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RECLAMATION

# **Stanislaus Watershed Team Annual Summary of Activities for Water Year 2024**

**Central California Area Office, Folsom, CA**

**Interior Region 10- California-Great Basin**



## **Mission Statements**

The U.S. Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated Island Communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

# **Stanislaus Watershed Team Annual Summary of Activities Water Year 2024**

**New Melones Reservoir, CA**

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Cover Photo: Recently restored habitat at Kerr Park along the Stanislaus River (Cramer Fish Sciences/Jesse Anderson)



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## Acronyms and Abbreviations

Term	Definition
AF	Acre-feet
BA	Biological Assessment
BiOp	Biological Opinion
CDEC	California Data Exchange Center
CDFW	California Department of Fish & Wildlife
CFS	cubic feet per second
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CV	Central Valley
cy	Cubic yards
Districts	Oakdale and South San Joaquin Irrigation Districts
DO	Dissolved Oxygen
DWR	California Department of Water Resources
ESA	Endangered Species Act of 1973 (Section 7)
LTO	Long term operations of CVP
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OBB	Stanislaus River at Orange Blossom Bridge (CDEC gauge)
OID	Oakdale Irrigation District
PA	Preferred Alternative
PSMFC	Pacific States Marine Fisheries Commission

Reclamation	U.S. Bureau of Reclamation
rm	River mile
ROD	Record of Decision
SEWD	Stockton East Water District
SOG	Stanislaus Operations Group
SRP	Stepped Release Plan
SSJID	South San Joaquin Irrigation District
SWP	State Water Project
SWT	Stanislaus Watershed Team
SWRCB	State Water Resources Control Board
TAF	Thousand-acre feet
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish & Wildlife Service
WAPA	Western Area Power Administration
WIF	Winter Instability Flow
WY24	Water year 2024

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# Chapter 1 Introduction and Background

## 1.1 Introduction

This Summary of Activities provides an overview of biological, fishery, and operational discussions, as well as operational decisions related to the Stanislaus River in Water Year 2024 (WY24) in compliance with the United States Bureau of Reclamation's (Reclamation) 2020 Record of Decision (ROD) for the Coordinated Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP) and analyzed in the 2019 National Marine Fisheries Service (NMFS) Biological Opinion (BiOp).

## 1.2 Background

The Stanislaus River is important to a variety of stakeholders, including fishery management agencies, the public, water users, and federal government agencies. The United States Army Corps of Engineers (USACE), the United States Fish and Wildlife Service (USFWS), NMFS, California Department of Fish and Wildlife (CDFW), and the State Water Resources Control Board (SWRCB) in conjunction with Reclamation are agencies that hold trust responsibilities for fishery and water resources in the Stanislaus River. Reclamation is responsible for operating the East Side Division, which includes New Melones Dam and powerplant. The East Side Division is operated to provide flood control, water supply, power generation, general recreation, water quality, and fish and wildlife enhancement. The Tri-Dam Project, a partnership between the Oakdale Irrigation District (OID) and the South San Joaquin Irrigation District (SSJID), owns and operates multiple features on the Stanislaus River. These include Donnell's and Beardsley dams and reservoirs (upstream of New Melones) and Tulloch Dam and Reservoir (downstream of New Melones). The Tri-Dam Project owns Goodwin Dam and Reservoir located downstream of Tulloch Dam. A map of key locations in or near the Stanislaus River watershed is provided in **Figure 1-1**.

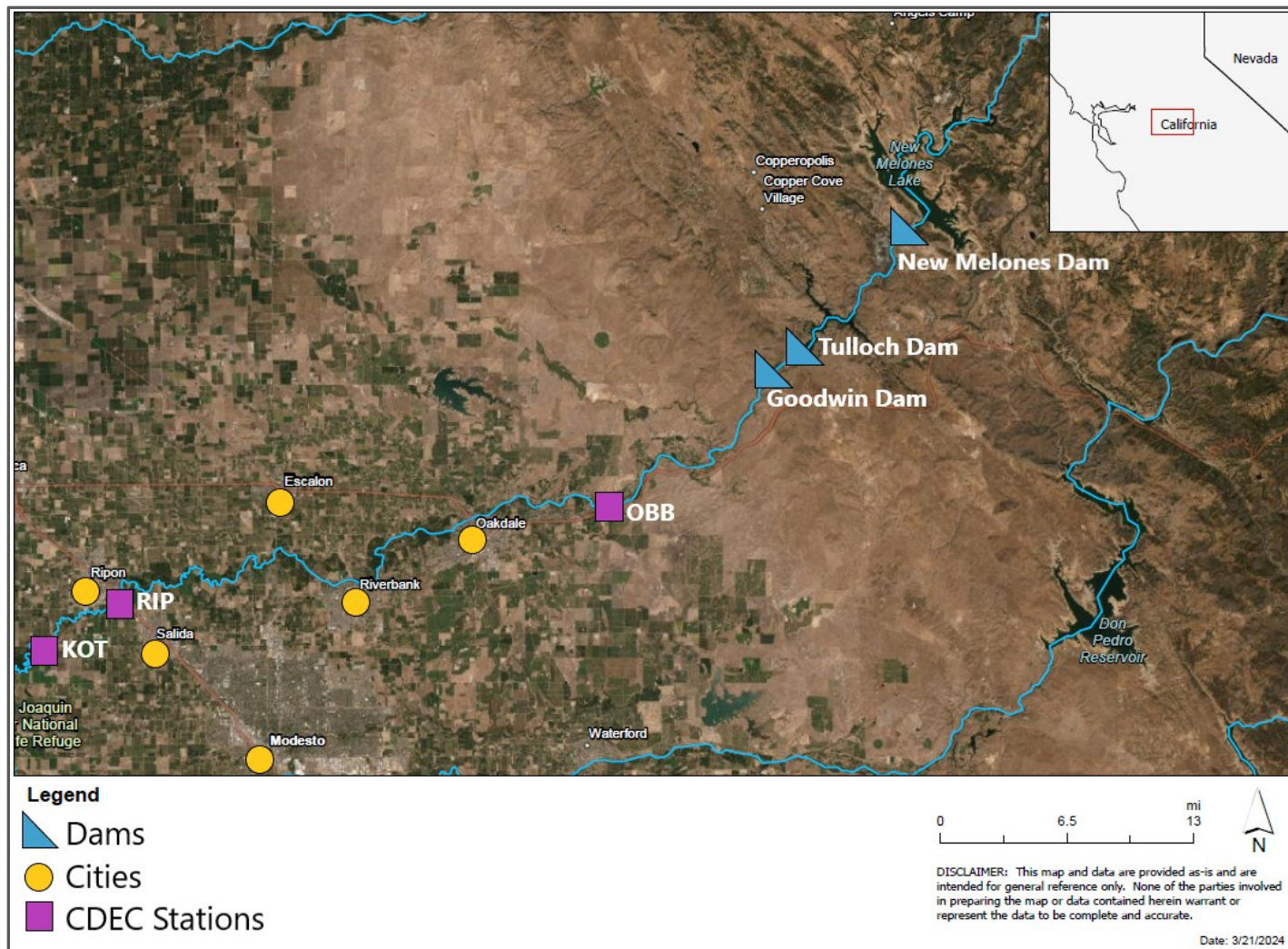


Figure 1-1. Key locations on or near the Stanislaus River watershed.

Figure 1-1 is a map of the Stanislaus River watershed, key locations such as dams (blue triangles), cities (yellow circles), and CDED stations (purple squares) are shown.

## 1.3 SWT Membership

On March 18, 2020, the Stanislaus Watershed Team (SWT) convened for the first time. Reclamation contracted with a meeting facilitation management firm to help develop and implement a transition plan for the technical team from Stanislaus Operations Group (SOG) to SWT. In July 2020, some local stakeholders (the Districts and Stockton East Water District [SEWD]) and monitoring organizations (FISHBIO and PSMFC) were incorporated into the SWT.

SWT member agencies and local stakeholders during WY24 included:

- U.S. Bureau of Reclamation
- U.S. Fish and Wildlife Service
- National Marines Fisheries Service
- California Department of Fish and Wildlife
- California Department of Water Resources (DWR)
- State Water Resources Control Board
- South San Joaquin Irrigation District
- Stockton Eastern Water District
- Oakdale Irrigation District
- FISHBIO
- Pacific State Marines Fisheries Commission
- Western Area Power Administration (WAPA)

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# Chapter 2 Preferred Alternative

## 2.1 Summary of Preferred Alternative Action Components

Implementation of the 2020 ROD began on February 19, 2020. The Preferred Alternative (PA) for the Stanislaus River operations includes flow and non-flow components (**Table 2-1**), summarized below.

Table 2-1. Components of the Preferred Alternative Related to the Stanislaus River System per Table 4-7 in Chapter 4 of the Biological Assessment (BA)

Component
Seasonal Operations
Stanislaus River Stepped Release Plan (including pulse flows)
Alteration of Stanislaus DO requirement
Spawning and rearing habitat restoration
Temperature Management Study
Yellow-billed cuckoo surveys

The following non-flow components of the PA are not discussed in this report as they have not been standing topics of discussion at SWT meetings during WY24.

- Temperature Management Study: Reclamation has been studying approaches to improving temperature for listed species on the lower Stanislaus River, including evaluating the utility of conducting temperature measurements/profiles in New Melones Reservoir. Reclamation is in the end stages of developing updated temperature models for all our rivers including the Stanislaus River. Once the Stanislaus River temperature model has completed testing and finalizing, Reclamation can start evaluating different means to improve temperatures in the lower Stanislaus River.
- Yellow-billed cuckoo surveys: Reclamation will coordinate with the USFWS to develop a baseline survey for the Yellow-billed cuckoo. The survey for this action would focus on the critical habitat areas, associated project sites, and occupied habitat within the action area. As of December 2024, this project has not yet started and coordination with USFWS is ongoing.
- Alteration of Stanislaus DO Requirement: During the summer, Reclamation is required to maintain applicable dissolved oxygen standards on the lower Stanislaus River for species

protection. Reclamation currently operates to a 7.0 mg/L dissolved oxygen requirement at Ripon from June 1 to September 30. Reclamation proposed to move the compliance location to Orange Blossom Bridge (OBB), where the species are primarily located at that time of year. This proposal has not yet been enacted.



## Chapter 3 SWT Discussion Topics

The following outlines topics consistent with the 2020 ROD components, as well as other agenda items, discussed at monthly SWT meetings from October 2023 through September 2024. Meeting notes and supplemental SWT documents were made available to SWT members and posted on the SWT Technical Group website.<sup>1</sup>

### 3.1 Monthly Discussion Topics

- Hydrology and temperature updates
- Operations Update and Forecast
- Stanislaus River Forum Call Review
- Fish Monitoring and Studies
- Restoration Project Updates
- Progress Update on Proposed Action Elements
- Flow Planning (seasonal)

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<sup>1</sup> The SWT Technical Team webpage can be found at the [Bureau of Reclamation Bay Delta Office Stanislaus Watershed Team](#) webpage.

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# Chapter 4 Water Operations Summary

## 4.1 Water Year Conditions and Operations

The WY24 Stanislaus River operations from October through January were based on Water Year type Wet from WY23. The beginning storage in New Melones for WY24 was 1,896 TAF. Beginning in February, the operations were based on Dry / Below Normal until the final DWR Bulletin 120 in May, when the final water year type was determined to be Above Normal (see **Table 4-2** for the progression of water year types during WY24). The WY24 Fall Pulse Flow occurred October 2, 2023, through November 3, 2023. Following the Fall Pulse Flow, the Stanislaus River flows were held at the minimum Stepped Release Plan (SRP, Appendix A) flow of 200 CFS. Even though the inflows were tracking below normal for the first part of the water year, with the excellent beginning storage conditions, Goodwin releases were increased to 1,000 CFS beginning January 5, 2024, and were increased again January 26, 2024, to 1,500 CFS for storage management purposes. Releases were held at that level with brief reductions to implement the winter instability flow, retrieve egg baskets and remove the weir at Riverbank until March 28, 2024. New Melones end of WY24 storage was 1,823 TAF, a decrease of 73 TAF from the beginning of water year storage. Salinity standards were not an issue in WY24 as they were met through existing flows.

## 4.2 New Melones Stepped Release Plan

The Stanislaus River watershed has annual obligations that can exceed the average annual runoff in a given year due to several factors, including SWRCB water rights decisions D-1641<sup>2</sup>, D-1422 and D-1616, the 1987 CDFW agreement, CVPIA (Central Valley Project Improvement Act) objectives, ESA (Endangered Species Act) requirements, the 1988 Agreement and Stipulation with OID and SSJID, riparian water right diverters, and CVP water delivery contracts.

The SRP (Appendix A) described in the 2020 ROD represents Reclamation's minimum contribution to lower Stanislaus River flows at Goodwin Dam. Reclamation may release additional flow at Goodwin Dam for storage management or other objectives, for example Ripon Dissolved Oxygen (DO) requirements.

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<sup>2</sup> D-1641 (2000) established flow and water quality requirements for the Sacramento-San Joaquin Delta to protect fish and wildlife beneficial uses, as well as to ensure proper water management and allocation in the region. It integrates guidelines for water rights, storage, and diversion activities to support both ecological health and water supply reliability.

Reclamation operates New Melones Reservoir (to provide targeted releases measured at Goodwin Dam) in accordance with an SRP that varies by hydrologic condition/water year type as shown in **Table 4-1**.

Table 4-1. New Melones SRP Annual Releases by Water Year Type

Water Year Type	Annual Release (TAF)
Critical	185.3
Dry	234.2
Below normal	345.7
Above normal	345.7
Wet	483.7

The SRP is implemented with a default daily hydrograph and the ability to shape monthly and seasonal flow volumes to meet specific biological objectives. The complete daily hydrograph for the New Melones SRP is available in Appendix A of this report.

## 4.3 Flow Management

The WY24 classifications for determining minimum flows are provided in **Table 4-2**. The water year classification was based on the San Joaquin Valley "60-20-20" Water Year Hydrologic Classification (60-20-20). The 60-20-20 index was developed for D-1641 implementation, and it provides operations that better represent current hydrology of the San Joaquin River Basin and correlates more closely to water year types for other nearby tributaries.

Table 4-2. Water Year Classification by Month during WY24

Month	Water Year Index (60-20-20) 90% Exceedance	Water Year Type (60-20-20) 90% Exceedance
October	6.31	Wet
November	6.31	Wet
December	6.31	Wet
January	6.31	Wet
February	2.18	Dry
March	2.81	Below Normal
April	3.06	Below Normal

Month	Water Year Index (60-20-20) 90% Exceedance	Water Year Type (60-20-20) 90% Exceedance
May	3.31	Above Normal
June	3.31	Above Normal
July	3.31	Above Normal
August	3.31	Above Normal
September	3.31	Above Normal

## 4.4 Seasonal Operations

### 4.4.1 WY24 Fall Pulse Flow

A Fall Pulse Flow is one component of the daily flow schedule in the SRP pursuant to Section 4.10.6.1 of Reclamation and DWR's Proposed Action for the coordinated long-term operations (LTO) of the CVP and the SWP, dated October 2019, and the corresponding BiOp issued pursuant to Section 7 of the ESA by National Oceanic and Atmospheric Administration's (NOAA) NMFS, dated October 21, 2019. As noted on page 4-81 of the Biological Assessment (BA), "the New Melones SRP will be implemented similarly to current operations under the 2009 biological opinion with a default daily hydrograph, and the ability to shape monthly and seasonal flow volumes to meet specific biological objectives." On page 4-82 of the Biological Assessment, it is further described that "The Stanislaus Watershed Team will also provide input on the shaping and timing of monthly or seasonal flow volumes to optimize biological benefits."

At the September 20, 2023, SWT meeting, the technical team discussed the alternatives for the Fall Pulse Flow schedule. Based on discussion, and in order to accommodate flows needed for important carcass surveys and recreational activities on the Stanislaus River, the SWT provided feedback for an alternative shaping of the default fall pulse flow schedule.

The Alt-1 schedule (**Figure 4-1**) had the same total volume (50,182 AF, including base flows) for the October 1 through November 3 period as the default SRP Wet schedule. Reclamation, and the SWT, believe that the Alt-1 reshaping optimizes biological benefits by improving instream conditions and providing an attraction cue for adult salmonids returning to spawn in the Stanislaus River. Higher flows are expected to reduce water temperature (or at least buffer daily maximum water temperature) to provide conditions suitable for the migration and holding of adult salmonids. By starting the fall pulse flow on October 4 and extending the reshaped fall pulse flow into November, SWT expects the higher-than-base flows will help buffer water temperatures during the seasonal transition to cooler air temperatures. Scheduled flows in Alt-1 are down to base flows by the 2nd of November, before peak spawning is expected to occur.

The higher flows will also inundate some shallow water habitat which may provide rearing juvenile steelhead with short-term growth benefits as well as potential refuge from predation.

Some key features of the Alt-1 fall pulse include:

- As in the default schedule, higher fall flows (compared to base flows) are intended to provide an attraction cue for salmonids returning to spawn.
- Reshaping the single pulse identified in the default SRP schedule into a four-peak pulse period increases flow variability within the season. This variability is expected to deter spawning at the higher flows that will not be sustained through egg incubation and fry emergence.
- The time frame of the Alt-1 pulse (which has an earlier start, and is slightly longer in duration, compared to the default SRP schedule) is expected to provide temperature buffering from early-October into early November.
- Other considerations for in-basin interests:
- No flows > 1,500 CFS are scheduled in consideration of concerns regarding agricultural seepage.
- Weekend flows are designed to provide flows suitable for recreational rafting.

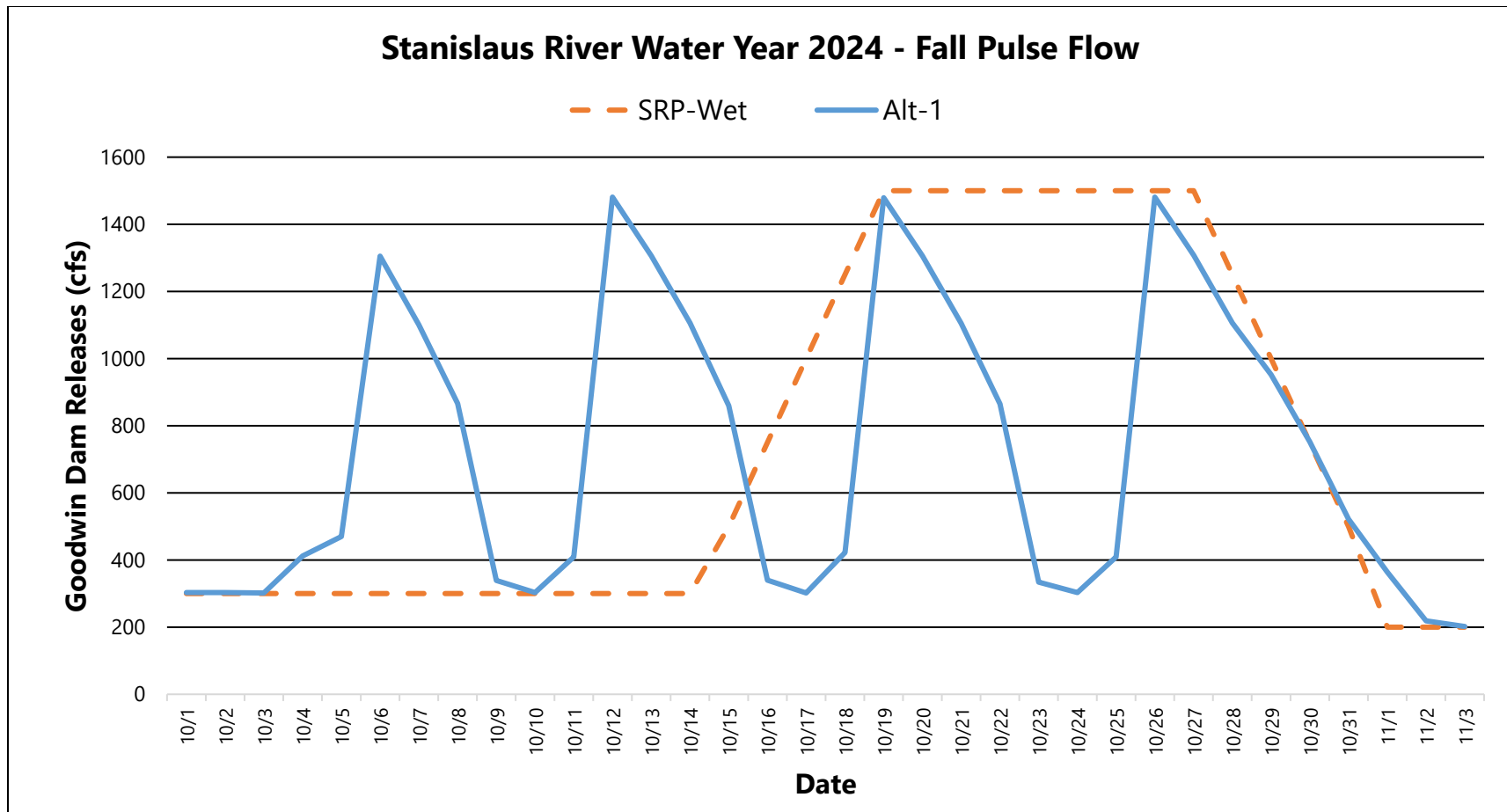


Figure 4-1. Figure showing daily flows from October through early-November in the default SRP and Alternative 1 (Alt-1) schedule for a Wet water year type.

Figure 4-1 is a line graph that compares Goodwin Dam Releases (cfs) daily flows over time from October to November. The default SRP is shown as a dashed line which spikes around October 14, before leveling out, and declining on October 28. Alternative 1 (Alt-1) is a solid line that spikes over time. .

#### 4.4.2 Water Year 2024 Winter Instability Flows

Winter Instability Flows (WIFs) in January and February are a component of the daily flow schedule in the SRP proposed in Reclamation's October 2019 BA, evaluated in NMFS's October 2019 BiOp, and implemented per the February 2020 ROD. As noted in the 2019 BA (p. 4-81), the "SRP will be implemented similarly to current operations under the 2009 BiOp with a default daily hydrograph, and the ability to shape monthly and seasonal flow volumes to meet specific biological objectives." The 2019 BA further notes (p. 4-82) that "The Stanislaus Watershed Team will also provide input on the shaping and timing of monthly or seasonal flow volumes to optimize biological benefits."

In previous years, the WIF Operations Plan has been developed before the planned WIF. However, due to timing of events, the document was developed after the WIF took place. In addition, the Operations Plan incorporated feedback from SWT who discussed the WY24 WIF on December 20, 2023, January 17, and on February 21, 2024.

**Water Volume Accounting.** Reclamation allocated a volume of water for the WIF during WY24 even though the releases for January and February were well above the SRP flows. Reclamation had been making storage management releases at New Melones which were flat (constant release). Allocating water for the WIF allowed some instability to be introduced to the system for fishery benefit.

Reclamation implemented a WIF that was reshaped according to the alternative flow schedule (Alt-1 – described in **Figure 4-2**) that combines the default SRP flow schedule for the water year types in effect (wet in January and dry in February). The default SRP flow for a month in a Wet year type (January) is five days at 400 CFS for an extra 1.983 TAF and the default SRP flow for a month in a Dry year type (February) is three days at 400 CFS for an extra 1.190 TAF; when combined, the default SRP for these two months is 3.174 TAF. Alt-1 proposed roughly this same amount (3.176TAF) distributed over two days to allow for a more substantial instability flow action and variability in the hydrograph.

The alternative flow schedule has the same volume as the default SRP schedule for the wet + dry water year types but has been reshaped to include higher-peak flows and variability. The SWT reviewed and provided feedback on this flow alternative to provide greater variability in the winter hydrograph, which simulates a small storm pulse.

**Reshaping.** On February 25th, the storage management releases were decreased from 1,500 CFS to 1,000 CFS to allow for Reclamation and the fishery agencies to simulate a pulse flow that would provide for fisheries benefit. The WIF started on February 26th, lasting through February 27th, 2024, for 47 hours total. The shape of this alternative flow schedule, with a rapidly rising limb, sustained peak flow, and a slower descending limb, is a flow pattern associated with storm events. The Alt-1 included a day one peak of 2,500 CFS for 14 hours (1,500 CFS in addition to the storage management releases of 1,000 CFS). After the peak, the flows decreased rapidly. The flows reached previous storage management releases (1,000 CFS) by the 23rd hour of February 27th. On March 6, storage management releases were increased back up to 1,500 CFS.



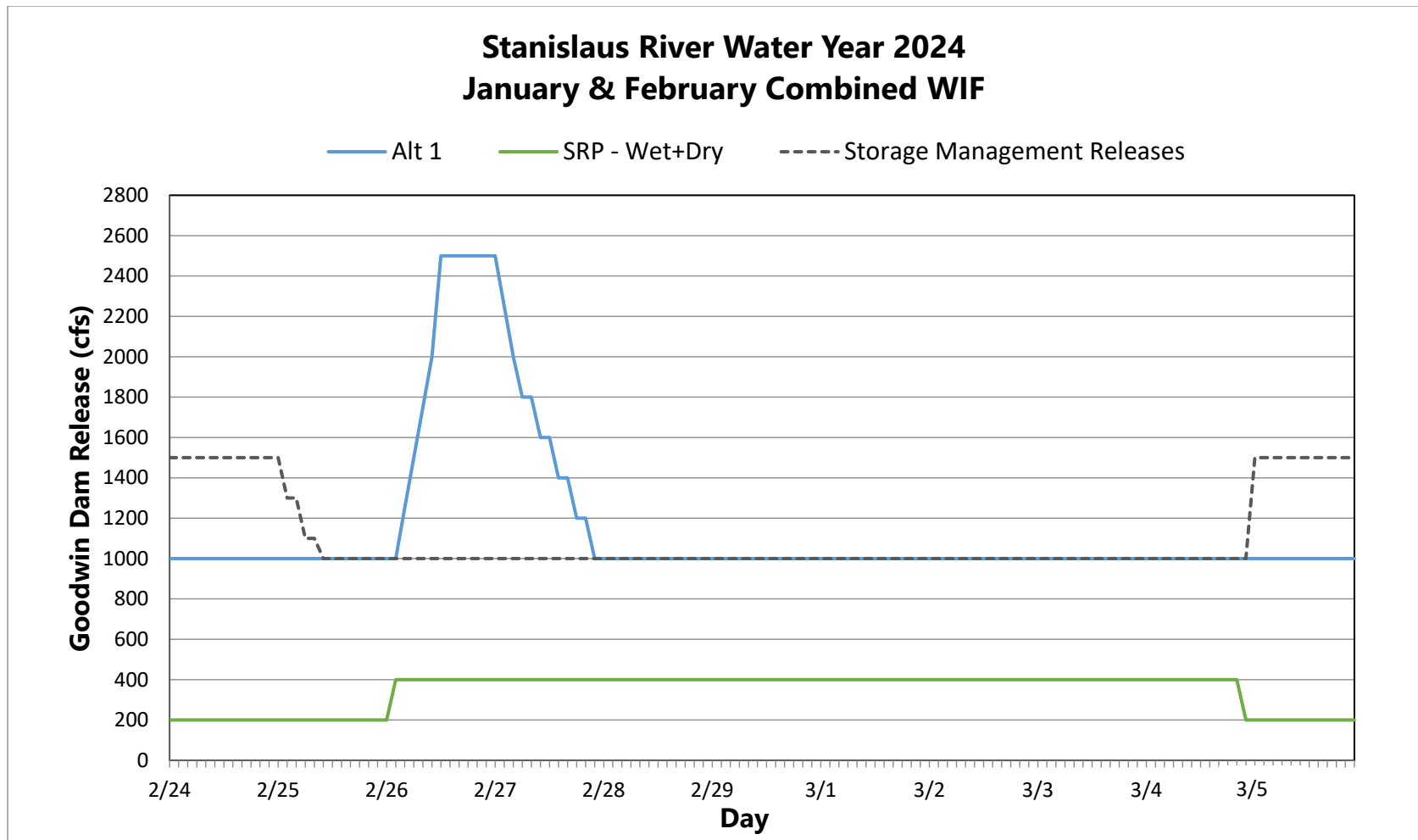


Figure 4-2. Hourly flows in the proposed Alternative 1 and the default SRP for wet + dry water year type combined (actual CFS released).

Figure 4-2 is a line graph that compares Goodwin Dam Releases (cfs) daily flows over time from February 24 to March 5. The storage management releases represented by a dashed line, the Alt-1 as a blue line, and the SRP -Wet & Dry as a green line. For January and February combined WIF, the graph shows storage management releases and Alt-1 above the SRP – Wet & Dry.

### 4.4.3 Spring Pulse Flows

**Water Volume Accounting.** The 60-20-20 San Joaquin Index (the index used to determine the water year type for SRP implementation) was “Below Normal” based on the March 2024 forecast. The total required instream flow volume pursuant to the SRP for the April 1-June 30, 2024, period in both Below Normal and Above Normal water year types is 190,413 AF. If the water year type per the 60-20-20 San Joaquin Index had changed to a water year type other than from Below Normal or Above Normal based on the April, May, or June forecasts, Reclamation would have recalculated the volume requirement and sought input from the SWT on an updated flow schedule. Because the water year type remained Below Normal or Above Normal throughout the spring, no adjustments to the spring pulse flow were needed.

**Reshaping.** At the March 27, 2024, SWT meeting, the technical team discussed, reviewed, and provided feedback on the Alt-BN1 option for WY24 SPF (**Figure 4-3**). The default SRP Below Normal schedule has the same total volume (190,413 AF) for the April 1-June 30 period as the Alt-BN1. Reclamation and the SWT believe that the Alt-BN1 reshaping optimizes biological benefits by providing a pulse that may cue outmigration and improve migratory habitat in both the Stanislaus River and in the mainstem San Joaquin River and southern Delta. In the Stanislaus River, higher flows are expected to reduce water temperature (or at least buffer daily maximum water temperature) and inundate some shallow water habitat which may provide juvenile salmonids with short-term growth benefits as well as potential refuge from predation. In the mainstem San Joaquin River and south delta, higher flows from the Stanislaus River (and other San Joaquin tributaries) are expected to convey out-migrating salmonids more rapidly along their migratory pathway, which may improve outmigration success.

Some key features of the Alt-BN1 SPF include:

- As in the default schedule, higher spring flows (compared to winter base flows) are intended to cue outmigration and improve migratory habitat downstream.
- Reshaping the two pulses identified in the default SRP schedule into eight peaks for the first two-thirds of the pulse period increases flow variability within the season. This variability provided opportunities for a broader range of salmonid outmigration timing since outmigration may be cued by flow variability as well as magnitude (Zeug et al. 2014).
- The time frame of the Alt-BN1 pulse provided some inundation of shallow-water habitat and temperature buffering from April through early-May; the extent of such benefits will vary with flow throughout the spring pulse period. The timing of Alt-BN1 puts most of the pulse volume in a 31-day window which aligns better with the State Water Resources Control Board D-1641 Vernalis pulse flow period.
- Other considerations for in-basin interests:
  - No flows >2,500 CFS are scheduled in consideration of concerns regarding stability of the weir at Riverbank, as well as attempting to minimize agricultural seepage.

- Variations in operations from the plan:
  - The Spring Pulse Flow, as designed for WY24, was intended to have a long, slow reduction in releases during the month of June. The plan was to reduce releases by 50 CFS at Goodwin Dam every 2 days. The intent of this slow reduction in releases was intended to help riparian habitat recruitment during the late spring period. However, the Vernalis based flow objective, as outlined in SWRCB D-1641, was not being met by current instream flows at Vernalis. As a result, Reclamation needed to stop the Goodwin Dam release reduction and increase releases back up to 1,500 CFS on June 11, 2024, to provide flows at Vernalis for the base flow objective. Releases were increased again on June 18, 2024, to 2,500 CFS again to attempt to meet the Vernalis Base Flow Objectives. See red box in **Figure 4-3**.
  - The Vernalis Base Flow Objective for the month of June was required to be 2,990 CFS. Despite Reclamation's efforts, Vernalis Base Flow was a daily average of 2,786 CFS for the month of June, which was 222 CFS/day short of the Base Flow requirement.

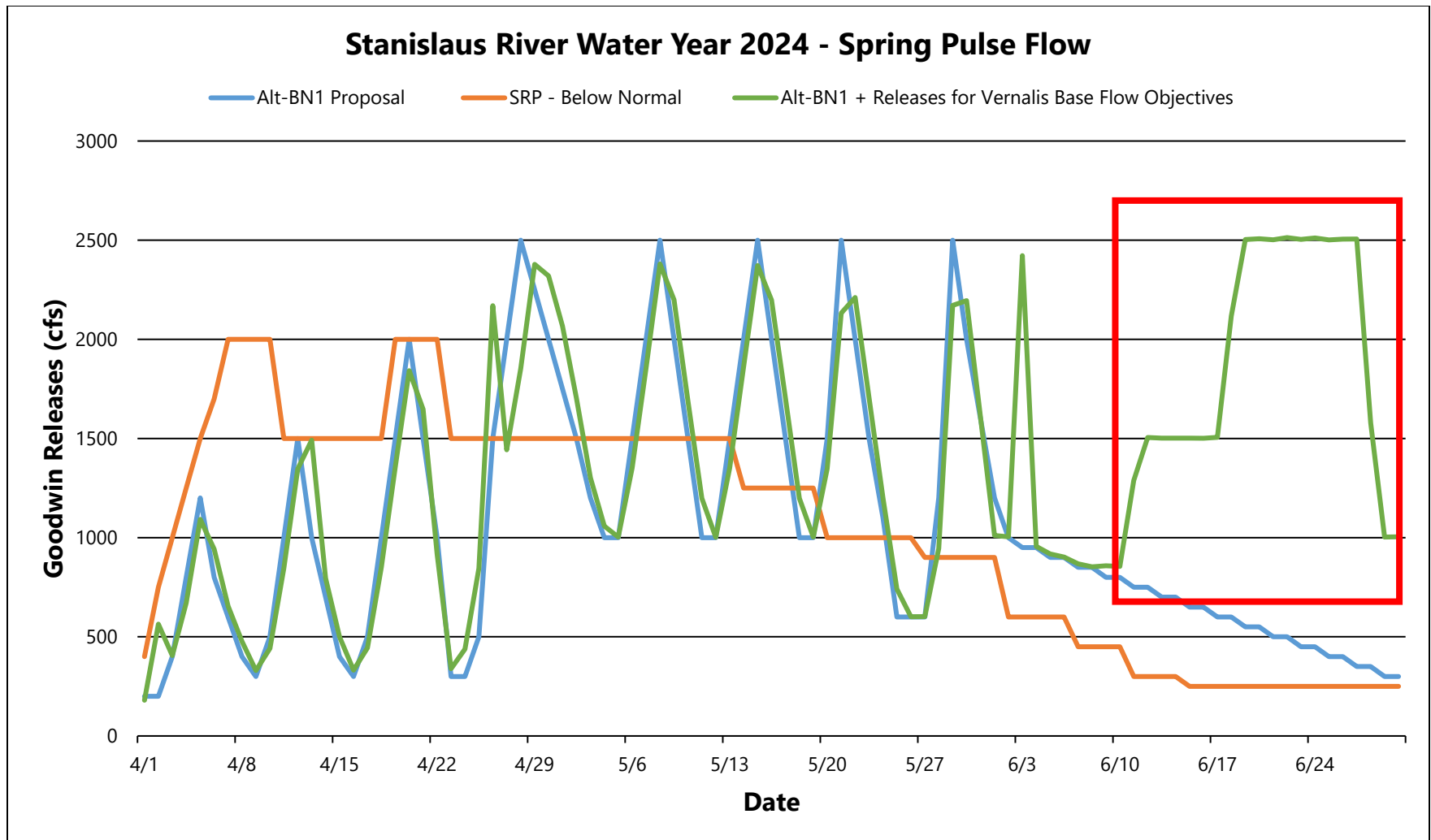


Figure 4-3. Daily flows in the default SRP, Alt-BN1 proposal, and actual releases for BN1 plus Vernalis Flow Objectives.

Figure 4-3 is a line graph showing Spring Pulse Flow for Goodwin Releases (cfs) over time from April to June. The graph compares Alt-BN1 Proposal, SRP-Below Normal, and Alt-BN1 + Releases for Vernalis Base Flow Objectives. A Red box represents deviations from the planned Spring Pulse Flow. Releases of up to 1,500 CFS on June 11, 2024, and of up to 2,500 CFS on June 18 were made for the Vernalis Base Flow Objectives.

## **4.5 Storage Management and Flood Control Releases**

During WY24, New Melones experienced a prolonged storage management operation. Beginning January 5, 2024, Goodwin Dam releases were increased to 1,000 CFS. Releases were increased to 1,500 CFS on January 26, 2024, and were held at that level until February 25, 2024. Flows were cut for 1 day to 1,000 CFS prior to the winter instability flow, which occurred on February 26-27, 2024. After the Winter Instability Flow, the releases were brought back down to 1,000 CFS on February 28, 2024. Releases were held at 1,000 CFS for 7 days and were increased to 1,500 CFS again on March 6, 2024. Releases remained at 1,500 CFS for storage management purposes until preparation for the Spring Pulse flow began on March 28, 2024. Storage management releases were no longer needed after the end of the Spring Pulse Flow.

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# Chapter 5 Stanislaus River Fish Monitoring Data and Non-flow Conservation Measures

## 5.1 Fish Monitoring Data

Monitoring data from the Stanislaus River are summarized below for both fall-run Chinook salmon (*Oncorhynchus tshawytscha*) and Central Valley (CV) steelhead (*Oncorhynchus mykiss*). The locations of monitoring sites are shown in **Figure 5-1**.



Figure 5-1. Locations of fish monitoring efforts on the Stanislaus River.

Figure 5-1 is a map of the Stanislaus River Fish Monitoring area from New Melones Lake and Caswell Rotary Screw Trap Juvenile Sampling. The green-shaded "Carcass Surveys Area" depicts the survey zone for all fall-run Chinook salmon escapement.

### 5.1.1 CDFW 2023 Escapement Summary

CDFW began conducting fall-run Chinook salmon (*Oncorhynchus tshawytscha*) escapement and redd surveys on October 3, 2023, and concluded surveying on January 25, 2024. The preliminary Stanislaus River escapement estimate for 2023 fall-run Chinook salmon, as reported in the May 20, 2024, GrandTab<sup>3</sup>, was 1,617 fish, compared to 1,341 fish on the Tuolumne River and 3,256 fish on the Merced River; the Merced River total combines 894 fish taken at the Merced River Hatchery and 2,371 fish estimated in-river adult returns. During the Stanislaus River survey season 438 carcasses were found and samples collected (scales, otoliths, and coded wire tag if present). Two hundred thirty-seven, or 54%, of the tagged fish were female, and 201, or 46%, were male. In addition, 346 skeletons were tallied and chopped, for a total of 784 individual Chinook handled during the survey. The Honolulu Bar side channel (riffle K1S) was not surveyed for part of November and all of December due to it being dry and disconnected. During the 2023 survey, high flows resulted in one side channel (U1) not surveyed during the first two weeks. Goodwin Canyon was only partially surveyed in week 14. Finally, Goodwin Canyon (A1-4, B1, C1-2) and four side channels (H2, H5, K1S, and U1) were not surveyed in the last two weeks of the season due to high flows and turbidity. **Figure 5-2** illustrates these survey results along with flow (CFS) at OBB, mean daily spill and temperature, and the thermal limit for incubation.

In 2023, out of 237 female carcasses, two were found with enough eggs present to be classified as unspawned, and one other fish had enough eggs present to be classified as partially spawned.

Maximum weekly redd counts are used when analyzing the distribution of spawning because no effort is made to avoid counting the same redd every time a riffle was surveyed; this means maximum weekly redd counts provide the minimum estimation of overall spawning within a riffle. Redds were built throughout the survey area, with riffles closer to Goodwin Dam having more use than riffles downstream. **Figure 5-3** illustrates the sum of maximum redd counts by river mile. Throughout the 17-week survey period, CDFW observed a maximum of 694 redds on the Stanislaus River (compared to 599 on the Tuolumne River and 1,027 on the Merced River).

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<sup>3</sup> The report can be found at [Chinook Salmon: Anadromous Assessment](#).



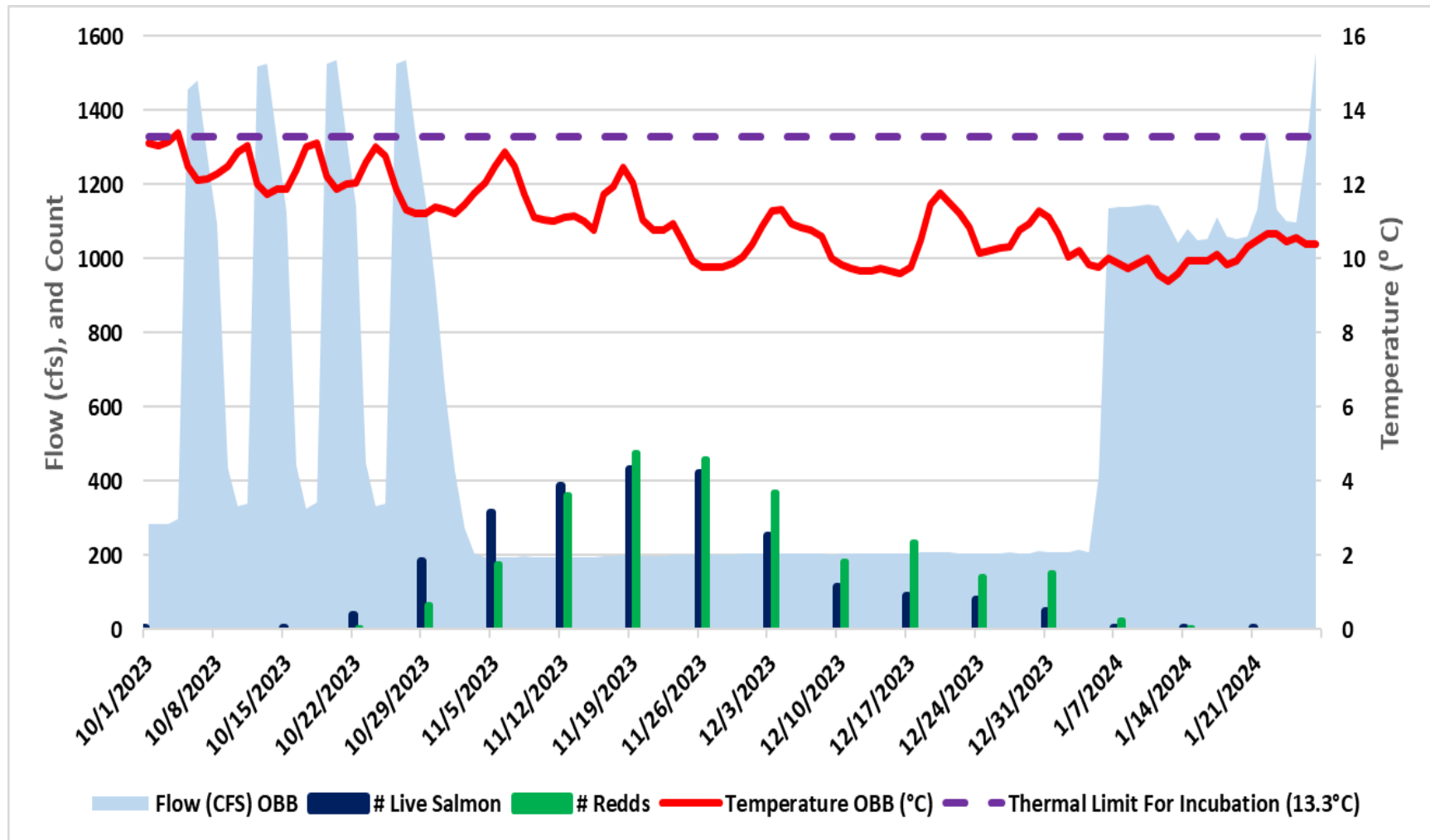


Figure 5-2. Weekly live and redd counts, mean daily spill, and temperature measured at Orange Blossom Bridge (OBB) RM 46 for the 2023 Stanislaus Escapement Survey.

Figure 5-2 is a graph comparing weekly live and redd counts by week to flow (cfs) and count as well as temperature (°C). There is a spike in population counts from November 5, 2023, to November 26, 2023, before decreasing. Temperature remains below the thermal limit for incubation (13.3 °C).

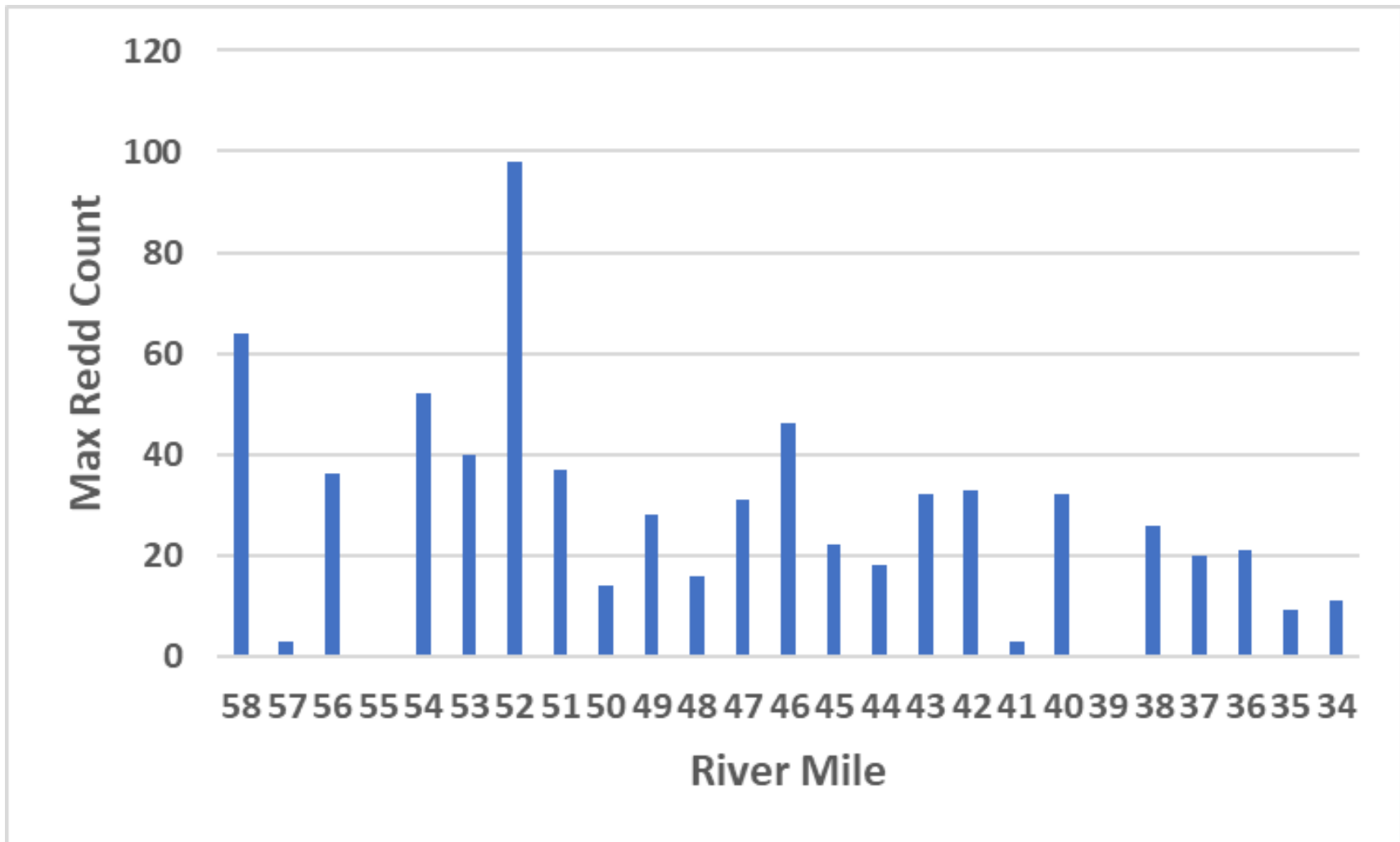


Figure 5-3. Sum of maximum redd counts by river mile.

Figure 5-3 is a bar graph summarizing the maximum redd counts at each river mile. High counts were recorded at River mile 58 and 52, whereas lower counts were recorded at 57, 55, 41, and 39.

One hundred twenty-one coded wire tags (CWT) were recovered from carcasses during the 2023 escapement survey. Estimates of the total number of hatchery Chinook salmon in the Stanislaus River is beyond the scope of this summary but will be included in a future Constant Fractional Marking Report. Most of the tagged fish came from the Mokelumne River Hatchery and were from Brood Year 2020. Brood years 2019, 2020 and 2021 were all represented in the CWTs with fish originating from the Coleman National Fish Hatchery, Merced River Hatchery, and Nimbus Hatchery in addition to the Mokelumne (**Table 5-1**).

Table 5-1. Table of coded wire tag results from the 2023 escapement survey.

Hatchery	Release Location	2019 Brood Year	2020 Brood Year	2021 Brood Year	N/A	Total
Coleman NFH	Point San Quentin Net Pen	0	4	0	0	4
Merced River Hatchery	San Joaquin River – Sherman Island Net Pen	0	2	2	0	4
Mokelumne River Hatchery	Fort Baker – Minor Point	3	11	2	0	16
Mokelumne River Hatchery	Half Moon Bay – John PR Net	0	15	0	0	15
Mokelumne River Hatchery	Monterey – Major Point	0	5	0	0	5
Mokelumne River Hatchery	San Joaquin River - Sherman Island Net Pen	6	35	9	0	50
Mokelumne River Hatchery	Santa Cruz Harbor	0	4	0	0	4
Nimbus Fish Hatchery	Mare Island Net Pen	0	11	0	0	11
Nimbus Fish Hatchery	Point San Quentin Net Pen	0	3	0	0	3
Nimbus Fish Hatchery	Wickland Oil Net Pen	0	1	2	0	3
Nimbus Fish Hatchery	Unknown (Duplicate tag releases in 2018/2020)	0	0	0	1	1
UNKNOWN	TAG NOT FOUND / LOST	-	-	-	5	5
<b>GRAND TOTAL</b>	N/A	<b>9</b>	<b>91</b>	<b>15</b>	<b>6</b>	<b>121</b>

The Honolulu Bar side channel was disconnected in November 2023 after the fall pulse flow. On November 2, 2023, the crew observed fish stranded in isolated pools within the side channel (see **Figure 5-4**). CDFW staff used seines and dip nets to capture and relocate stranded fish from the side channel to the main river. In total 208 adult and juvenile Rainbow trout (*Oncorhynchus mykiss*), and 12 juvenile and two adult Chinook salmon were rescued as well as an unknown number of Stickleback, Pikeminnow, Sacramento Sucker, Bluegill, and Tule Perch. One Chinook salmon redd was also found in the disconnected side channel. Due to time limitations and the presence of overhanging vegetation it is unlikely that all the fish were

captured and re-located, therefore these numbers should be considered a minimum. The side channel remained disconnected through the rest of the survey season.



**Figure 5-4** Photos of the fish rescue at Honolulu Bar on November 2, 2023.

### **5.1.2 CDFW *O. mykiss* Redd Survey Summary**

The 2024 CDFW Stanislaus River *Oncorhynchus mykiss* redd survey began on January 3, 2024, with the first four weeks of the *O. mykiss* redd survey overlapping with the last four weeks of the Chinook salmon escapement survey.<sup>4</sup> Surveys continued weekly through April 25, 2024. Section one, which includes Goodwin Canyon, was not surveyed due to high flows from weeks 2 through 13 (January 8 through March 25), while one side channel was not surveyed for two weeks due to high turbidity. During the 17-week survey period a total of 594 *O. mykiss* were observed, with 28 of these estimated to be greater than 400 mm in fork length. **Figure 5-5** illustrates these survey results along with mean daily flow and temperature.

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<sup>4</sup> Field differentiation between the resident Rainbow trout and anadromous steelhead is not currently possible, therefore we use *O. mykiss* in this summary.

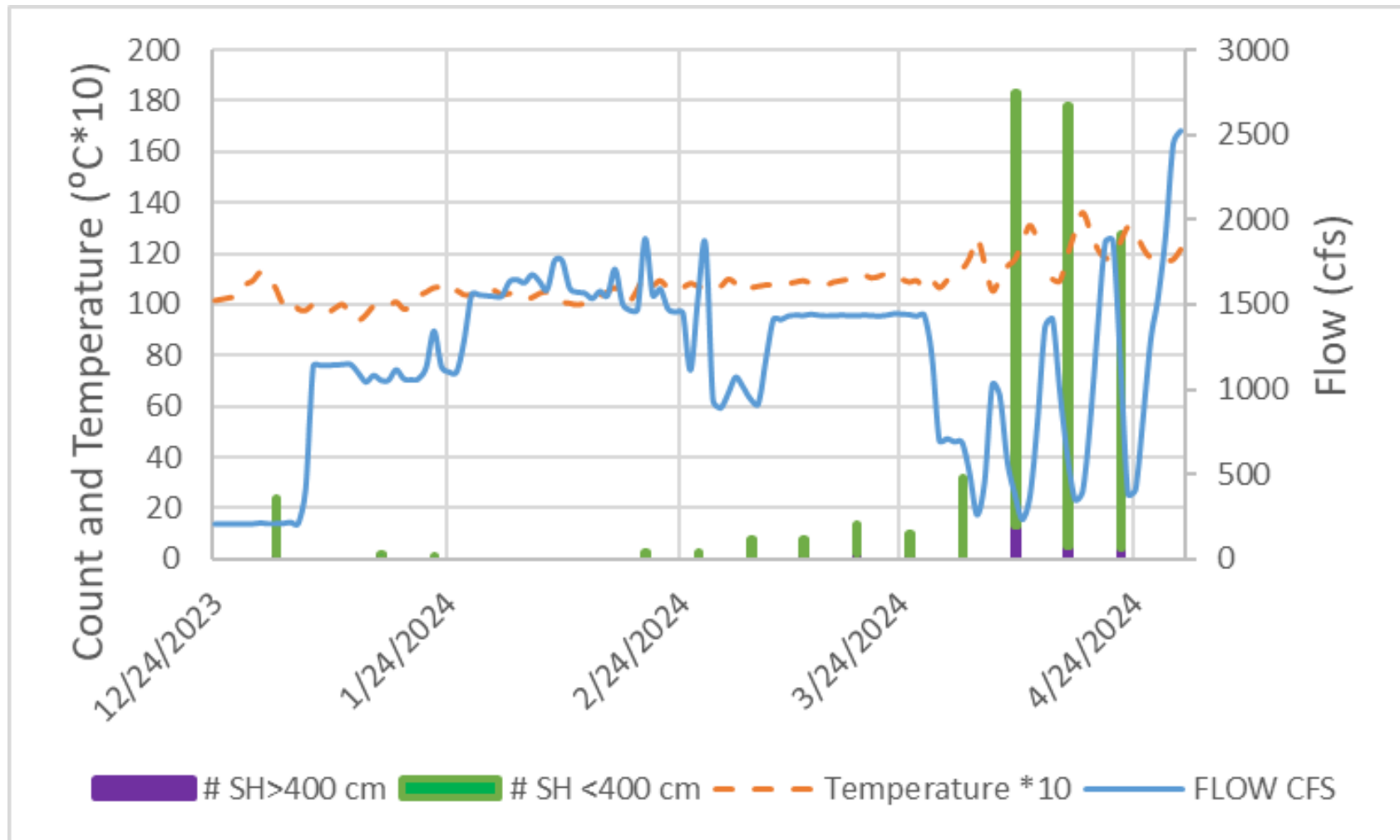


Figure 5-5. Weekly Live *O. mykiss* counts by size class, mean daily flow and temperature measured at Orange Blossom Bridge (OBB) for the 2024 Stanislaus *O. mykiss* redd Survey.

Figure 5-5 is a graph of weekly live *O. mykiss* counts from December 2023 to April 2024. Counts are compared over time to temperature ( $^{\circ}\text{C} \times 10$ ) and flow (cfs). Counts spike between March and April 2024.

Zero live Chinook salmon and one live Pacific lamprey were observed during the survey. Three redds were identified as belonging to *O. mykiss*. These redds were all found at RM 58.3 during the month of April. One pacific lamprey redd was found at RM 35.9 on April 11, 2024. Three Chinook redds were also observed during overlap of the Escapement and *O. mykiss* surveys. One *O. mykiss* carcass was found during the redd survey, and six were found during the Chinook escapement survey (see **Table 5-2**).

Table 5-2. Date, sex, fork length, and location of *O. mykiss* carcasses found during both surveys.

Date	Sex (M/F)	Fork Length (cm)	River Mile
1/4/2024	M	40	40.2
4/10/2024	M	32	51.5
11/9/2023	M	20	39
11/14/2023	F	34	52.9
11/14/2023	M	35	49.3
12/27/2023	F	34	50.8
12/28/2023	M	29	46.2

### 5.1.3 Stanislaus Weir

Reclamation funded FISHBIO to conduct adult fish monitoring at the Stanislaus River weir near Riverbank, California (approximately river mile 31, see **Figure 5-6**). Monitoring at the weir near Riverbank (for upstream passage of adult salmonids) began for the season on September 7, 2023, and ended on April 15, 2024. The cumulative net upstream passage through April 15, 2024, was 2,443 Chinook (at least 25% were ad-clipped, indicating a hatchery origin; presence/absence of adipose fin could not be determined on 55 Chinook) and 55 *O. mykiss* (at least 56% were ad-clipped; presence/absence of adipose fin could not be determined on three *O. mykiss*). At least thirty-three of the *O. mykiss* exceeded the 406 mm length (size range 410 mm to 729 mm) criterion for steelhead (lengths of 16 *O. mykiss* could not be determined) and 22 of the steelhead were adipose fin-clipped indicating hatchery origin. The timing of Chinook salmon passage at the weir is shown in **Figure 5-7**; **Figure 5-8** shows seasonal passage timing compared to the passage timing of the previous five years. The timing of *O. mykiss* passage at the weir is shown in **Figure 5-9**

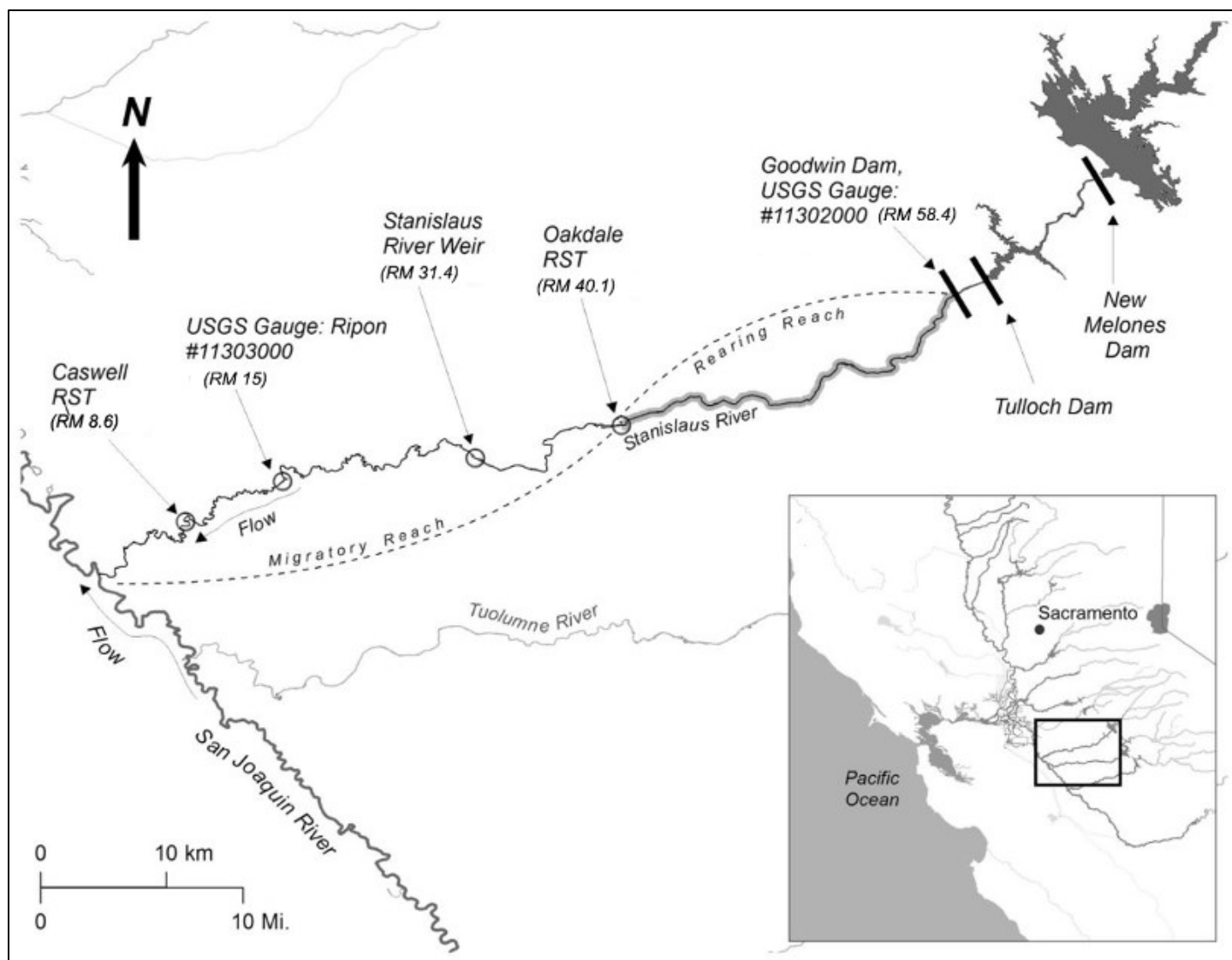


Figure 5-6. Map of Stanislaus River fish sampling stations, flow gauges, and dams. The highlighted area between Goodwin Dam and Oakdale RST indicates the salmonid spawning area. Map courtesy of FISHBIO.

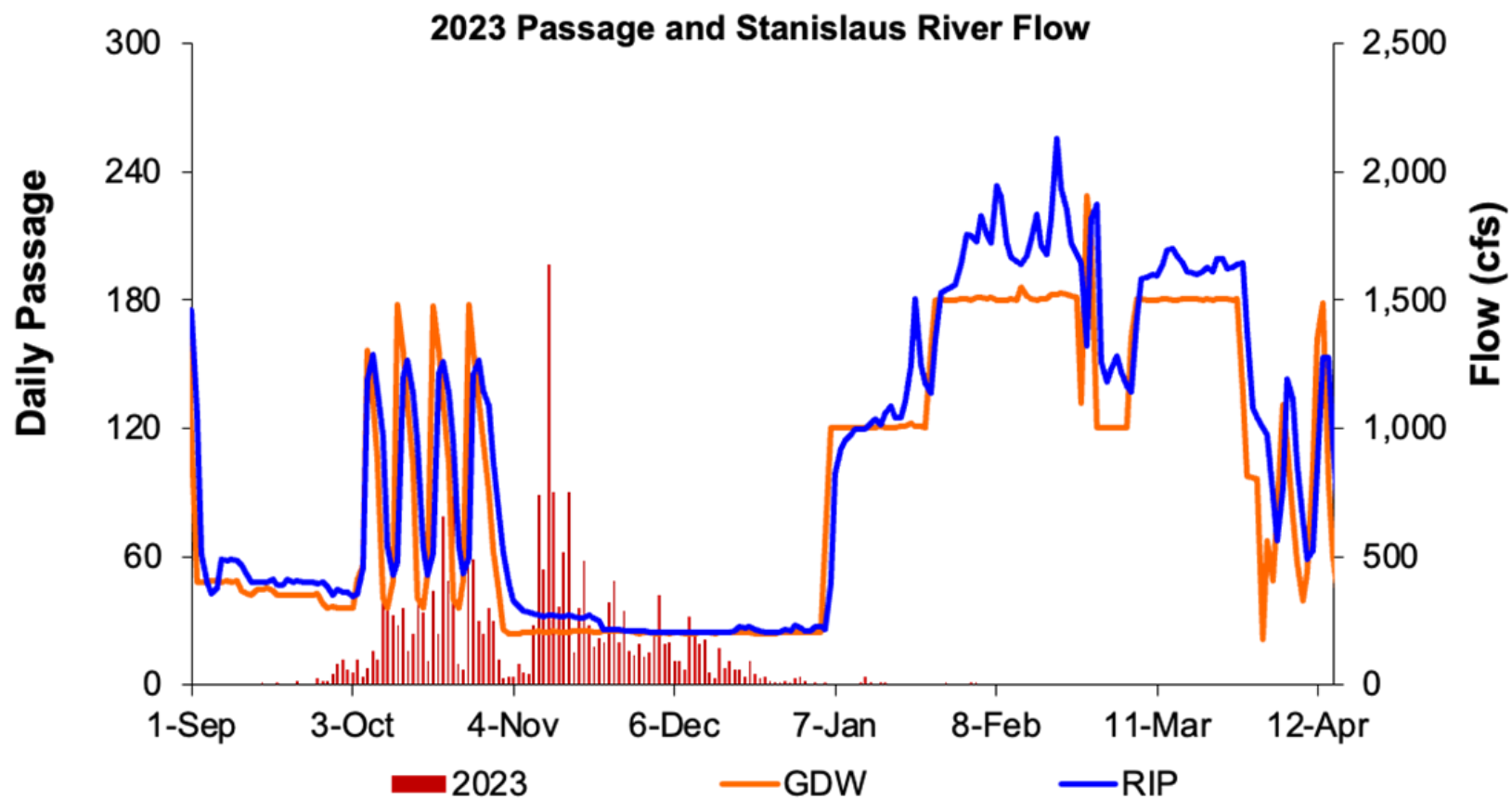


Figure 5-7. Daily Chinook salmon passage through April 15, 2024, at the Stanislaus River weir near Riverbank. Figure courtesy of FISHBIO.

Figure 5-7 is a graph that shows Daily Chinook salmon passage from September 2023 to April 2024 comparing daily passage counts to river flow (cfs). The graph also compares 2023 counts, GDW, and RIP.



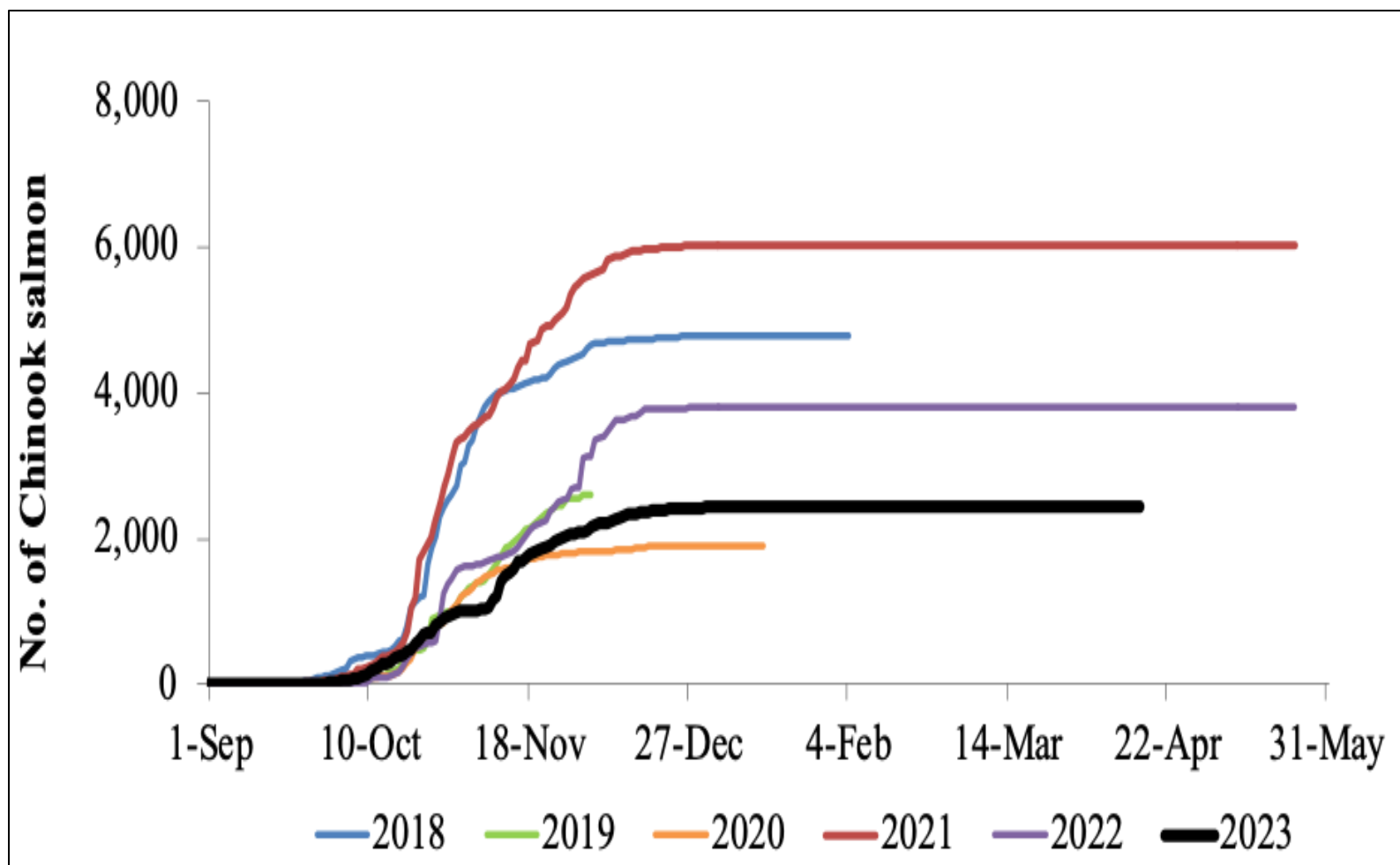


Figure 5-8. Cumulative count of Chinook salmon passage through April 15, 2024, at the Stanislaus River weir near Riverbank. Figure courtesy of FISHBIO.

Figure 5-8 is a graph that compares cumulative counts of Chinook salmon from 2018, 2019, 2020, 2021, 2022, and 2023. All show increasing counts until they level out between November 18 and December 27.

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#### 5.1.4 Rotary Screw Traps near Caswell

Rotary screw trap sampling at Caswell Memorial State Park (approximately river mile 9) was funded by USFWS and conducted by PSMFC for the 2024 season for monitoring of out-migrating juvenile salmonids.<sup>5</sup>

Sampling for the 2024 survey season began on January 6 and ended on June 28 with 164 days of sampling effort in the 175-day season. Two 8-foot diameter RSTs were deployed at the Caswell Memorial State Park trapping site in a side-by-side configuration. Total catch for the season was 6,080 unmarked Chinook Salmon, 1 adipose-clipped *O. mykiss* smolt, and 173 lampreys. The adipose-clipped *O. mykiss* was captured on January 18 and measured 239 mm. Chinook catch timing and fork lengths from the Caswell RST sampling location are summarized in **Figure 5-10**, **Figure 5-11**, and **Figure 5-12** (figures provided by PSMFC).

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<sup>5</sup> Rotary screw trap sampling at Oakdale RST during WY24 did not occur due to lack of funding.

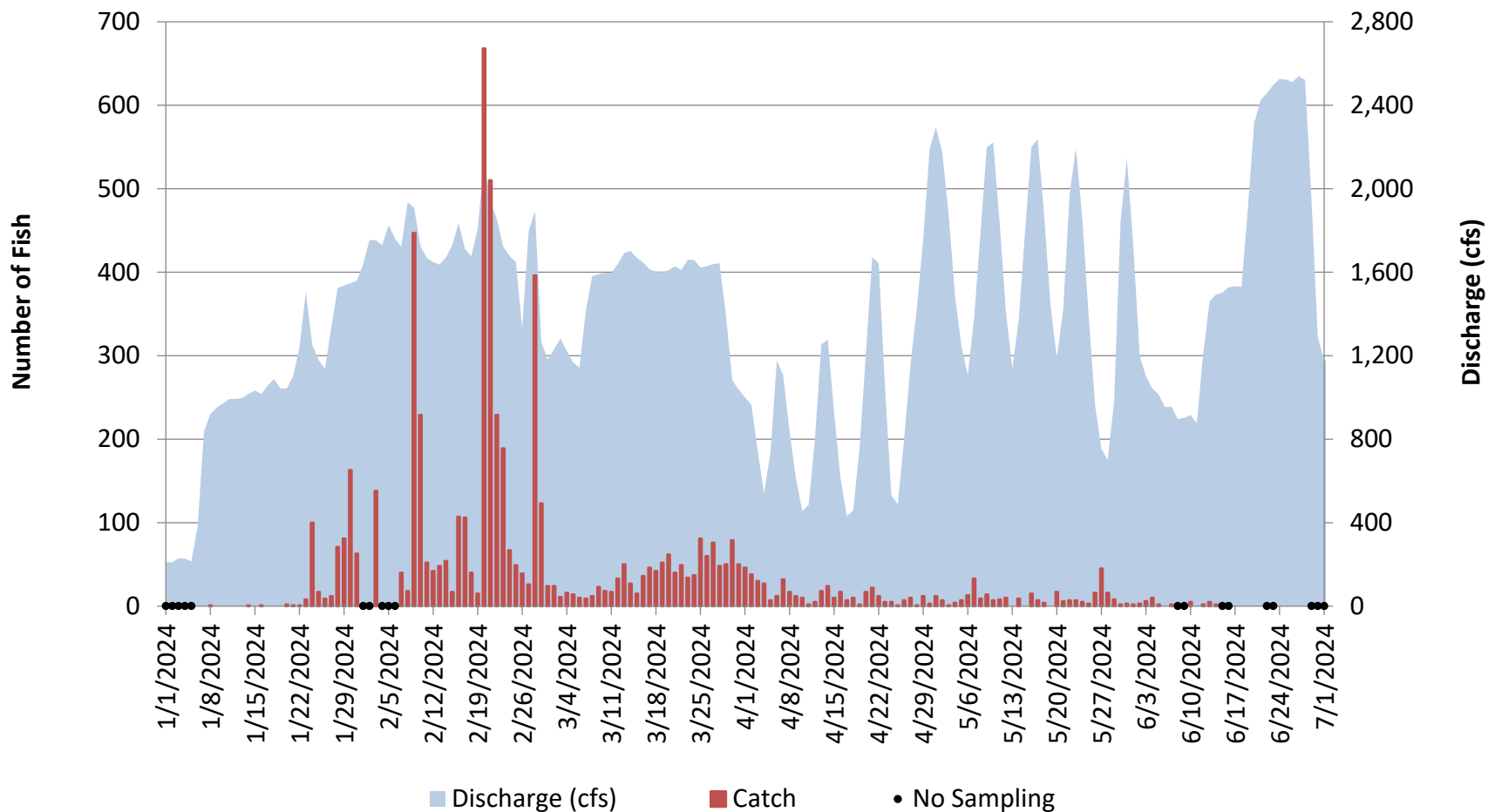


Figure 5-10. Daily catch of unmarked Chinook Salmon and daily average discharge at Ripon during the 2024 Stanislaus River at Caswell Memorial State Park rotary screw trap survey season. Data provided by PSMFC.

Figure 5-10 is a bar graph that compares discharge (cfs) and catch from January 1, 2024, to July 1, 2024.

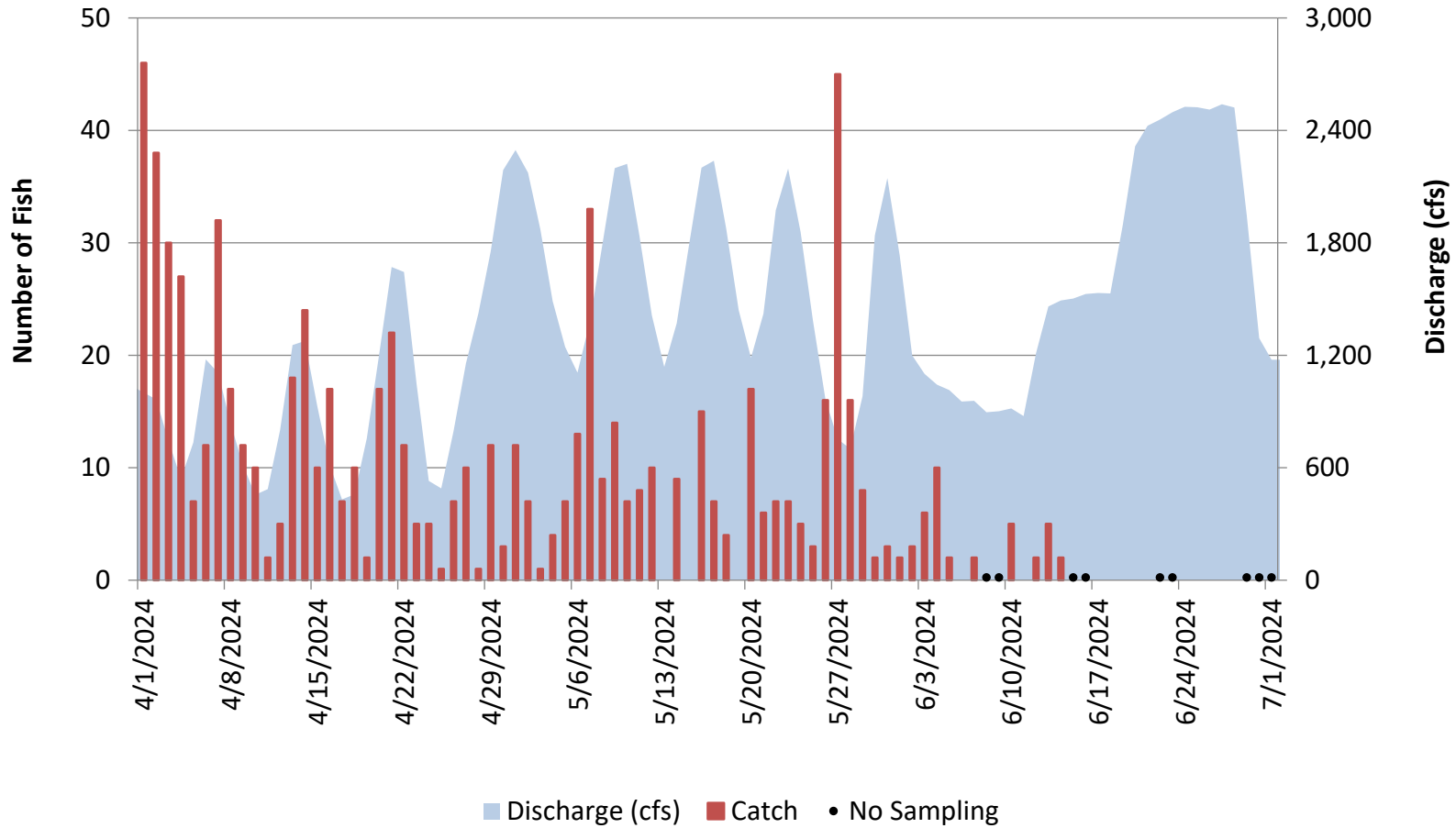


Figure 5-11. Daily catch of unmarked Chinook Salmon and daily average discharge at Ripon between April 1, 2024, and July 1, 2024, during the 2024 Stanislaus River at Caswell Memorial State Park rotary screw trap survey season. Data provided by PSMFC.

Figure 5-11 is a bar graph that compares discharge (cfs) and catch from April 1, 2024 to July 1, 2024.

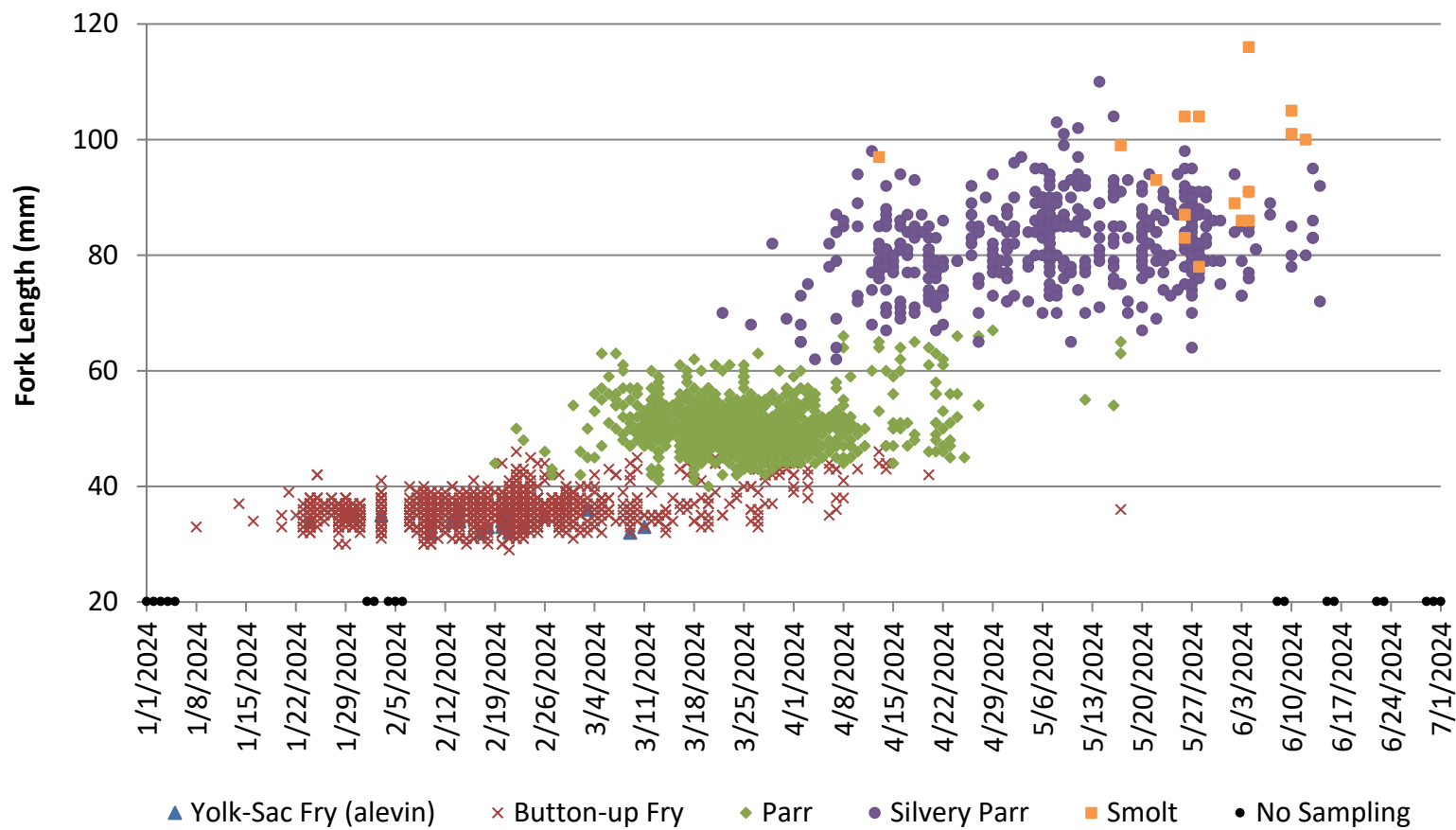


Figure 5-12. Daily fork length distribution by life stage of unmarked Chinook Salmon measured during the 2024 Stanislaus River at Caswell Memorial State Park rotary screw trap survey season. Data provided by PSMFC.

Figure 5-12 is a bar graph that compares fork length (mm) from January 1, 2024 to July 1, 2024.

### 5.1.5 Mossdale Trawl on San Joaquin River

The Mossdale Trawl is a Kodiak trawl located at RM 54 on the San Joaquin River. The trawl was operated cooperatively by CDFW and USFWS from January through March, and from July through September of 2024. In April, May, and June, the trawl was operated by CDFW. CDFW has operated a trawl at Mossdale during the spring outmigration season since the early 1990's to document the size and timing of juvenile salmonids leaving the San Joaquin basin.

In 2024, between April and June, the Mossdale trawl captured 2,134 unmarked Chinook salmon as well as 14 unmarked *O. mykiss* smolts (**Table 5-3**). Chinook salmon ranged in length from 47 mm to 130 mm. Four Chinook salmon were captured in January and another 87 were caught during February and March. The Chinook salmon captured from January through March ranged in fork length from 29 mm to 158 mm with an average of 49 mm. The first unmarked Chinook salmon was captured January 8, 2024, while the last was captured on June 28, 2024. In addition to unmarked Chinook salmon, the trawl also captured 52 hatchery fish between January and June. The coded wire tags from hatchery fish captured between April and June were decoded and 40 were identified spring-run Chinook salmon originating from the San Joaquin River Conservation Hatchery's 2023 brood year and released at Great Valley Grasslands in 2024.

**Figure 5-13** illustrates these catch counts along with flow at Vernalis (CFS) and temperature at Mossdale (C°).

Table 5-3. Date and fork length of the *O. mykiss* captured by the trawl.

Date	Marks	FL (mm)
1/26/2024	None	200
2/5/2024	None	224
2/28/2024	None	222
3/18/2024	None	212
3/25/2024	Ad-Clipped	251
3/27/2024	Ad-Clipped+ PIT	213
3/29/2024	None	261
4/2/2024	PIT+ JSAT	245
4/8/2024	None	220
4/8/2024	None	245
4/9/2024	None	245
4/9/2024	None	207
4/9/2024	None	266
4/15/2024	None	215
4/16/2024	None	248
4/18/2024	PIT+ JSAT	N/A
4/20/2024	None	260
4/20/2024	PIT+ JSAT	N/A
4/25/2024	None	240
4/26/2024	None	220
4/30/2024	None	208
5/3/2024	None	235

Date	Marks	FL (mm)
1/26/2024	None	200
2/5/2024	None	224
2/28/2024	None	222
3/18/2024	None	212
3/25/2024	Ad-Clipped	251
3/27/2024	Ad-Clipped+ PIT	213
3/29/2024	None	261
4/2/2024	PIT+ JSAT	245
5/11/2024	Ad-Clipped+ PIT+ JSATS	N/A
5/24/2024	None	229
5/31/2024	None	270

Estimates of the number of juvenile outmigrants passing the trawl location is not available at this time, and raw counts of catch do not provide meaningful comparisons of fish numbers between years. Raw counts can be used to look at timing of the out-migration which can be compared between years. **Figure 5-14** shows the cumulative timing of out-migrating juvenile Chinook captured by the trawl from 2015-2019, 2022, and 2024. The majority of the 2024 cohort appeared to pass Mossdale by late May, which is later than many years (2015, 2016, 2018, and 2022), but earlier than the wet years of 2017 and 2019.



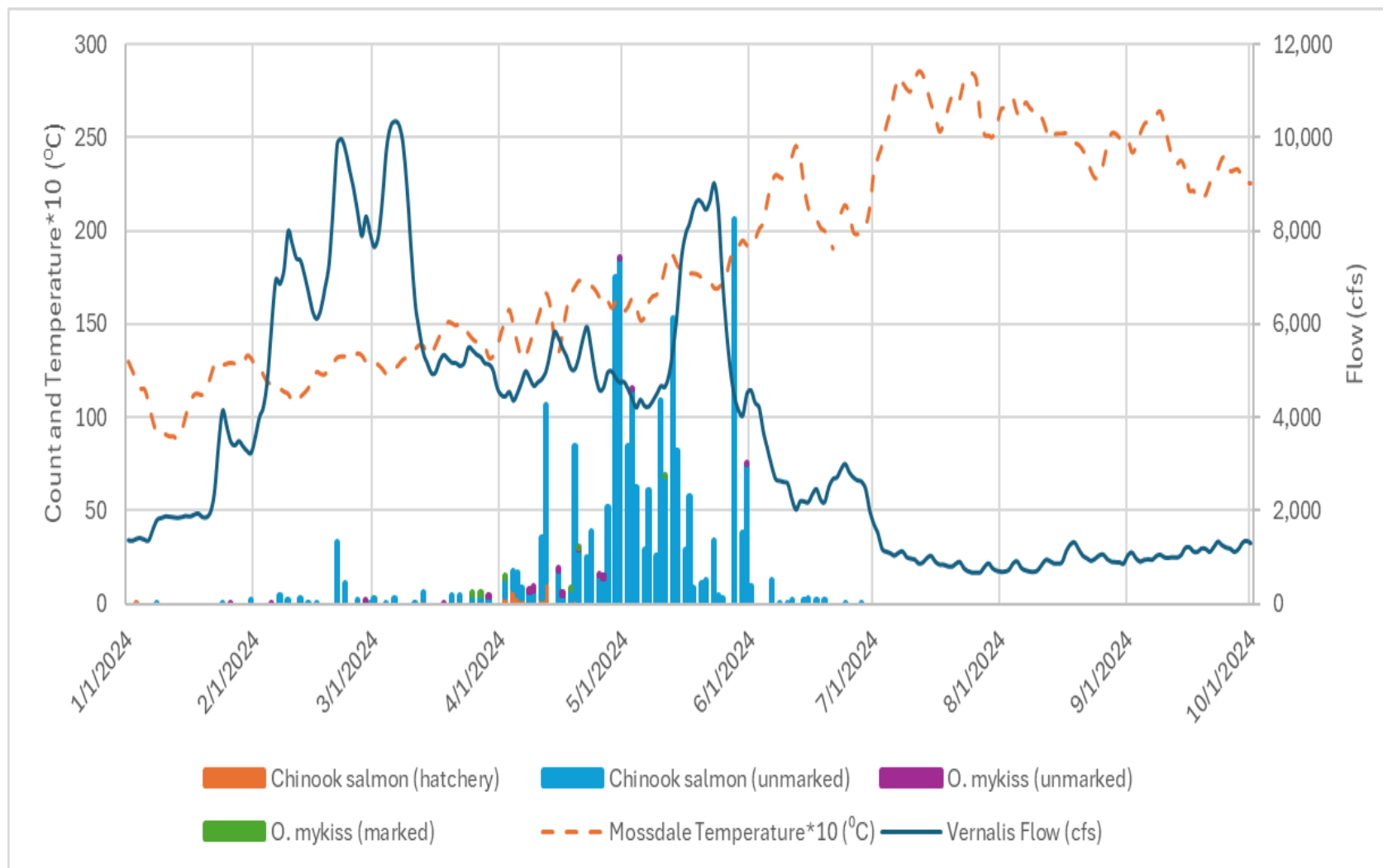
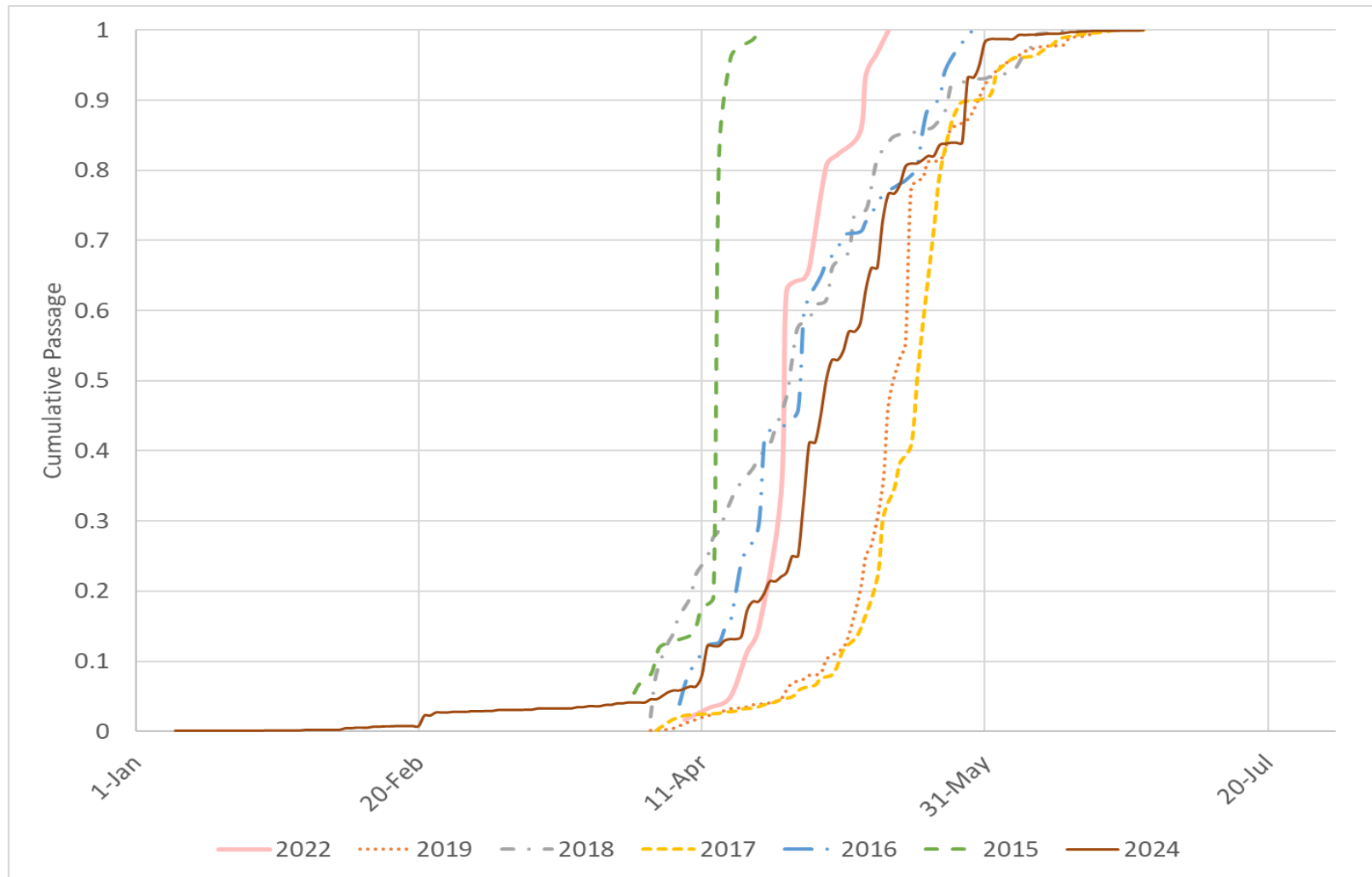


Figure 5-13. Catch of marked and unmarked Chinook and O. mykiss, flow at Vernalis and temperature at Mossdale.

Figure 5-13 is a bar graph showing Chinook salmon (hatchery), Chinook salmon (unmarked), O. mykiss (unmarked), and O. mykiss (marked) from January 1, 2024, to October 1, 2024. The graph also compares temperature\*10 (°C), Mossdale Temperature\*10 (°C), and Vernalis Flow.



**Figure 5-14** Cumulative fraction of juvenile chinook passage at Mossdale, 2015-2024.

Figure 5-14 is a line graph comparing cumulative fraction of juvenile Chinook passage from January to July for years 2015-2024. All show increasing slopes around April. Data from 2020 and 2021 were omitted due to gaps in sampling caused by COVID-19, while 2023 was omitted due to gaps in sampling from high flows.

## 5.2 Conservation Measures

As part of the Preferred Alternative, conservation measures were proposed to avoid, minimize, or compensate for CVP and SWP project effects. These two conservation measures were the focus of attention in WY24:

- **Spawning Habitat Restoration:** Under the CVPIA (b)(13) program, Reclamation's annual goal of gravel placement is approximately 4,500 tons in the Stanislaus River.
- **Rearing Habitat Restoration:** Reclamation proposes to construct an additional 50 acres of rearing habitat adjacent to the Stanislaus River by 2030.

Tables 5-4 through 5-7 detail these efforts.

Since 2009, a total of 54,450 tons of gravel have been added to the Stanislaus River (see Table 5-4), although no gravel was augmented in WY24. Historically, gravel augmentation efforts in the watershed have been ongoing since 1994 (see Table 5-5).

**Table 5-6** presents an overview of completed habitat restoration projects on the Stanislaus River from 2009 to the present. One of the earliest projects, the Lancaster Road side-channel completed in 2011, involved the creation of 640 linear feet of side-channel and 1 acre of floodplain habitat. In 2012, improvements were made to an existing side-channel at Honolulu Bar to reduce stranding risk, alongside the establishment of 2.4 acres of floodplain habitat in the same area. The Buttonbush project in 2017 expanded both side-channel and floodplain habitats, encompassing 4.4 acres and 2,400 linear feet of side-channel habitat. The Rodden Road project, completed in 2018, added another 4.9 acres of side-channel habitat.

In 2020, the Goodwin Canyon Float Tube Pool project introduced 0.25 acres of side-channel habitat on the south-side downstream end of the tube pool. Additionally, maintenance work was carried out at Honolulu Bar to improve water flow into the side-channel, as previous scouring of gravel in the main channel had diminished these flows. This maintenance included suggestions for augmenting the main channel with more gravel and the installation of a gravel bench on the island's upstream side. Most recently, in 2023, the Stanley Wakefield Wilderness Area (Kerr Park) restoration project succeeded in restoring 23 acres of riparian habitat, including 8.45 acres of floodplain. These projects collectively contribute to the enhancement of ecological health and habitat diversity along the Stanislaus River.

**Table 5-7** outlines several in-progress gravel and habitat restoration projects along the river. The Goodwin Canyon project at river mile 58 aims to introduce approximately 4,500 tons of gravel per year, as detailed in the 2020 Record of Decision (ROD). Meanwhile, the Migratory Corridor Rehabilitation project, specifically the Buffington Restoration at river miles (rms) 2-3, is expected to create 5.6 acres of seasonally inundated habitat, with designs currently underway. Additionally, two projects at Mohler Tract (rm 12) and Tortuga (rm 42) aim to develop approximately 5 acres and 4 acres of rearing habitat, respectively, both of which are also in the

design phase. Collectively, these initiatives focus on enhancing habitat diversity and ecological health in the area.

**Table 5-8** outlines potential gravel and habitat restoration projects along the river, highlighting several sites with varying levels of viability and development. The Two Mile Bar project at rm 56 is identified as a potential gravel augmentation site; however, it is not expected to be a viable habitat restoration project in the near term due to land access issues. Other projects, including Honolulu Bar Phase II at rm 51, Lovers Leap at rm 52, and Honolulu Bar Gravel augmentation at rm 50, are anticipated to involve gravel and habitat restoration, although specific details are yet to be determined. Additionally, the project at Caswell State Park (rm 8) is also mentioned, with acreage still to be determined. These potential projects highlight ongoing considerations for enhancing habitat and gravel resources in the area.

Table 5-4. Annual gravel augmentation from 2009 to present.

Year	Annual Gravel Addition (cy)	Annual Gravel Addition (tons)	Annual Cumulative Gravel Addition (cy)	Annual Cumulative Gravel Addition (tons)	Annual Target (cy)	Annual Target (tons)	Annual Cumulative Target (cy)	Annual Cumulative Target (tons)	Annual Cumulative Target Deficit (cy)	Annual Cumulative Target Deficit (tons)	Cumulative Target Achieved Annually (%)
<b>2009*</b>	0	0	0	0	8,333	12,500	8,333	12,500	8,333	12,500	0%
<b>2010</b>	0	0	0	0	8,333	12,500	16,666	24,999	16,666	25,000	0%
<b>2011</b>	2,941	4,412	2,941	4,412	8,333	12,500	24,999	37,499	22,058	33,088	12%
<b>2012</b>	9,765	14,648	12,706	19,059	8,333	12,500	33,332	49,998	20,626	30,940	38%
<b>2013</b>	0	0	12,706	19,059	8,333	12,500	41,665	62,498	28,959	43,439	30%
<b>2014</b>	0	0	12,706	19,059	8,333	12,500	49,998	74,997	37,292	55,939	25%
<b>2015**</b>	4,706	7,059	17,412	26,118	8,000	12,000	57,998	86,997	40,586	60,880	30%
<b>2016</b>	0	0	17,412	26,118	8,000	12,000	65,998	98,997	48,586	72,880	26%
<b>2017</b>	2,838	4,257	20,250	30,375	8,000	12,000	73,998	110,997	53,748	80,623	27%
<b>2018</b>	1,250	1,875	21,500	32,250	8,000	12,000	81,998	122,997	60,498	90,748	26%
<b>2019</b>	0	0	21,500	32,250	8,000	12,000	89,998	134,997	68,498	102,748	24%
<b>2020**</b> *	10,000	15,000	31,500	47,250	3,000	4,500	92,998	139,497	61,498	92,248	34%
<b>2021</b>	4,800	7,200	36,300	54,450	3,000	4,500	95,998	143,997	59,698	89,548	38%
<b>2022</b>	0	0	36,300	54,450	3,000	4,500	98,998	148,497	62,698	94,048	37%
<b>2023</b>	0	0	36,300	54,450	3,000	4,500	101,998	152,997	65,698	98,548	36%
<b>2024</b>	0	0	36,300	54,450	3,000	4,500	104,998	157,497	68,698	103,048	35%
<b>Totals</b>	<b>36,300</b>	<b>54,450</b>	<b>N/A</b>	<b>N/A</b>	<b>104,998</b>	<b>157,497</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>

**Note:** 15,000 tons = 10,000 cubic yards or 1.5 tons/cy. \*Action III.2.1 "catch-up" requirement is for the "addition of 50,000 cubic yards of gravel by 2014." The 8,333 cubic yard annual target is an approximation, assuming the 50,000 target is uniformly spread over the six-year 2009-2014 period. NMFS had granted an extension.

\*\*Action III.2.1 "maintenance" requirement is for the "minimum addition of 8,000 cubic yards per year for the duration of the Project Actions." \*\*\*Conservation measures changed after new ROD issued in 2020, which included an annual goal of gravel placement of 4,500 tons.

Table 5-5. Historical annual averages of gravel augmentation at the Stanislaus River from 1994 to present according to different annual targets.

Time Period	Annual Average Gravel Addition (Cubic Yards)	Annual Average Gravel Addition (Tons)	Annual Target (Cubic Yards)	Annual Target (Tons)	Percent of Target Achieved (%)
1994-2008	3,647	5,470	N/A	N/A	N/A
2009-2014*	1,995	2,992	8,333	12,500	25%
2015-2019**	1,759	2,638	8,000	12,000	20%
2020-2024***	2,960	4,440	3,000	4,500	98%

**Note:** \*Action III.2.1 “catch-up” requirement is for the “addition of 50,000 cubic yards of gravel by 2014.” The 8,333 cubic yard annual target is an approximation, assuming the 50,000 target is uniformly spread over the six-year 2009-2014 period. NMFS had granted an extension. \*\*Action III.2.1 “maintenance” requirement is for the “minimum addition of 8,000 cubic yards per year for the duration of the Project Actions.” \*\*\*Conservation measures changed after new ROD issued in 2020, which included an annual goal of gravel placement of 4,500 tons.

Table 5-6. Completed habitat restoration projects on the Stanislaus River from 2009 to present.

Project	Project Extent
Lancaster Road side-channel (rm48) 2011	640 linear feet of side-channel and 1 acre of floodplain habitat
Side-channel at Honolulu Bar (rm50) 2012	Improvement of existing side-channel to reduce stranding risk
Floodplain at Honolulu Bar(rm50) 2012	2.4 acres of floodplain habitat
Buttonbush (rm48) 2017	4.4 acres of side-channel and floodplain habitat and 2,400 linear feet of side-channel habitat
Rodden Road (rm43) 2018	4.9 acres of side-channel habitat
Goodwin Canyon Float Tube Pool (rm58) 2020	0.25 acre of side-channel habitat located on the south-side/downstream end of the Float Tube Pool.
Honolulu Bar Maintenance (rm50) 2020	Maintenance was conducted in the project area to redirect flow into the side channel. Scour of gravel in the main channel had reduced flows into the side-channel. The project would be improved with the addition of more gravel to the main channel and installing a gravel bench on the upstream side of the island.
Stanley Wakefield Wilderness Area (Kerr Park) Restoration (rm43) 2023	The project restored 23 acres of riparian habitat including 8.45 acres of floodplain.

Table 5-7. In-progress gravel and habitat restoration projects.

<b>Project</b>	<b>Project extent</b>
Goodwin Canyon (rm58)	Anticipated gravel: 4,500 tons/year as described in the 2020 ROD.
Migratory Corridor Rehabilitation – Buffington Restoration (rm2-3)	Anticipated 5.6 acres of seasonally inundated habitat in the lower river. Designs in progress.
Tortuga (rm42)	Anticipated habitat: Approximately 4 acres rearing habitat. Designs in progress.
Mohler Tract (rm12)	Anticipated habitat: Approximately 5 acres rearing habitat. Designs in progress.

Table 5-8. Potential gravel and habitat restoration projects.

<b>Project</b>	<b>Project extent</b>
Two Mile Bar (rm56)	Potential gravel augmentation site Not likely a viable habitat restoration project in the near-term because of land access issues.
Honolulu Bar Phase II (rm51)	Anticipated gravel and habitat: TBD
Lovers Leap (rm52)	Anticipated gravel and habitat: TBD
Honolulu Bar Gravel augmentation (rm50)	Anticipated gravel and habitat: TBD
Caswell State Park (rm8)	Acres TBD

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