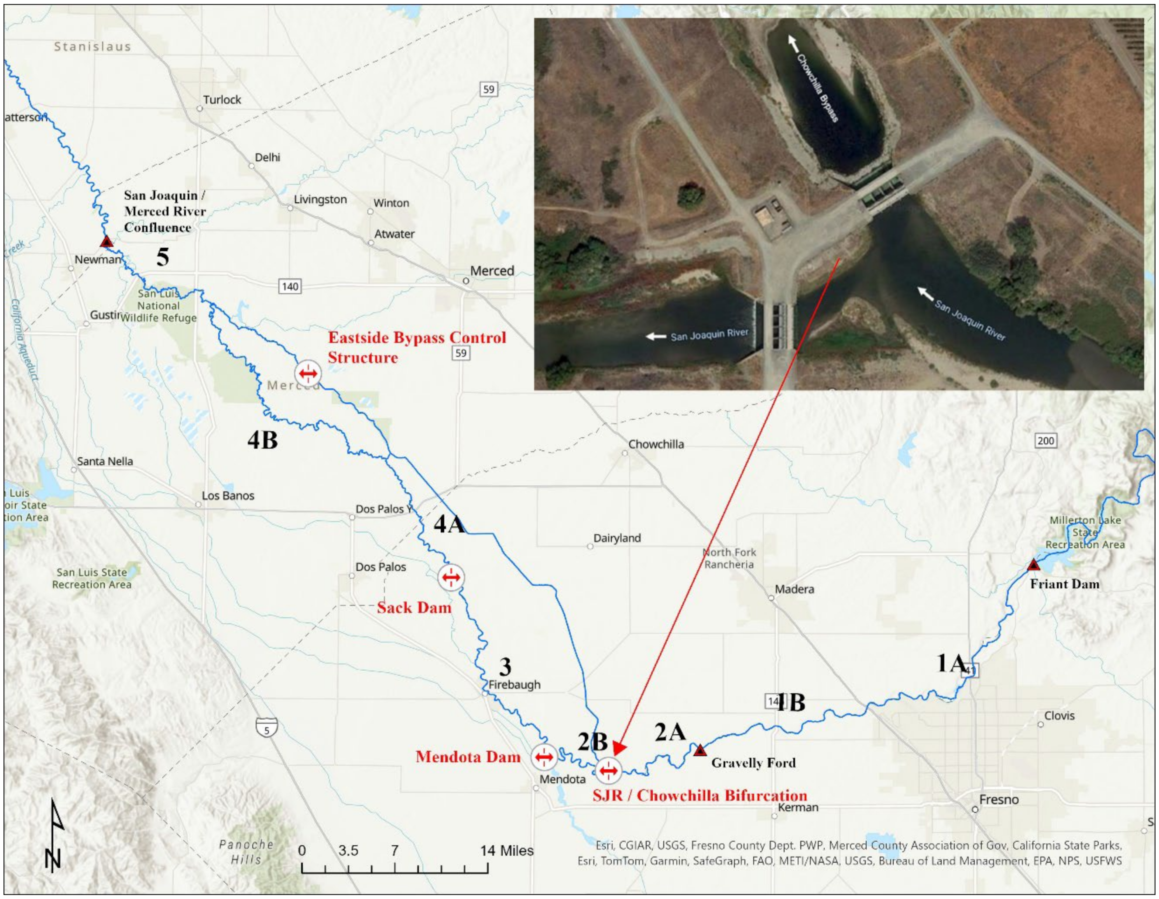


Figure 1. Map of the San Joaquin River Restoration Area with Reaches, Sub-reaches, and major passage impediments. Inset image is an aerial view of the San Joaquin River / Chowchilla Bypass bifurcation that can divert flows to the San Joaquin River (left) and/or to the Chowchilla Bypass (right). Photo courtesy of Department of Water Resources.

Since the early 1990's the California Department of Fish and Wildlife (CDFW) has intentionally blocked adult fall-run Chinook Salmon from migrating into San Joaquin River upstream of the San Joaquin River / Merced River confluence. The annual construction of a temporary weir (Hills Ferry Barrier) is intended to prevent fall-run from migrating into the upper San Joaquin River, to reduce negative impacts to the Central Valley Fall-run population, because of stranding caused by impassable structures and/or mortality due to lethal water temperatures and poor habitat quality. Annually a small portion of fall-run circumnavigate the barrier and become stranded below passage impediments or are lost in any one of the many irrigation ditches or drains. CDFW in concert with the U.S. Bureau of Reclamation trapped and transported adult fall-run that circumnavigated the Hills Ferry Barrier into Reach 1 beginning in 2012 and continuing annually through 2016 (Root et al. 2017). Fall-run encountered many of the barriers highlighted in Phase 1 of the Settlement, but no passage studies in the field have been conducted to-date within the Restoration Area (i.e., Merced / San Joaquin River confluence to Friant Dam).

In 2016, CDFW began annual releases of sexually mature adult spring-run Chinook Salmon (captive rearing) to the river, to aid in the research and reintroduction of spring-run (Berejikian et al. 2010 and 2011; Venditti et al. 2013). The SJRRP shifted its monitoring focus from fall-run and began actively monitoring spring-run during critical life-stages. In 2019, the SJRRP effectively acknowledged the first volitionally returning spring-run adults to the Restoration Area. Passage impediments still unresolved triggered Trap and Haul efforts of adult spring-run, released as juveniles to the RA and returning from the ocean as adults. Since 2019, annual Trap and Haul efforts have trapped and transported adult spring-run Chinook Salmon upstream of major passage impediments into Reach 1 of the Restoration Area (**Figure 1**). The nature of this effort means that adults never encounter the structures at the bifurcation of the San Joaquin River and the Chowchilla Bypass, except in the wettest of water year types. In 2019 and 2023, adult spring-run Chinook Salmon were able to migrate past the CBS and/or the SJRBS with the release of flood flows from Friant Dam. It is unclear, however, if fish passed the CBS using the Chowchilla Bypass or the SJRBS using the San Joaquin River. In 2019, flows through the SJRBS to the San Joaquin River ranged from (31 to 1690 cubic feet sec^{-1} March through June) and through the CBS to the Chowchilla Bypass (3 to 4672 cubic feet sec^{-1} March through June). In 2023, flows through the SJRBS to the San Joaquin River were (184 to 1833 cubic feet sec^{-1} March through June) and flows through the CBS to the Chowchilla Bypass were (22 to 7852 cubic feet sec^{-1} March through June). Further, it is unknown how many fish encountered these structures and were unable to pass. Additionally, it is unknown at what flows fish were able to pass either structure – only the range of flows that occurred at these locations during their migration period.

This study is proposed as a *pilot fish passage study.* The primary aim is to begin building a foundation and strategy for studying fish passage in the San Joaquin River. This study year will be a baseline evaluation of fish passage under a narrow range of flow conditions at the SJRBS. Simply – can adult fall-run Chinook Salmon (*Oncorhynchus tshawytscha)* pass the San Joaquin River Bifurcation Structure at (~160 – 180 cubic feet sec^{-1}) and/or at (~260 – 330 cubic feet sec^{-1})? Data interpretation and application should not be applied beyond the context of the study design.

1.2 Background

Creating a passable river for salmonids and other native fishes between the San Joaquin-Merced River confluence and Mendota Dam is critical to meet the Restoration Goal of the Settlement. Three major passage impediments stand in the way – Eastside Bypass Control Structure, Sack Dam and Mendota Dam (**Figure 1)**. These projects are nearing the completion of the design phase or have completed the design phase. A fourth passage impediment also stands in the way at the bifurcation of the San Joaquin River and the Chowchilla Bypass. To-date plans to improve this structure have not been widely explored or evaluated. Improvements to this structure are likely years behind the completion of the major passage projects.

The bifurcation of the San Joaquin River and the Chowchilla Bypass sub-divides Reach 2 into Reach 2A upstream and Reach 2B downstream. Reach 2 in general is a meandering, low-gradient channel that starts at Gravelly Ford and extends downstream to Mendota

Dam. The structures at the bifurcation of the San Joaquin River and the Chowchilla Bypass are the upstream-most passage impediments to naturally migrating adult and juvenile salmonids within the Restoration Area.

In 2010, the Department of Water Resources (DWR) conducted a fish passage evaluation on 68 structures in the Restoration Area (DWR 2010). This initial screening evaluation determined whether structures could be identified as a "total", "partial", or "temporary" fish passage impediments for adult and/or juvenile salmon and other native fishes within the Restoration Area. Both the SJRBS and the CBS are identified as a barrier to fish passage according to DWR's fish passage evaluation.

Both structures are similar in design and include four (18' x 20') radial gates (**Figure 2**). The structure's height is 19.4' and approximately 87.6' in length from the top deck.

Figure 2. Photo looking downstream at the Chowchilla Bifurcation Structure radial gates leading into the Chowchilla Bypass. Photo courtesy of Department of Water Resources.

There is a trash rack only on the upstream side of the SJRBS that consists of fourteen 4" galvanized pipe poles spaced approximately 1.35' on-center for each bay (radial gate) (**Figure 3**). The trash rack is set at a 20° angle with the direction of flow through the rack. On the downstream end the concrete apron and weir are armored by rip rap that extends approximately 18'. There is a 3' drop from the weir to the pool. The 3' drop and the trash rack are the main characteristic that DWR mentions as why this structure was classified as 'red' - "likely to fail to meet DFG and NMFS passage criteria at all flows for the strongest swimming species presumed to be present" (DWR 2010).

Figure 3. Image of the trash rack on the upstream side of the San Joaquin Bifurcation Structure. Photo courtesy of Department of Water Resources.

1.3 Past Findings

The (2010) DWR Fish Passage Evaluation evaluated the SJRBS structure and classified the structure as 'red'. DWR notes that under different flows, the drop on the downstream side of the structure might not be as significant, and the site could potentially be reclassified as 'grey' – stating "More information is needed to evaluate the structure". At the time of the survey (July and August 2010) Friant Dam was releasing between 295 and 361 cubic feet per sec^{-1}. Flows through the SJRBS ranged from 27 to 82 cubic feet per sec^{-1} at the time of the evaluation. This study proposes to evaluate fish passage at flows of ~160 – 180 cubic feet sec^{-1} and ~260 – 330 cubic feet sec^{-1} through the SJRBS – conditions that would decrease the drop and therefore potentially reclassify this structure to 'grey'. Additionally, the trash rack on the upstream end of the SJRBS can have a negative impact on adults migrating upstream as well as juveniles migrating downstream. Other fish species wider than 12.0" will not fit through the trash rack bars (DWR 2010).

Operations of the SJRBS and CBS may also negatively influence fish passage at this structure. The SJRBS and the CBS are operated in concert, where flows come down the mainstem of the San Joaquin River and converge at the bifurcation of the San Joaquin River and the Chowchilla Bypass. During Restoration Flows, when there are no Flood Flows in the system, the radial gates in the CBS are closed and Restoration Flows stay in the San Joaquin River through the SJRBS. However, during flood events, the opposite occurs. The radial gates in the CBS are opened and most of the flows are diverted down the Chowchilla Bypass. At this time the SJRBS radial gates are partially closed and, in most cases, mostly closed. With a high degree of certainty this will negatively impact fish passage through the SJRBS and might necessitate a change in flow operations and/or a change to the structure (e.g., fish ladder or nature-like fishway) (Romero 2020). It is unclear if passage can be improved at the SJRBS by changing the way operations historically have occurred as well as removing the trash rack and increasing flows during adult migration. Nevertheless, the concrete diffusers, and possibly the drop, will negatively impact the passage of other fish species, such as sturgeon (*Acipenser spp.*).

The Eastside Bypass Control Structure is similar in design to the SJRBS and was classified as 'red' in the (2010) DWR Fish Passage Evaluation. Modeling various flow scenarios through the structure confirmed DWR's assessment; however, a field experiment was not conducted to confirm this outcome. The Eastside Bypass Fish Passage Improvement Project has completed the design phase, and the project is ready to go out for bid once funding has been secured. Advancing from this project, it would be beneficial to model flows through the SJRBS as well as conduct a field experiment to truth these results.

1.4 Anticipated Outcomes

This study will provide valuable insight regarding how to study and evaluate fish passage in the San Joaquin River. Insight into experimental design and data analysis as well as flow management. In addition, aging acoustic telemetry equipment will need to be replaced as passage projects near completion to adequately study fish passage through newly constructed structures. This study will explore any limitations of the existing equipment, in a practical way, to make fiscally responsible recommendations regarding the procurement of new and costly acoustic equipment.

This study aims to answer two questions: (1) Can fall-run Chinook Salmon pass the SJRBS at 160-180 cubic feet per sec^{-1} (low flow) and/or 260-330 cubic feet per sec^{-1} (high flow)? (2) If so, how long does it take them to pass (e.g., hours, days, weeks)? This study provides valuable insight into whether passage at the structure is achievable by salmonids at low flows or if passage can be improved by increasing flows. Thus, providing an assessment of potential passage solutions at an early evaluation point for the SJRRP. These data can provide management the evidence needed to inform flow management decisions that may temporarily allow partial passage of migrating adult salmon until the construction of a passage solution is complete at this location.

Study questions can be expanded for this evaluation in future years if more resources are acquired (Appendix A). For example, study questions could become more complex to evaluate fish passage efficiency and migration timing/delays. Such as, what percent of migrating adults successfully pass the structure during all base flow schedule component periods and water year types of the Settlement (excluding Critical-Low water year type)? Or how long and how many attempts does it take for salmon to successfully pass the structure? Further, having a field passage experiment conducted prior to construction improvements is necessary for comparing post-construction experiments to determine how effective the improvements were.

The SJRRP recognizes that this structure does not meet passage criteria. Therefore, findings from this study are not intended to justify a non-action management decision regarding future improvements for fish passage at this structure. The necessity and commitment to remedy passage at this structure has already been identified by the SJRRP in Implementation documents and the Record of Decision. Data collected during this study can inform the design of future passage evaluation studies using Acoustic Telemetry. These data will inform whether partial passage of adult salmon can be achieved by modifying flows, until physical improvements can be made.

1.5 Study Questions

Primary questions of this study are:

- Can adult fall-run pass the San Joaquin River Bifurcation Structure under base flow conditions (e.g., ~160 – 180 cfs - Low)? Under elevated flows (e.g., ~260 – 330 cfs - High)?
    - *($H1_0$) Flows will have no effect on fish passage.*
- How long does it take fall-run to pass the Chowchilla Bifurcation Structure?
    - *($H2_0$) Flows will have no effect on the amount of time it takes a fish to pass the structure.*

1.6 Methods and Analysis

Type of Study: Field Study

Reach(es): Reaches, 1, 2, and 5

Methods:
Monitoring will occur from October to December 2024, but the exact timing of the monitoring will vary around the peak fall-run Chinook Salmon adult migration period. Monitoring may start earlier or continue later depending on unforeseeable circumstances.

Six stationary acoustic receivers (Innovasea Mfg., VR2W-69kHz) will be arranged strategically downstream and upstream of the SJRBS. Periodically, data will be offloaded from the receivers for quality assurance. Frequency of the offloads will be dependent on staffing availability. Individual study fish will be intragastrically tagged with an acoustic transmitter V9T-2x-069kHz with an internal temperature sensor (Innovasea Mfg.; delay 30 – 60 sec, ~ 320-day battery lifespan. Additionally, acoustically tagged adults will be externally tagged with color coded ‘spaghetti-style or t-bar’ (e.g., Floy Tags) tags. Study fish will be released at San Mateo Crossing (Latitude: 36.781973°, Longitude: -120.312524°) (Figure 4) using similar adult release protocols as Adult Trap and Haul operations (Stuphin and Root 2024). Up to 24 adult fall-run Chinook Salmon will be tagged. Study fish will be released in groups of 4 individually tagged fish - 3 groups per flow level. Release groups will have staggered releases a week apart to account for any unmeasured day effect, as well as to lower the probability of transceiver overlap, which can be caused by too many fish near a receiver at one time. Probability estimates provided by Innovasea estimate that if 5 acoustically tagged adults are co-located at a receiver detection probability will be about 44%. If 10 acoustically tagged fish are co-located at a single receiver the detection probability drops to 16%. These detection probability estimates suggest a maximum of 25 fish can be released in total under this study design because of equipment limitations. Future study efforts similar in design will need to consider using alternative receiver types, equipped to handle larger numbers of fish co-located, such as Innovasea's 180kHz (HR2) or 307kHz (HR3) receivers.

Flow Releases

Typical Restoration Flows under a "normal" Exhibit B schedule in November are around 235 cubic feet per sec^{-1} at Gravelly Ford and 160-180 cubic feet per sec^{-1} at CDEC station SJB (San Joaquin River Below Bifurcation). Flows of 160-180 cubic feet per sec^{-1} for the purpose of this study will be classified as 'low flow'. Low flows will be sustained for a 4-week period. Over the 4-week low flow period 3 groups of 4 acoustically tagged fish will be released – 1 group per week. Flows will be raised by 100-150 cubic feet per sec^{-1} (260-330 cubic feet per sec^{-1}) at the end of the 4-week low flow period. Flows of 260-330 cubic feet per sec^{-1} measured at CDEC station SJB will be classified as 'high flow'. High flows will be sustained for a 4-week period. During this 'high flow' period 3 more groups of 4 acoustically tagged fish will be released – 1 group per week. Passage success or failure and time to pass will be evaluated for both 'low' and 'high flow' scenarios.

Detailed Receiver Array

A total of 6 stationary acoustic receivers will be deployed between San Mateo Crossing and Thomas Farms (**Figure 4**). Study fish will be released at San Mateo Crossing, and approximately 2.0 river kilometers (rkm) upstream will encounter the first of the six stationary receivers (i.e., start). Moving upstream from the 'start' receiver, approximately 4.0 rkm, study fish will encounter the downstream directional gate (i.e., two stationary receivers located marginally with each other's detections ranges). The SJRBS is approximately 0.4 rkm upstream of the downstream directional gate, around a bend in the river. This was done to reduce the likelihood of false detections and/or tag collisions due to fish aggregated at the SJRBS. If study fish pass the SJRBS they will encounter the upstream directional gate approximately 0.8 rkm upstream of the SJRBS. As the name implies the directional gates will enable a higher degree of certainty in determining directional movement. Approximately, 19.0 rkm upstream from the upstream directional gate will be the last receiver (i.e., end). The study area is located within river mile markers 212 – 230.

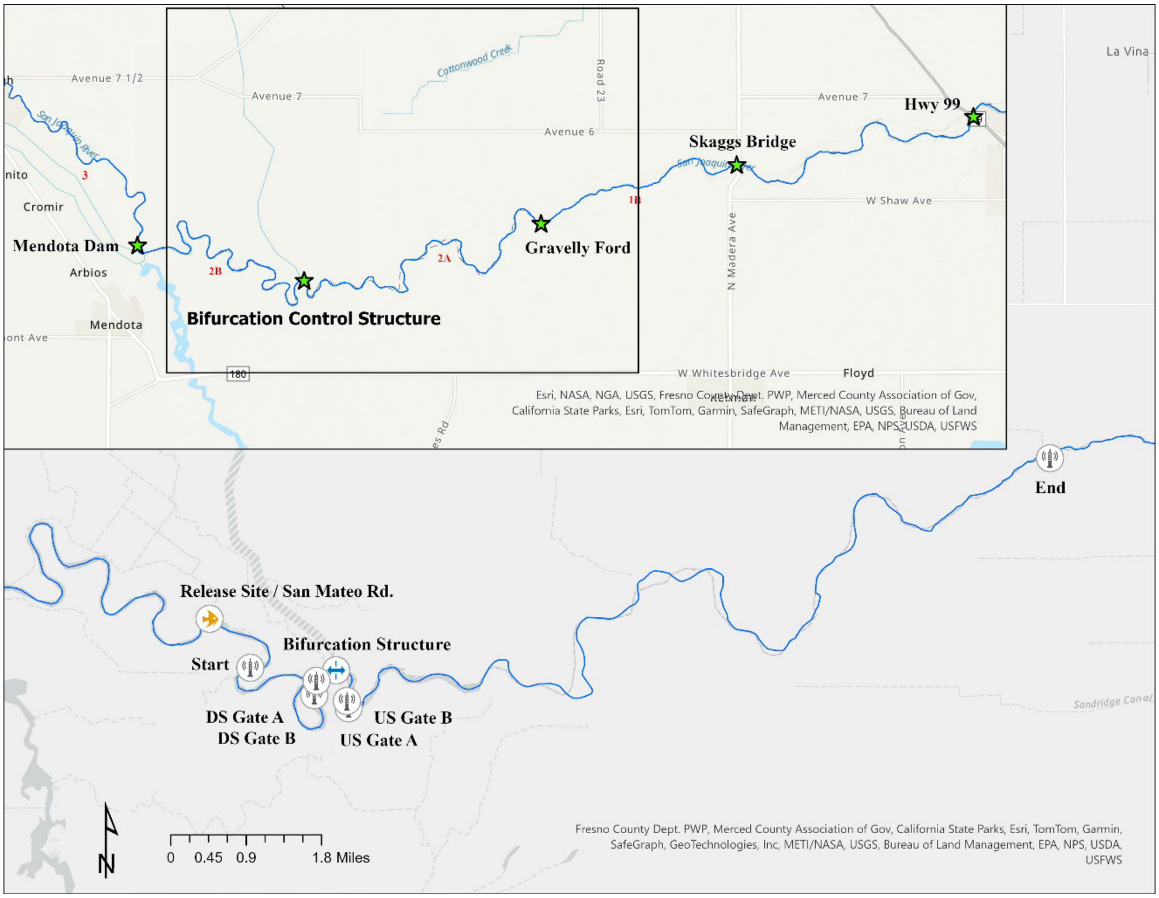


Figure 4. Proposed study area San Mateo Road - Release Site (Latitude 36.781914°, Longitude -120.312525°) upstream to the Thomas Farm – End (Latitude 36.810159°, -120.131497°). A total of 6 stationary receivers will be deployed including 1 directional gate downstream of the bifurcation structure and 1 upstream.

Tagging Process

At the time of release, study fish will be measured (e.g., fork length and total length (mm)) and visually assessed for health deformities (e.g., lesions and/or listless behavior). Sex will be determined by sexually dimorphic characteristics (e.g., kype, color, presence/absence of milt or eggs). Study fish will be intragastrically administered an acoustic tag and externally T-bar tagged, before release to the river at the release location. A balling gun coated with vegetable glycerin will be used to intragastrically tag each adult. The acoustic transmitter will be inserted past the esophageal sphincter muscle into the esophagus leading to the stomach. External tags will be inserted along the dorsal muscle near the posterior edge of the dorsal fin. An external tag will be inserted on both sides of the fish for redundancy purposes.

Source of Study Fish

Fall-run Chinook Salmon will be sourced from the San Joaquin River leveraging existing downstream monitoring efforts and using existing equipment on-hand. Adults will be sourced from the river using two options:

Option 1: During routine Steelhead monitoring efforts conducted by the USBOR fall-run Chinook Salmon are often captured within the Restoration Area as by-catch. We propose that instead of releasing these captured fall-run back to the river they can be held in net pens at the site of capture. These fish can then be transported the same day and released as part of this study. Assuming daily fish captures across all sites is between 4-5 fish.

Option 2: Adults can also potentially be sourced from various drains and irrigation ditches – like CDFW's effort during fall-run Trap and Haul. Sourcing fish from these locations can be used to make up any shortfall for Option 1 if necessary.

Data Analysis

Data will be analyzed using R version 4.2.3 (R Core Team 2023). Data exploration will be done using the *DataExplore* package (v0.8.2; Cui 2020). Data will be modeled using the *stats* package in base R (v 4.2.3; R Core Team 2023) and the *Survival* package (v3.5-3; Therneau 2023). Data will be visualized using the *ggplot2* package (v3.3.5; Wickham 2016).

Our primary study question is, can fish pass the SJRBS in 'low flows' (160 – 180 cubic feet per sec^{-1}) and/or at 'high flows' (260 – 280 cubic feet per sec^{-1})? The response variable is binary in nature (i.e., Yes or No). Since flow will be held constant and the study will ultimately test 'low flow' and 'high flow', the predictor variable will be treated as a categorical variable for the analysis. Since our sample size will be small, Fisher's exact test will be used to analyze the data (Fisher 1971, Bower 2003, Soetewey 2020). The "fisher.test()" function in base R will be used for analysis (R Core Team 2023). Statistical significance will be evaluated based on an $\alpha = 0.05$. Study fish will be released in groups of 4 (3-groups per treatment level) to account for random day variation and reduce the chance of non-detection due to signal overlap. Passage estimates (percentage of fish that passed) per flow level will be calculated for descriptive purposes only. Fisher's exact test requires the construction of a two-by-two contingency table and uses the total population ($N = 24$) when calculating the exact p-value and odds ratio (Fisher 1971). Confidence interval for the odds ratio will be calculated as well. Covariates (e.g., fork length, sex, age – estimate from length, internal body temperature, and ambient water temperature) will be recorded and used for potential additional analysis if model assumptions are met. Additionally, the percentage of wetted area blocked by debris on the trash rack at the time of the study will be estimated and photo recorded.

Our secondary study question is, how long does it take fish to pass the SJRBS? The response variable is continuous in nature (i.e., minutes, hours, days) and the predictor variable is again categorical, either low or high flows. Time to event analysis such as Kaplan-Meier or Cox Proportional Hazards model will be used to model the variance in time it takes each fish to pass the structure. This analysis could be limited in application and will be dependent on final detection rates. Both models allow for data to be censored and are the primary reason they were selected.

Land Access

Land access will be coordinated through the SJRRP's Land Coordinator, Craig Moyle and Public Affairs Specialist, Josh Newcom. Permissions to enter the river on lands that are privately owned will be obtained prior to entering. When possible, entry from public access areas will be used unless it is time prohibitive. A field activity advisory notifying the public of our activities will be made available on the SJRRP website prior to the start of the study at: https://www.restoresjr.net/get-involved/field-advisories/.

Preliminary Cost Estimates

It is estimated that the implementation of this study will cost approximately $87,923.63 U.S. dollars, supported by State monies through Proposition 84. Apart from capturing and releasing fish the study is predominantly passive. The only federal appropriations used will be those necessary for obtaining land access and general in-meeting coordination. Acoustic telemetry equipment is already procured for the study, including necessary acoustic tags.

Fall-run and Spring-run Interactions

Spring-run Chinook Salmon migrate upstream from March through June and hold in deep pools until they are ready to spawn. Fall-run Chinook Salmon adults migrate into fresh water between September and December. Under restoration conditions, both spring-run and fall-run could spawn within the same river reaches. Although spring-run and fall-run have different spawn timing, enough overlap could exist such that in the absence of any management efforts to preclude hybridization, introgression could occur in the Restoration Area (Tomalty et al. 2014). However, this study is scheduled to begin in November and most if not all the spring-run in the upper San Joaquin River will have likely spawned by the time this study begins. This still leaves the possibility for superimposition. This study will allow for Program staff to make general observations should superimposition occur. The small number of fall-run as part of this study are not likely to grossly impact overall juvenile spring-run production.

Schedule and Reporting

A summary report on telemetry findings will be produced for the study and distributed to the FMWG, Program Management Team, Restoration Administrator, and Technical Advisory Committee.

1.7 Applicability to SJRRP Fisheries Efforts

The 2010 Fisheries Management Plan (FMP) and 2018 Fisheries Framework (FF) both identify fish passage objectives (SJRRP 2010, 2018). The SJRRP has adopted the following spring-run Chinook Salmon habitat objective related to fish passage:

Habitat Objective 4. During the Recolonization Phase, provide passage conditions that allow 90 percent of migrating adult and 70 percent of migrating juvenile Chinook Salmon to successfully pass to suitable upstream and downstream habitat respectively, during all base flow schedule component periods and water year types of the Settlement, except the Critical-Low water year Type. Increase the adult upstream passage survival rate to greater than 95 percent and the juvenile downstream passage survival rate to greater than 90 percent during the Local Adaptation Phase.

1.8 Outline of Additional Study Years

This proposal is focused on answering the basic question of can adult fall-run Chinook Salmon pass the SJRBS under two distinct flow conditions. Expanding Study questions (Appendix A) beyond this aim would require the purchase of acoustic receivers that can adequately sample large numbers of acoustically tagged fish. This pilot study can be used to evaluate the cost/benefit of purchasing the appropriate receivers necessary to sample larger groups of fish, and strength future grant applications for competitive external funds for procuring such equipment. Larger sample sizes would allow for a more thorough evaluation of passage success/failure as well as time to pass. And allow evaluation of other passage improvements that would provide a measure of success or provide insight into what impacts the remaining structures have on migrating fish and how those might impact the achievement of the Restoration Goal. Further, a larger sample size would allow for more thorough evaluation of fall-run/spring-run interactions within the spawning Reaches before volitional recolonization of fall-run occurs at the completion of Program passage projects.

1.9 Point of Contacts/ Principal Investigators

Principal Investigator

Mike Grill, California Department of Fish and Wildlife, 559-240-5978,
mike.grill@wildlife.ca.gov

1.10 References

Berejikian, B.A., D.M. Van Doornik, R.C. Endicott, T.L. Hoffnagle, E.P. Tezak, M.E. Moore, and J. Atkins. 2010. Mating success of alternative male phenotypes and evidence for frequency dependent-selection in Chinook Salmon, Oncorhynchus tshawytscha. Canadian Journal of Fisheries and Aquatic Sciences 67:1933-1941.

Berejikian, B.A., J.T. Gable, and D.T. Vidergar. 2011. Effectiveness and trade-offs associated with hydraulic egg collections from natural salmon and Steelhead redds for conservation hatchery programs. Transactions of the American Fisheries Society 140: 549 – 556.

Bower, K.M. 2003. When to use Fisher's Exact Test. Research Gate.

Cui, B. 2020. DataExplorer: Automate Data Exploration and Treatment. R package version 0.8.2, https://CRAN.R-project.org/package=DataExplorer

Department of Water Resources. 2010. San Joaquin River Restoration Program Fish Passage Evaluation. Division of Integrated Regional Water Management, South Central Region Office. March 2010.

Fisher, Sir R.A. 1971. The design of experiments. https://home.iitk.ac.in/~shalab/anova/DOE-RAF.pdf

National Marine Fisheries Service (NMFS). 2021. Reintroduction of Spring-run Chinook Salmon to the San Joaquin River, from the Merced confluence to the Friant Dam. Endangered Species Act Section 10(a)(1)(A) Permit, File Number 20571.

NRDC et al. v. Kirk Rodgers et al. 2006. United State District Court. Case No. CIV S-88-1658 LKK/GGH.

R Core Team. 2023. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Root, S., Z. Sutphin, J. Hutcherson, C. Hueth, D. Portz, P. Ferguson, and M. Bigelow. 2017. San Joaquin River Fall-run Chinook Salmon Trap and Haul, 2012–16. San Joaquin River Restoration Program, Final Monitoring and Analysis Report. Bureau of Reclamation, Denver Technical Service Center, Colorado.

Romero, Paul. November 2020 presentation and discussion with the Flood Board. Available at: https://mavensnotebook.com/2020/11/05/flood-board-update-on-the-san-joaquin-river-restoration-program/

San Joaquin River Restoration Program (SJRRP). 2018. Fisheries Framework: Spring-run and Fall-run Chinook.

San Joaquin River Restoration Program (SJRRP). 2010. Fisheries management plan: a framework for adaptive management in the San Joaquin River Restoration Program.

San Joaquin River Restoration Program (SJRRP). 2021a *in draft prep*. Administrative Draft Fishery Long-Term Monitoring Plan. May 2021.

Soetewey, A. 2020. Fisher's exact test in R: independence test for small sample. https://statsandr.com/blog/fisher-s-exact-test-in-r-independence-test-for-a-small-sample/

Sutphin, Z. and S. Root. 2024. Adult Spring-run Chinook Salmon monitoring and trap and haul. 2024 Administrative Draft Proposal.

Therneau T. 2023. A Package for Survival Analysis in R. R package version 3.5-3, https://CRAN.R-project.org/package=survival

Tomalty, K., M. Stephens, M. Baerwald, K. Börk, M. Meek, and B. May. 2014. Examining the causes and consequences of hybridization during Chinook salmon reintroductions: Using the San Joaquin River as a restoration case study of management options. San Francisco Estuary and Watershed Science 12(2):1–18.

Vendittie, D.A., C.A. James, P. Kline. 2013. Reproductive Behavior and Success of Captive-Reared Chinook Salmon Spawning Under Natural Conditions. North American Journal of Fisheries Management. 33:97-107.

Weeber, M. A., G. R. Giannico, and S. E. Jacobs. 2010. Effects of Redd Superimposition by Introduced Kokanee on the Spawning Success of Native Bull Trout. North American Journal of Fisheries Management 30(1):47–54.

Wickham, H. 2016. ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag New York. *Personal Communications*

Yoshiyama, R. M., Fisher, F. W., and P.B. Moyle. 1998. Historical abundance and decline of chinook salmon in the Central Valley region of California. North American Journal of Fisheries Management 18: 487-521.

APENDIX A

Additional future study questions:

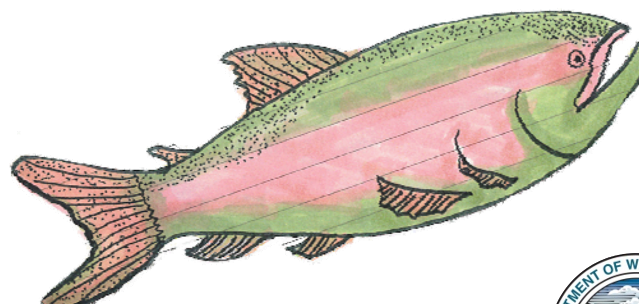
- What type of difficulties can be observed at the bifurcation structure constraining fish passage for fall-run Chinook Salmon?
- If the tagged fall-run Chinook Salmon pass the bifurcation structure, what type of observations can be documented regarding their interaction with spring-run in the spawning grounds of Reaches 1 and 2?
- What scheduled flow benches result in successful migration past the Chowchilla Bifurcation Structure?
- What hydrologic conditions are observed within the barrier reach, including flow velocities and depths?
- What is the passage efficiency of adult fall-run Chinook Salmon at the Chowchilla Bifurcation Structure?
- What delays in migration are observed, and to what extent, during adult fall-run migration?
- What behavior is observed by adult fall-run Chinook Salmon from time of release until reaching the spawning grounds?
- What other factors, such as flow, temperature, and other parameters, affect adult movement upstream?

4. Chowchilla Fish Passage Structures_f

Chowchilla Bypass

FISH PASSAGE DILEMMA

Alexis Phillips-Dowell, P.E.
Senior Engineer
Department of Water Resources
DIRWM South Central Region Office

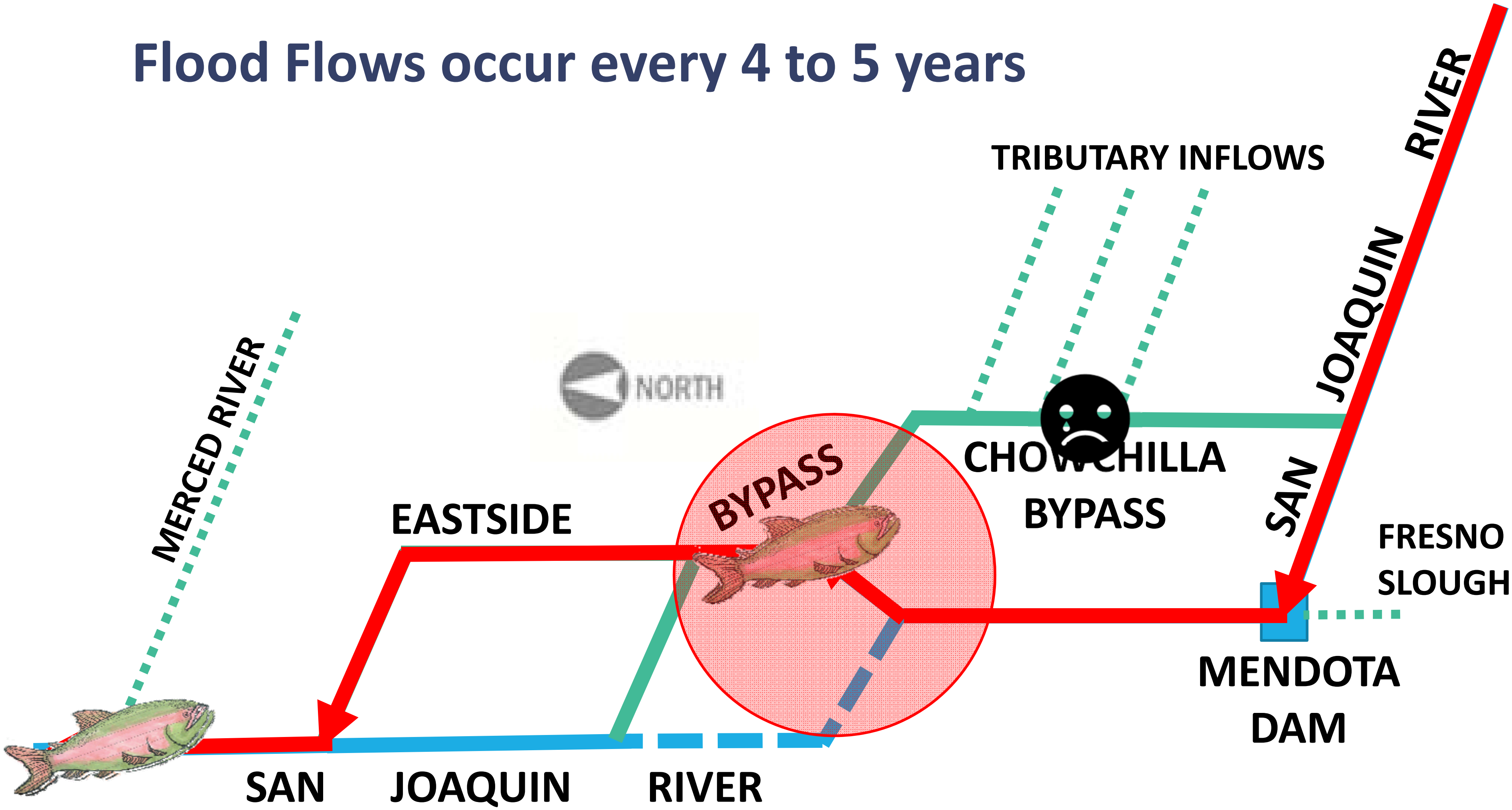


Overview

- Existing System
- Dilemma
- Fish Passage Constraints
- Potential Solutions
- Future Program Considerations

San Joaquin River and Flood System

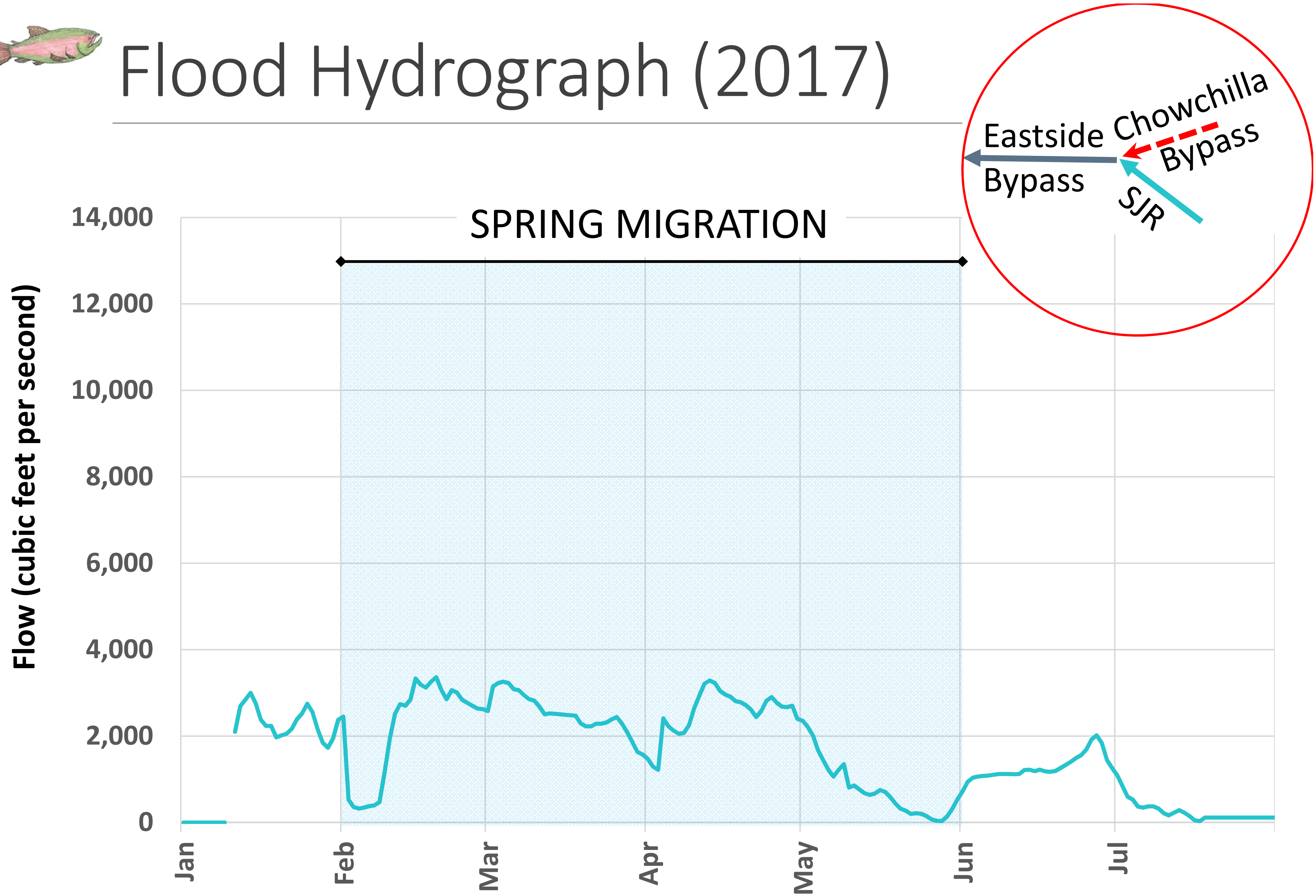
Flood Flows occur every 4 to 5 years

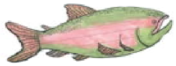


Heavily managed system

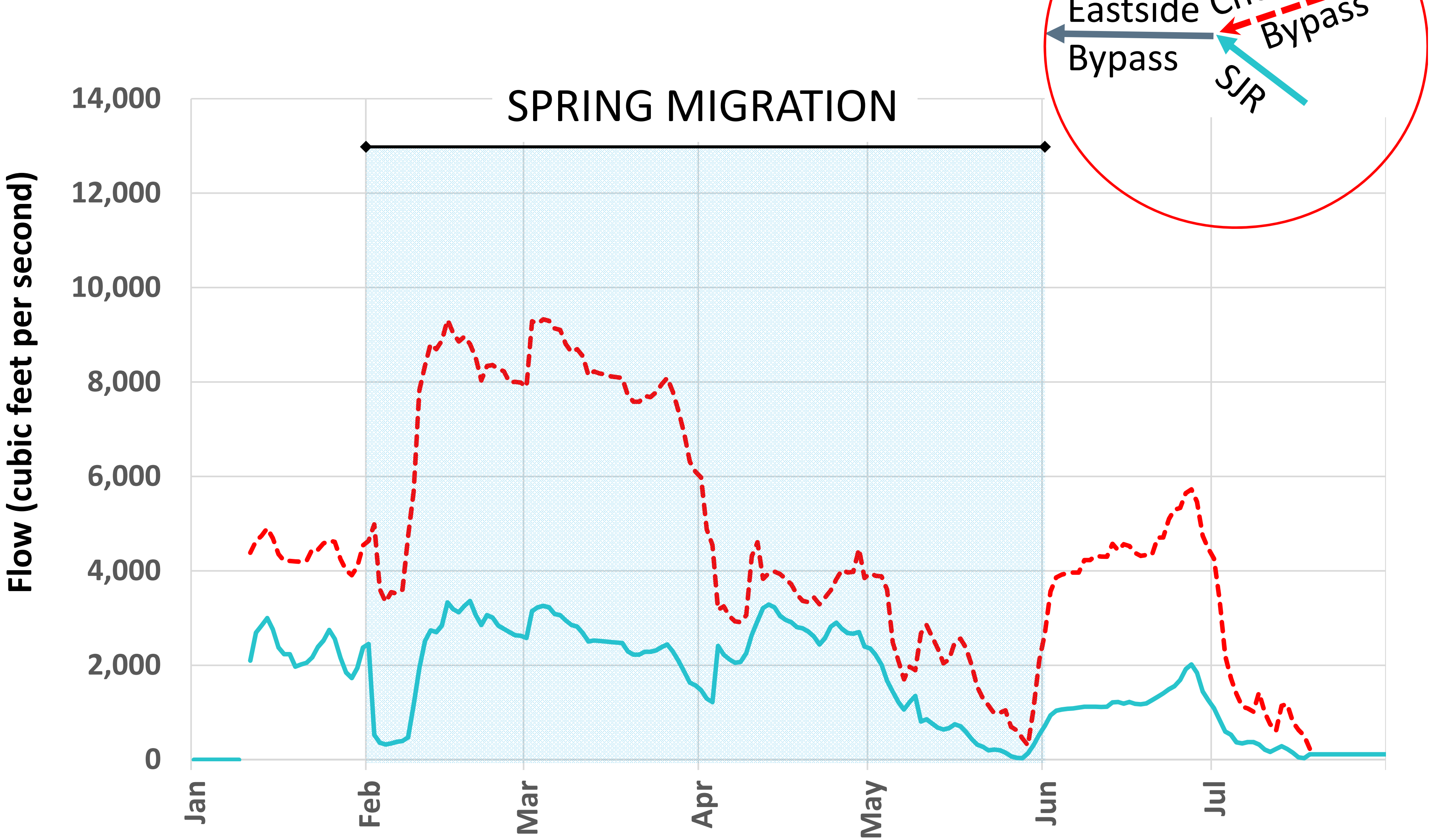
Bypass and River Interchange

Flood Hydrograph (2017)

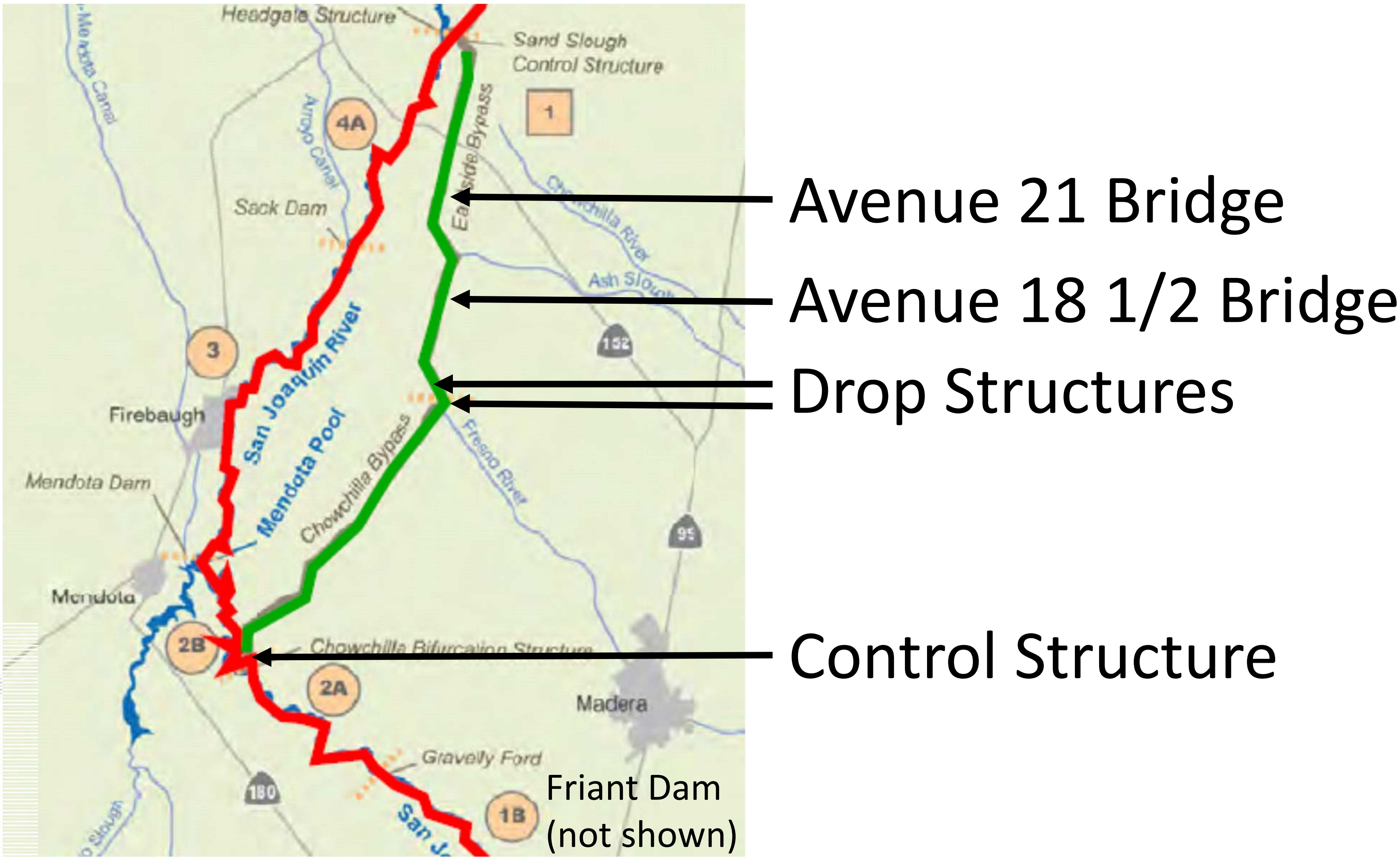




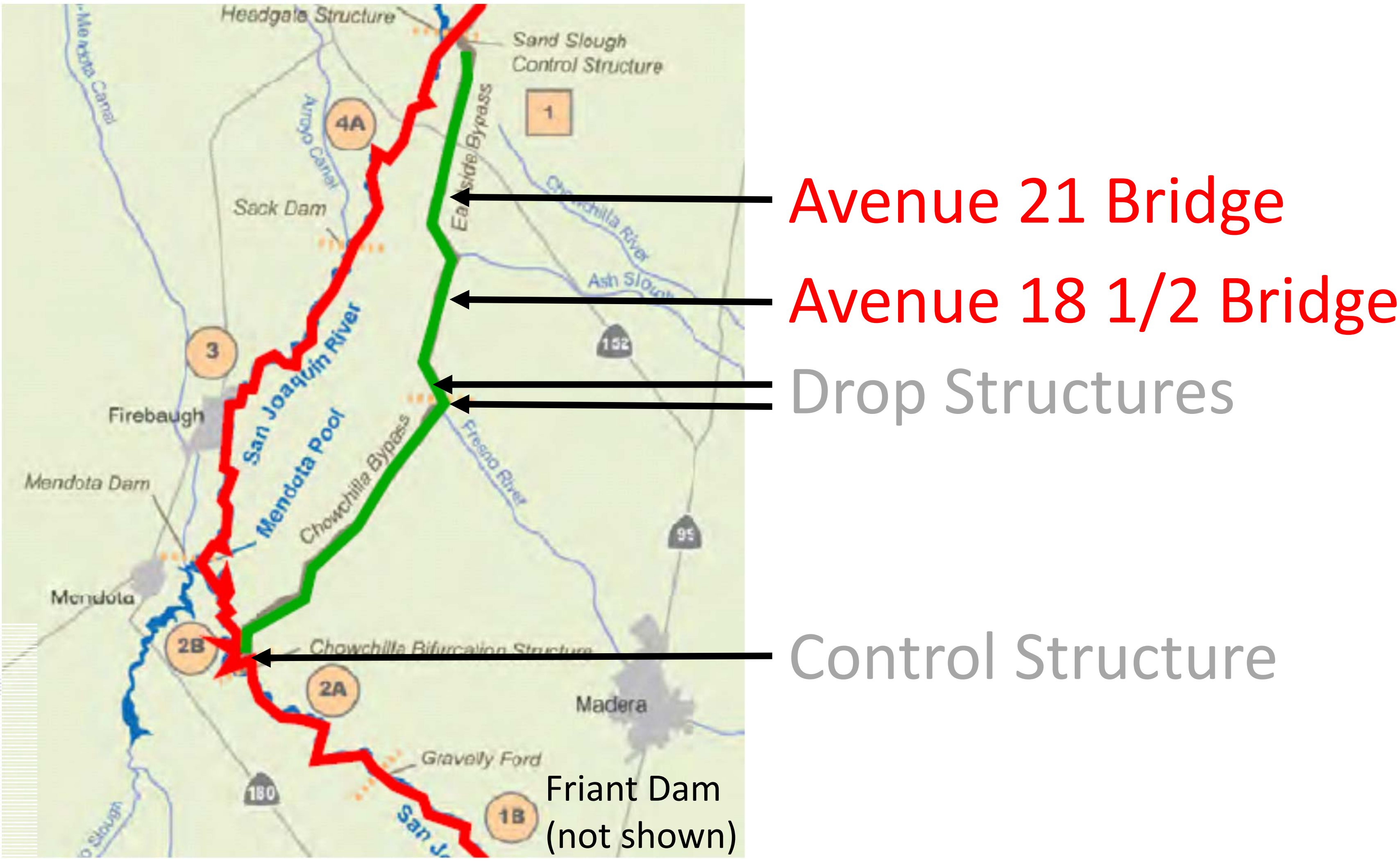
Flood Hydrograph (2017)



Chowchilla Bypass Overview Map

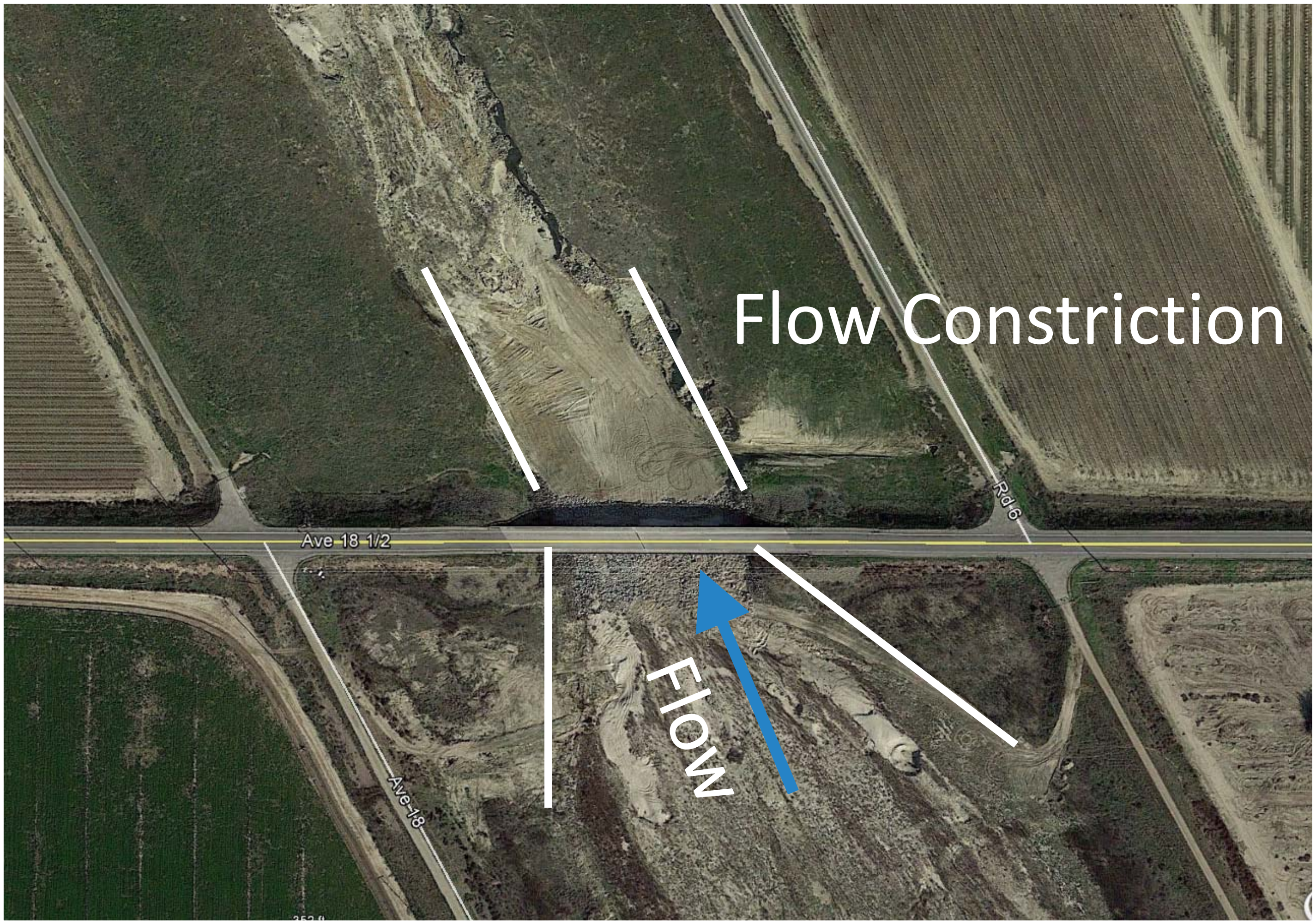


Chowchilla Bypass Overview Map



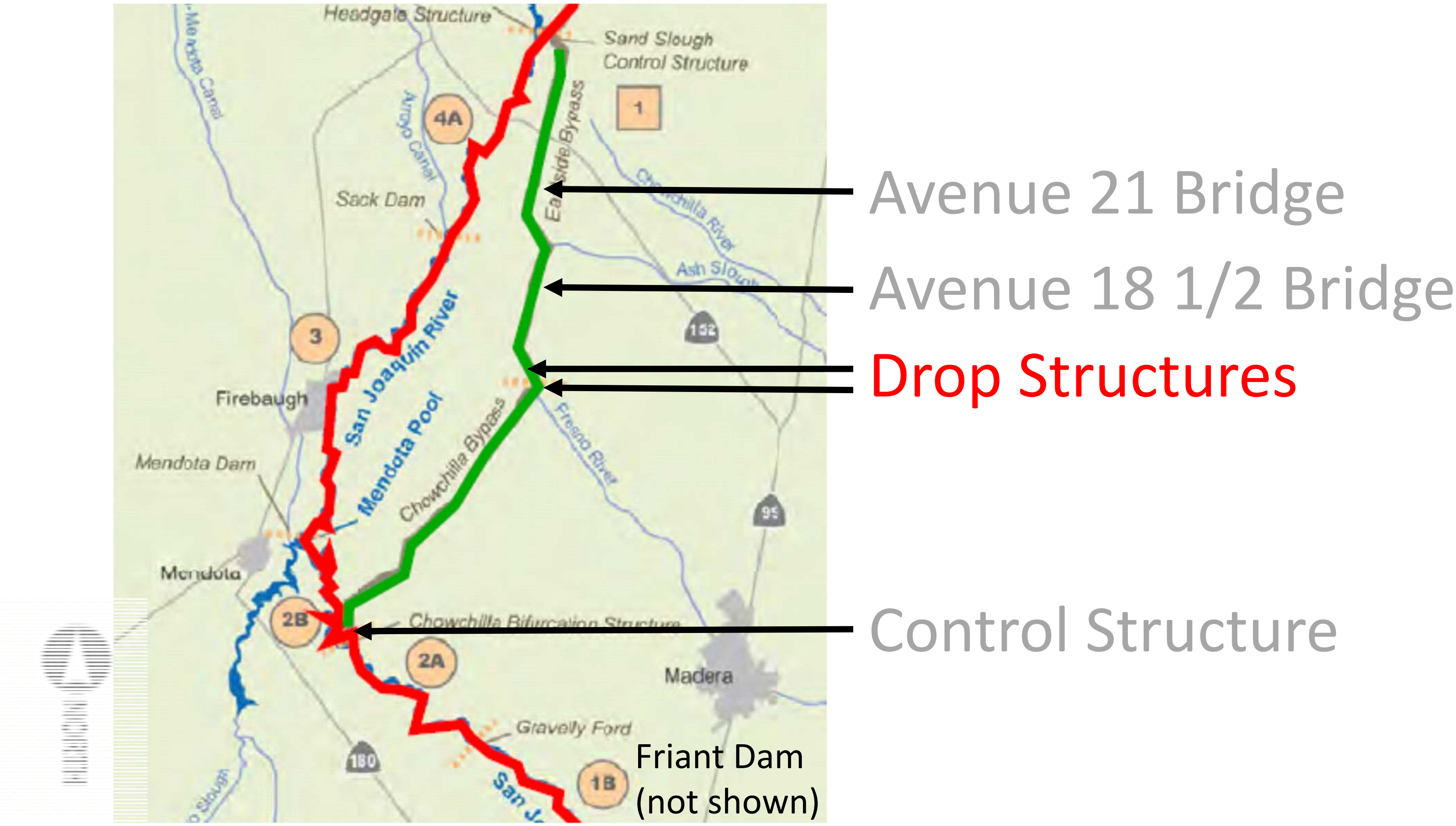
Avenue 21 and 18 1/2 Bridges

Avenue 21 and 18 1/2 Bridges



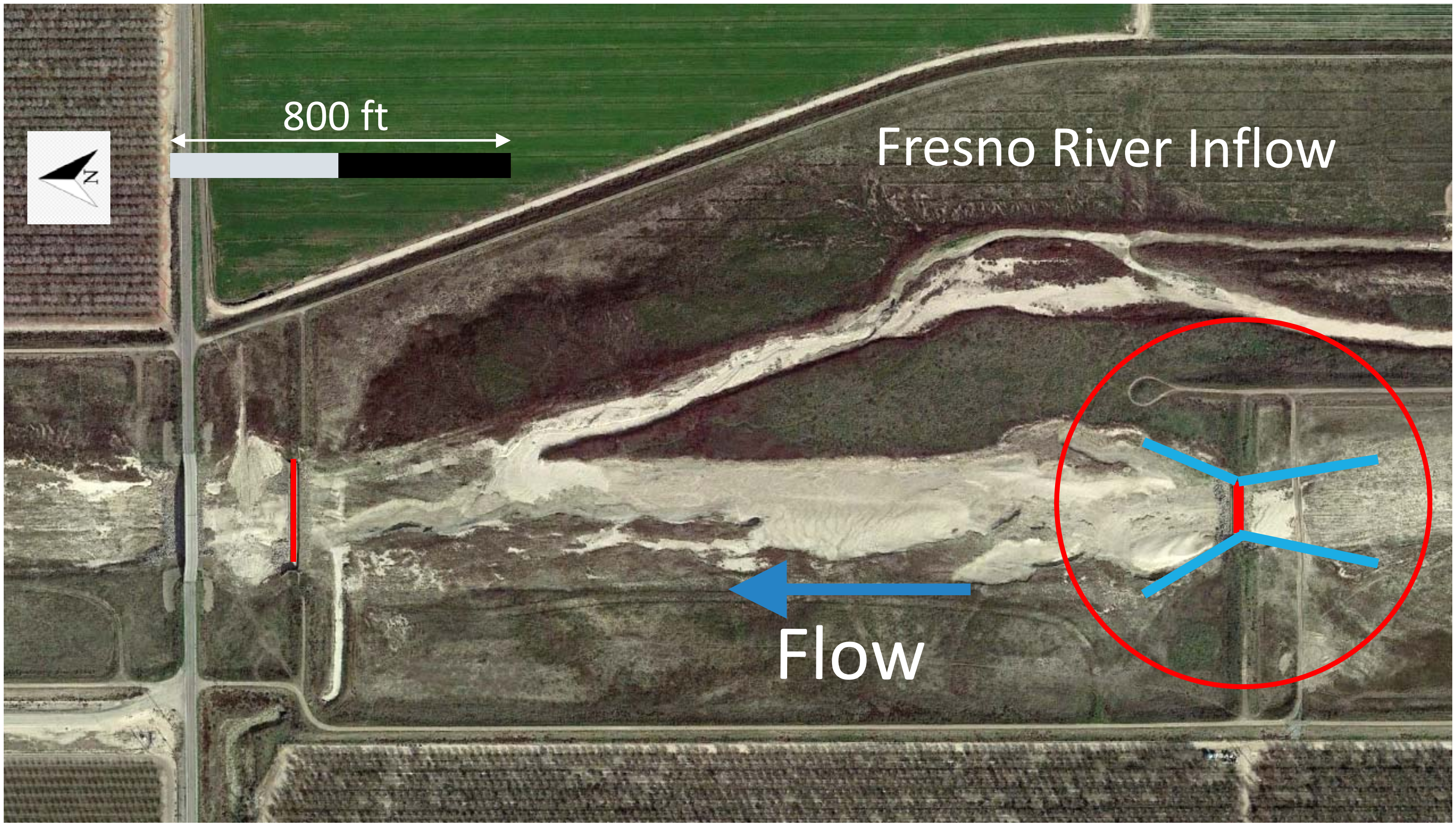
Avenue 18 ½ Bridge

Chowchilla Bypass Overview Map



Drop Structures

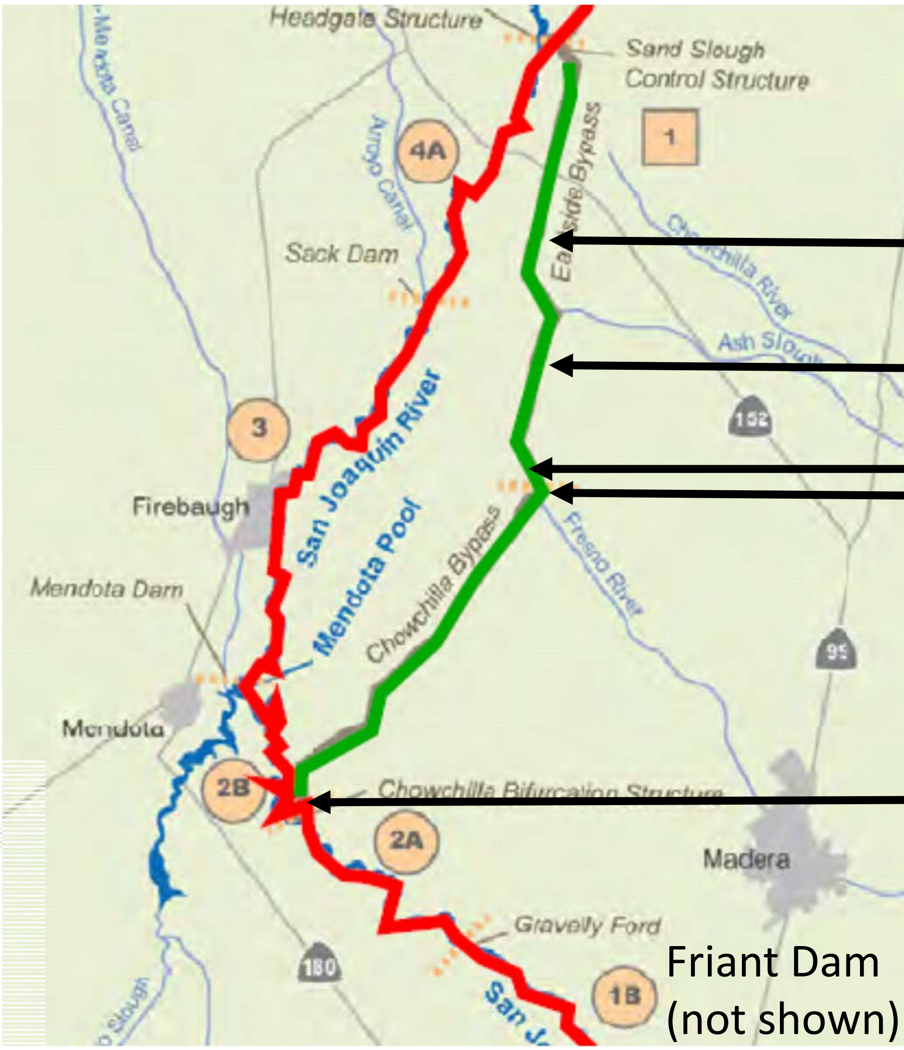
Drop Structures



Constricted Flow

Drop Structure 2

Chowchilla Bypass Overview Map



Avenue 21 Bridge

Avenue 18 1/2 Bridge

Drop Structures

Control Structure

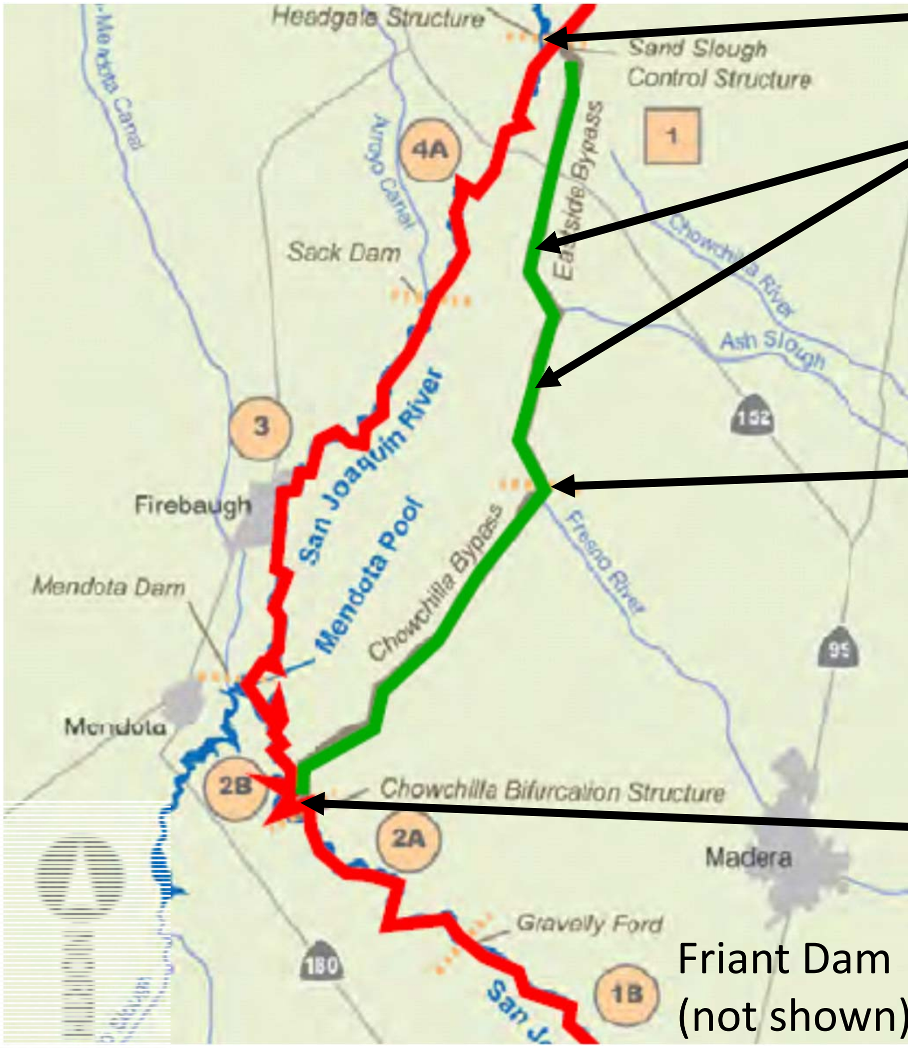
Chowchilla Bifurcation Structure

Energy Dissipation Blocks

Chowchilla Bifurcation Structure

Typical Improvements

Potential Options

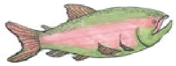


New Screen/Barrier

Bridges
- -Remove/Replace
- -Natural Fishway
- -Grade control

Drop Structures
- -Remove/Replace/Modify
- -Natural Fishway
- -Ladder

Control Structure
- -Modify
- -Natural Fishway
- -Ladder

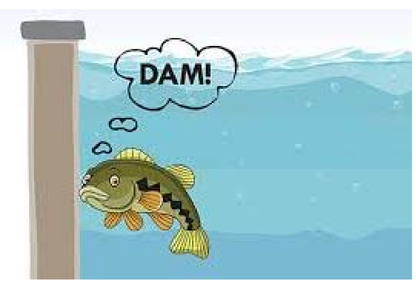


Future Program Considerations

- How could fish migrating into the Chowchilla Bypass during flood years (every 4 to 5 years) affect the SJRRP reintroduction efforts?

- Is providing fish passage in the Chowchilla Bypass a priority to the SJRRP given the potential costs?

- What information is needed for the SJRRP to determine the next steps?



5. 2023 June16_Site Visit Summary Eastside Bypass Fish Barriers

Introduction

The California Department of Water Resources (DWR) South Central Region Office (SCRO) and the San Joaquin River Restoration Program (SJRRP) Restoration Administrator (RA) conducted a site visit to six previously identified fish passage barriers within the Eastside Bypass on June 16, 2023. The six sites include Drop 2 (the upstream drop structure near the Fresno River and Eastside Bypass confluence), Avenue 18.5 bridge, Avenue 21 bridge, Mariposa Bypass Drop Structure, Mariposa Bypass Control Structure, and the Eastside Bypass Control Structure. These fish passage barriers are further described in Tasks 1 and 2 in the SJRRP Fish Passage Evaluation reports. The purpose of the site visit was to discuss fish passage conditions and brainstorm potential low-cost, short-term solutions, that can be implemented within the next few years — with concepts created by the end of this calendar year.

Sites were prioritized based on brief observations and discussions at each site. Barriers within the Upper Eastside Bypass (UESB) were given higher priority to further evaluate; these barriers include Drop 2, Avenue 18.5, and Avenue 21. The following sections include a brief summary on flow conditions and discussions between DWR and the RA at each priority site.

Drop 2

We arrived at Drop 2 at approximately 8:45am. Flow diagrams from the SJRRP and Mendota Pool watermaster show an average flow of approximately 4,200 cfs on June 16th through the Chowchilla Bypass (Attachments 1 and 2). Furthermore, the California Data Exchange Center (CDEC) station CBP recorded unsteady flows through the reach between 4,000 and 4,400 cfs (Figure 1). This excludes a dip in the hydrograph observed late morning showing a sudden flow reduction down to approximately 3,600 cfs. Given the state of unsteady flows and considering the travel time between the CDEC station and the drop structure, actual flows at the site may be greater than flows recorded that day. In addition, the Fresno River had a flow of approximately 150 cfs (Attachment 2). This additional inflow is much lower than the flow in the bypass and backwater conditions from it likely had a negligible impact on the observations.

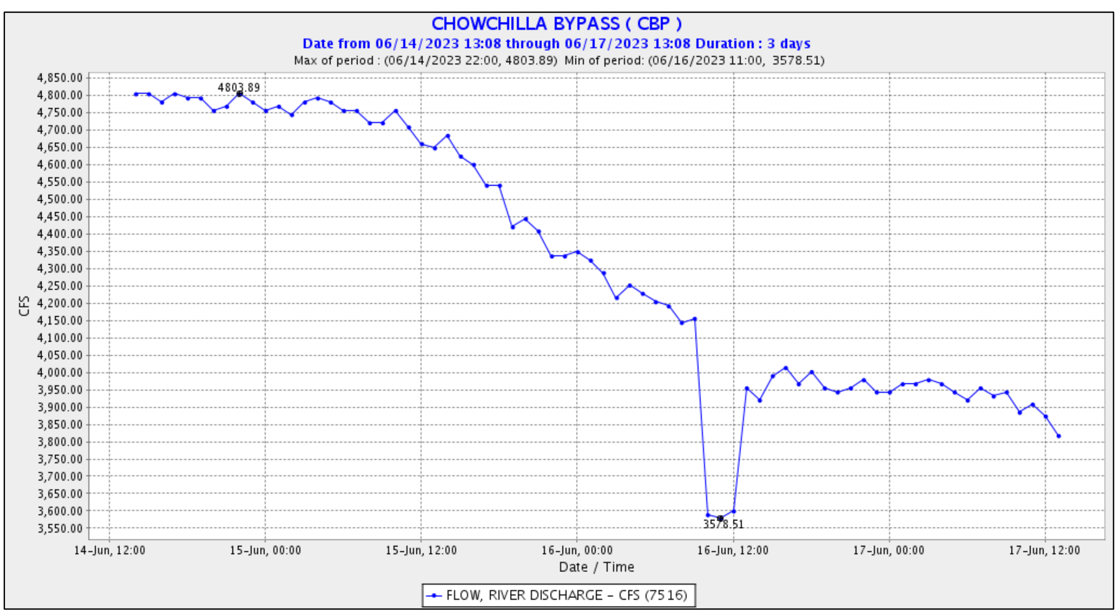


***Figure 1** CDEC Station CBP, hourly flow data between June 14th and 17th*

As shown in Figure 2, a 3–4 feet (ft) drop in water surface elevation (WSE) was observed over the drop structure with a hydraulic jump occurring immediately downstream forming an undulating water surface pattern as the energy dissipates. All agreed that the observed velocity and drop at this site are barriers to upstream fish migration.

Figure 2 *Drop 2 structure with high velocities and a drop that can prevent fish passage upstream*

The RA is seeking a "quick and easy solution" that could be done potentially by the Lower San Joaquin Levee District (LSJLD) through their maintenance activities. This includes either retrofitting the existing structure or constructing a 20–30 ft-wide fish ladder around it on either bank. The modification would be designed to provide fish passage at a minimum flow of 4,000 cfs and focus only on salmonid criteria.

Steps we would need to take include updating the hydraulic model, collecting field data (topographic and hydraulic), evaluating fish passage conditions, understanding the LSJLD maintenance around the area, and creating project concepts within the capacity of the LSJLD. Additional considerations include researching the purpose and existing needs for Drop 2 (i.e., flood, diversions, confluence dynamics, etc.).

Avenue 18.5 Bridge

We arrived at the Avenue 18.5 bridge at approximately 9:30am. The total flow at this site would have been similar to the conditions at Drop 2, with the exception of tributary inflows from the Fresno River and Berenda Slough, and potential backwater from Ash Slough. Berenda and Ash sloughs had a combined inflow of approximately 300 cfs (Attachment 2). The flow split between sloughs is unknown, but the impacts may have been negligible considering that flows in proportion were significantly lower compared to what was already in the bypass.

Figure 3 *Avenue 18.5 Bridge. (Left) Observed drop downstream of the bridge with high velocities from the right bank. (Right) Eroded right approach embankment exposing the abutment.*

The bridge remained closed to traffic after high flows earlier in the year eroded the right approach embankment and exposed the abutment (Figure 3). There was an apparent drop in WSE just downstream of the bridge appearing to range between 2 –3 ft. The drop appeared to vary along the length of the bridge deck. Flows around the right bank continued further downstream forming an eddy over a relatively gradual slope giving the appearance of a lower drop compared to the other areas; whereas the total drop along the left bank appeared to be split between a series of two drops. These flow conditions along the channel banks provide potential opportunities for fish passage if velocities do not exceed the bursting capability of adult salmon.

The RA suggested a solution to make improvements for fish passage when the maintaining agency (County?) maintains or fixes the bridge. The solution would involve making recommendations on the placement of riprap protection that would also benefit fish passage. The placement would not need to encompass the entire span of the bridge and could focus just on a 20–30 ft section on either or both banks where riprap would likely be placed to protect the abutments.

Fish passage improvements to this area would be designed to provide passage at a minimum flow of 4,000 cfs and focus only on salmonid criteria. Steps we would need to take include updating the hydraulic model, collecting field data (topographic and hydraulic), evaluating fish passage conditions, understanding the maintenance plan (current and future), and creating project concepts that would fit within the maintenance scope. A 2-dimensional model would be beneficial in understanding the hydraulic variability downstream of the bridge.

Avenue 21 Bridge

We arrived at the Avenue 21 bridge at approximately 10:00am. Total flows would have been similar to that at Avenue 18.5, with a minor addition from Ash Slough.

Figure 4 *Avenue 21 Bridge. (Left) Photo taken from the right showing a potential fish passage route along the right bank where the drop appeared lower. (Right) Potential fish passage route along the left bank where the drop also appeared to be lower.*

Similar to the bridge at Avenue 18.5, the hydraulic conditions just downstream of Avenue 21 varied along the span of the bridge deck. The total drop appeared to range between 1–2 ft with lower drops along the channel banks (Figure 4). The areas along the channel banks appeared to have a more gradual hydraulic slope as opposed to the sudden drop around the channel center. The gradual slope was most apparent along the right bank where the total drop was spread over a greater distance as flows were routed along a slight curve before entering the main channel — somewhat mimicking a partial-width rock ramp fishway. A gradual slope in water surface was also observed along the left bank, although not as obvious because of the appearance of rapid whitewater (Figure 4).

Fish passage conditions at this bridge appeared opportunistic and may be passable if velocities do not exceed salmonid bursting capabilities. This would need to be confirmed with data collection and hydraulic modeling. If the conditions on either bank are appropriate for fish passage, it can be used as a model and example for improvements at Avenue 18.5. Because this bridge did not appear to be a complete barrier to fish passage, it was placed on a lower priority for developing project concepts. However, based on historical aerial imagery from Google Earth, it appears that the County and/or LSJLD maintains the channel and riprap protection following a flood event. Maintenance following this year's flood may change fish passage conditions observed during the site visit. Although this site has a low priority for developing concepts, it would be good to know what sort of maintenance is planned in order to evaluate its potential impacts and make recommendations to either preserve or improve fish passage conditions. Engaging with the maintaining agencies following a flood event could provide opportunities for trial and error in placing riprap protection that would also benefit fish passage.

Lower Priority Sites

The Mariposa Bypass structures were given a lower priority because the observed conditions did not appear to be complete fish passage barriers. The reasoning may also be that most restoration flows would continue through the Lower Eastside Bypass (LESB) rather than the Mariposa Bypass. During the site visit, flows were approximately 7,000 cfs through the Middle Eastside Bypass (MESB) with a nearly even split of approximately 3,500 cfs between the LESB and Mariposa Bypass (Attachments 1 and 2).

Figure 5 *Mariposa Bypass Structures. (Left) Drop structure at the downstream end. (Right) Control structure at the upstream end.*

As shown in Figure 5, the drop in WSE appeared to be no more than 1 ft at both structures, which should be adequate for fish passage. However, the RA mentioned that the proposed project concepts for the Mariposa Bypass structures would be designed for a minimum flow of about 1,000 cfs. The drop in WSE would likely be greater than what was observe, which would further obstruct fish passage. Data collection and hydraulic modeling would be required to evaluate and verify fish passage conditions at these sites. Concepts discussed at the downstream drop structure were similar to Drop 2 and include researching modifications designed for the LSJLD maintenance — either retrofitting the existing structure or designing a fish ladder around it.

6. Next Steps: Top Actions to improve Habitat and Productivity

- Forthcoming