BUREAU OF RECLAMATION

Clear Creek Technical Team Summary of Activities for Water Year 2024

U.S. Department of the Interior

March 25, 2025

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Acronyms and Abbreviations

ACID	Anderson-Cottonwood Irrigation District
BDA	Beaver Dam Analogue
BLM	Bureau of Land Management
BO	Biological Opinion
CCV	California Central Valley
CCRP	Clear Creek Restoration Program
CCTT	Clear Creek Technical Team
CDFW	California Department of Fish and Wildlife
CDWR	California Department of Water Resources
cfs	Cubic feet per second
CV	Central Valley
CVO	Central Valley Operations
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
ESA	Endangered Species Act
GRANDTAB	Grand Table (A CDFW compilation of Chinook Salmon escapement estimates in the Central Valley)
LCCFRP	Lower Clear Creek Floodway Restoration Project
LTO	Long-Term Operations
NMFS	National Marine Fisheries Service
NPS	National Park Service
PA	Proposed Action
PALS	Post Assisted Log Structure
RBFWO	Red Bluff Fish and Wildlife Office
Reclamation	U.S. Bureau of Reclamation
RM	River Mile
RPM	Reasonable and Prudent Measure
RWQCB	Regional Water Quality Control Board
SWP	State Water Project
USFWS	U.S. Fish and Wildlife Service

USGS	U.S. Geological Service
WSRCD	Western Shasta Resource Conservation District
WY 2024	Water Year 2024

Background

Clear Creek and the Technical Team

Since 1995, the Central Valley Project Improvement Act (CVPIA) and the CALFED Bay-Delta Program have undertaken anadromous salmonid habitat and flow restoration actions in Clear Creek. These actions have re-established Central Valley (CV) spring-run Chinook Salmon (Oncorhynchus tshawytscha) and California Central Valley (CCV) steelhead (O. mykiss) within the Clear Creek watershed (Figure 1). The Clear Creek Technical Team (CCTT) has been working together since 1996 to facilitate implementation of these CVPIA and CALFED restoration actions. Most issues and projects which the CCTT has facilitated involved physical habitat restoration of Lower Clear Creek (i.e., the stream downstream of Whiskeytown Dam to its confluence with the Sacramento River) and proposing flow recommendations. As of February 2020, the CCTT and Bureau of Reclamation (Reclamation)'s Central Valley Operations (CVO) office have performed Clear Creek management under the 2020 Record of Decision (ROD) for the Long-term Operations (LTO) of the CVP (Reclamation 2020) and SWP Biological Assessment and corresponding National Marine Fisheries Service (NMFS) Biological Opinion (WCRO-2016-00069; NMFS 2019).

Since being formally established in 1992 by CVPIA, the Clear Creek Restoration Program identified and implemented a variety of actions to improve salmon and steelhead habitat and the ecosystem on which these species depend. Past and continued actions include increased minimum flows, summer, and fall water temperature control through flow management, removal of a low-head dam, large-scale stream and floodplain restoration, gravel augmentation, spring and early summer pulse flows, and erosion control. The effects of these actions have been positive and have resulted in:

- greater than a four-fold increase in escapement of fall-run Chinook Salmon to Clear Creek (population estimate average = 1,749 from 1967 to 1991, and 7,974 from 1998–2023);
- re-established use of Clear Creek by Federal Endangered Species Act (ESA) listed threatened spring-run Chinook Salmon and threatened CCV steelhead;
- re-initiated sediment transport and stream channel movement processes, in some reaches, which help create and maintain fish habitat;
- an increase in the quality and quantity of streamside and floodplain riparian habitat; and
- increases in the amount of salmonid spawning habitat.

Active Members in Water Year 2024

- Kristin Begun, NMFS
- Tricia Bratcher, USFWS
- Matt Brown, USFWS
- Leslie Bryan, Redding Electric Utility
- Charles Chamberlain, USFWS
- Amy Lyons, Dept. of Water Resources (CDWR)
- Ross Perry, Western Shasta Resource Conservation District (WSRCD)
- Derek Rupert, Reclamation
- Maureen Teubert, WSRCD
- Russ Weatherbee, National Park Service (NPS)
- Tobias Felbeck, Bureau of Land Management (BLM)

Additional representatives from various agencies and entities participate on a less frequent basis (e.g., Redding Rancheria, Yurok Tribe, Clear Creek Community Service District, Horsetown-Clear Creek Preserve, Point Blue, and members of the public).

CCTT meetings in WY 2024 were facilitated and documented by Kearns & West (Jackson Gould)

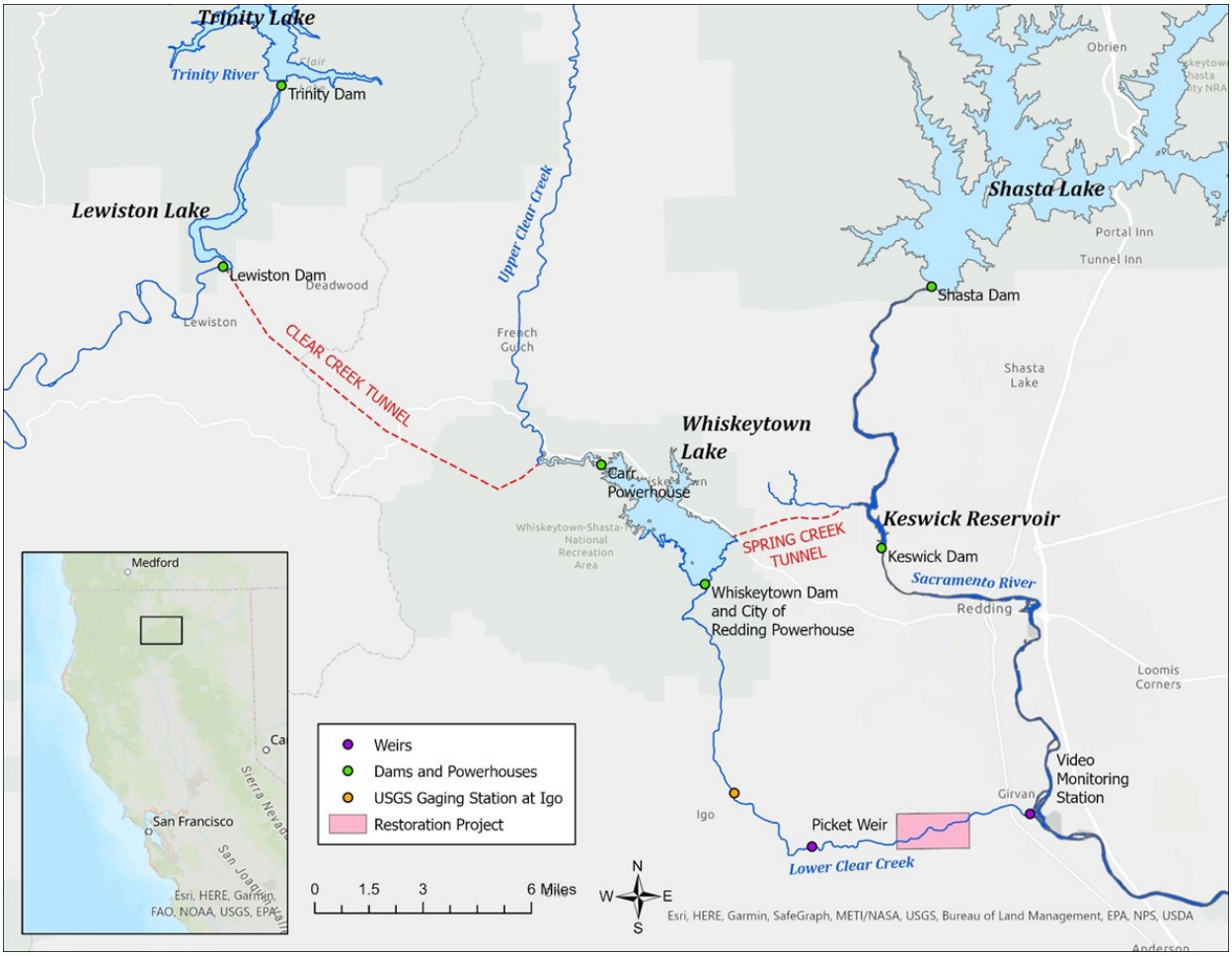

Figure 1. Location of Lower Clear Creek in Northern California, showing Trinity, Whiskeytown, and Shasta reservoirs and related CVP facilities.

This figure shows a map depicting the location of Lower Clear Creek in Northern California, in addition to Trinity Lake, Whiskeytown Lake, Lewiston Lake, Shasta Lake, and Keswick Reservoir. The map also depicts Weirs, Dams and Powerhouses, USGS Gaging Station at Igo, and the Restoration Project Location.

List of Clear Creek Technical Team Discussions

The following CCTT meetings, with an abridged list of discussions, occurred in water year (WY) 2024 (and since the 2023 CCTT Summary of Activities). The individual CCTT meeting notes provide considerably more detail than the synopses here.

December 14, 2023

- WSRCD staff and their contractor, NHC, presented their draft alternatives analysis for the ACID syphon fish passage project. Of the four alternatives they examined, a rock ramp and natural fish way was the preferred alternative.
- Reclamation staff provided a review of water year 2023, including SVI, precipitation totals, managed flow releases, spill events, Trinity River diversions, water temperature management, and climatic outlook.
- BLM staff provided an overview of their new Northwest CA Resource Management Plan. They discussed the potential implications of this plan for Clear Creek.
- USFWS staff provided an overview of their fish monitoring projects.
- USFWS staff provided an overview of the Water Year 2024 Flow and Temperature Management Proposal.
- DWR staff discussed their desire to increase their engagement with Clear Creek restoration actions.
- The CCTT discussed means to increase the public outreach efforts and awareness of the work being completed on Clear Creek.

March 14, 2024

- Reclamation provided an overview and outlook for WY 2024 operations and conditions. This included the SVI updates, proposed geomorphic and spring pulse flows, reservoir conditions, and climatic outlooks.
- USFWS staff provided an update on their fish monitoring projects.
- BLM staff discussed their project to clean up a shooting range ("Shooting Galley") along Clear Creek. There are high levels of lead in the area.
- NMFS staff gave a presentation on the recently completed spring-run Chinook Salmon mid-cycle viability assessment. Their report notes an increase in extinction risk for spring run Chinook Salmon, since their last assessment.
- WSRCD staff updated the team on their progress with the Phase 3B Completion project. They completed the revegetation and irrigation efforts and look to finish the invasive species treatments and irrigation removals over in the spring of 2024.
- WSRCD staff provided an update on the ACID syphon fish passage project.

- Reclamation staff provided an overview of the status of the gravel augmentation project. This included a discussion with the CCTT to determine the priority sites for augmentations for summer 2024.
- YTFP staff discussed their CDFW-funded grant to implement restoration actions on Clear Creek. Their 5-year grant should fund gravel augmentation implementations and planning for the Horsetown channel restoration and wood structure supplementation projects.

June 20, 2024

- Reclamation staff provided a review and outlook for WY 2024 operations and conditions. This included the SVI updates, implementation of the geomorphic and spring pulse flows, water temperature conditions, and climatic outlooks.
- USFWS staff provided an update on their fish monitoring projects.
- DWR staff provided a review of their recent/upcoming restoration projects on the Sacramento River, Feather River, and Battle Creek.
- WSRCD staff gave the final update on the complete Phase 3C Completion project and their ACID syphon fish passage project.
- Reclamation staff provided an overview of the gravel augmentation project sites to be implemented in summer of 2024, which will be completed by YTFP.
- Shasta Miners and Prospectors' member, Jim Rankin, presented his proposal to use suction dredging as a means of reclamation on Clear Creek. He suggests that suction dredges could remove hazardous materials, lead and mercury, from the creek.

September 19,2024

- WSRCD staff discussed their ACID syphon fish passage assessment project. In conjunction with NHC, they discussed further design details on the preferred alternative of a nature-like fishway.
- USFWS staff provided an update on their fish monitoring projects.
- USWS staff discussed their plans to post educational and warning signage along Clear Creek.
- NMFS staff provided an update on the Biological Opinion for the Long-term Operations of the Central Valley Project and State Water Project.
- YTFP staff provided a review of the gravel augmentations project completed during the summer. They also discussed their planning for the design and implementation of the Horsetown channel rehab project.
- Reclamation staff provided a review and outlook for WY 2024 operations and conditions. This included the SVI updates, implementation of the geomorphic and spring pulse flows, water temperature conditions, and climatic outlooks.

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Clear Creek Status

Water Year Characteristics

The water year classification for Clear Creek is determined through the Sacramento River Water Year Type Index (SVI) and this has important implications for the management of Clear Creek (see CHAPTER 3). The SVI as of May 1, 2024, revealed an "Above Normal" water year type (registering an 8.12 SVI, at 90% exceedance). Clear Creek flows at the Igo gage (USGS 11372000) saw several larger flow events through the winter and spring months. For example, there was a total of 20 days where the mean daily flows exceeded 800 cfs at the Igo Gage station (Figure 2). A Gloryhole Spillway event in February 2024, lead to the highest flows of the water year, peaking at instantaneous flow of 3,120 cfs at the Igo gage. Additionally, 29% of days in this water year (105 of 366 days) exceeded a mean daily flow at Igo gage of 300 cfs or more (which includes the artificial pulse flows).

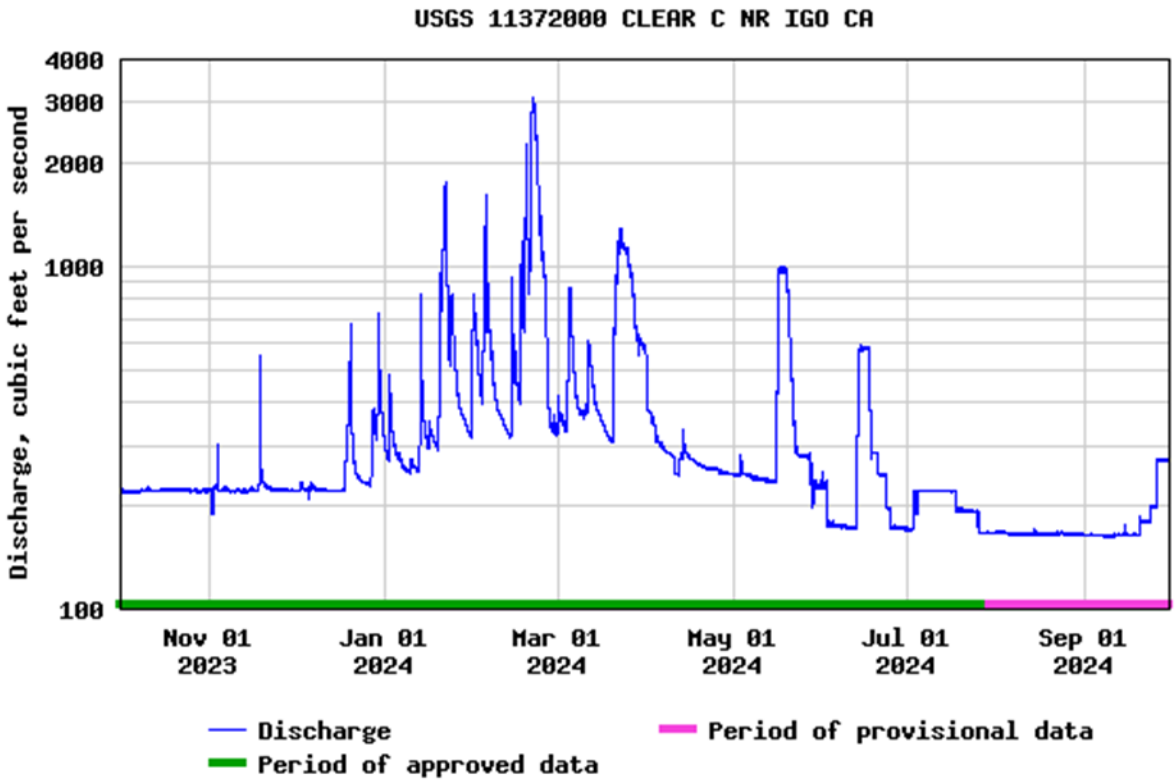

Figure 2. Instantaneous flow on Clear Creek at Igo gage during WY2024. Data courtesy of USGS.

This figure shows a line graph of Instantaneous flow on Clear Creek at Igo gage during WY2024. The graph measures Discharge in cubic feet per second, compared to dates spanning November 01, 2023, to September 01, 2024.

Glory Hole Spill

Uncontrolled releases can occasionally occur through Whiskeytown Dam's gloryhole spillway. These spills can have positive geomorphic impacts on Clear Creek which improve salmonid habitat.

In WY 2024, Whiskeytown Dam saw a 10-day uncontrolled spill event, occurring from February 19 to 28, 2024. During this event the mean daily maximum reached 2,578 cfs (Figure 3). One of the major contributors to this spill event, beyond heavy precipitation in the watershed, was that one of the two Spring Creek Powerplant's generators was down for repairs. This limited the amount of water that could be exported from Whiskeytown Reservoir. With the reduced export capacity, the Whiskeytown Dam spill event had an increased duration and magnitude of spill.

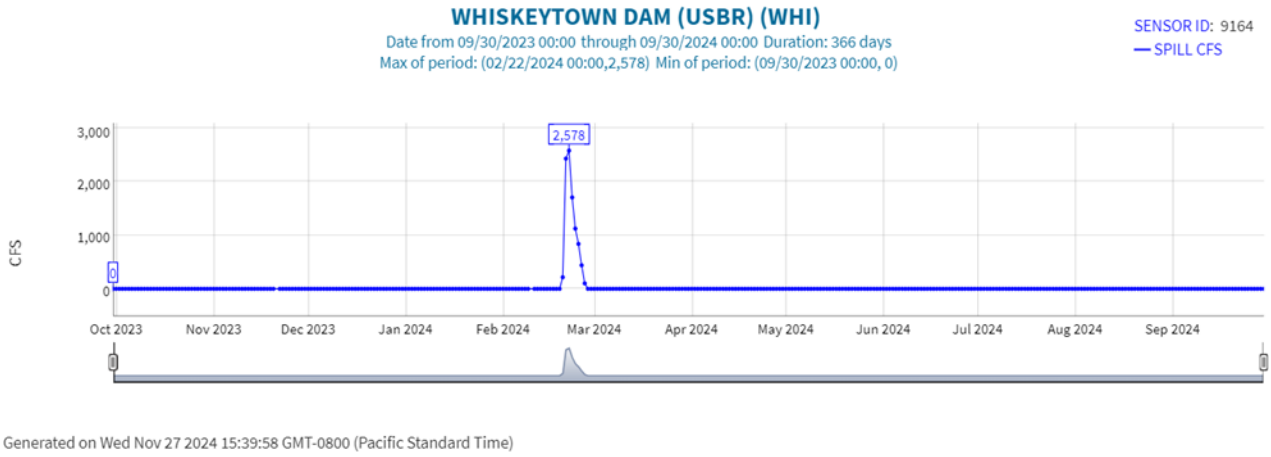

Figure 3. Whiskeytown Dam mean daily spillway discharge in water year 2024. Data courtesy of CDEC.

This figure shows a line graph of mean daily spillway discharge in WY2024 at Whiskeytown Dam. The y-axis shows CFS from 0 to 3,000, and the x-axis shows Dates October 2023 through September 2024. The peak of the line graph occurs between February 2024 and March 2024, at 2,578 cfs.

Figure 4. Water cresting the Whiskeytown Dam spillway during the WY 2024 gloryhole spill event. (Reclamation/M. Burke)

Water cresting the Whiskeytown Dam spillway during the gloryhole spill event in WY2024. The spillway is in the center of the image, with a road on the left, and powerlines against mountains in the background.

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Clear Creek Management Actions

The following sections highlight the management actions that occurred in Clear Creek during WY 2024 (October 1, 2023–September 30, 2024). Occasionally, additional information is included that covers other water years (i.e., WY 2025) for continuity, as some actions cross water years (e.g., water temperature management). With significant precipitation in the winter and spring 2024, the Water Year was designated as "Above Normal" (see Section 2.1) allowing for full channel maintenance and spring pulse flow volumes to be utilized. There was a Gloryhole spill event in February 2024 (see Section 2.2), but this event did not have sufficient magnitude and duration to trigger pulse flow volume reductions for the Clear Creek channel maintenance pulse flow.

The following Table 1 is a summary of the management actions from WY 2024.

Table 1. Summary of WY 2024 management actions, Clear Creek

Management Action Item	**Progress in WY 2024**
1. Minimum Base Flows	Completed
2. Water Temperature	Implemented with some excursions
3. Spring Attraction Flows	Completed
4. Channel Maintenance Flows	Completed
5. Fish Habitat Restoration and Management ("Gravel Augmentation")	Completed
6. Fisheries Monitoring	Completed

Minium Base Flows

Objective: *Provide flows to allow for sufficient spawning, incubation, rearing, and migration for salmon and steelhead.*

Action: *"Reclamation proposes a minimum base flow in Clear Creek of 200 cfs from October through May and 150 cfs from June to September in all year types except Critical year types. In Critical years, Clear Creek base flows may be reduced below 150 cfs based on available water from the Trinity Reservoir." (Section 4.10.2.4. of the PA).*

Results: In WY 2024, Clear Creek's minimum base flows were met across the entire year (Figure 5). Base flows were purposefully increased in June and September to improve water temperature conditions (see Section 3.2).

Whiskeytown Dam can provide controlled releases of water to Clear Creek via the City of Redding powerhouse and/or the bypass. The bypass's coarse level of control makes fine-tuning difficult. As such, CVO makes coarse bypass adjustments which are often followed up by several

smaller adjustments for fine-tuning of flows. There are also measurement discrepancies between the Whiskeytown Dam flow gage and the USGS Igo gage, with preference placed on the Igo gage's readings, due to the USGS's continual gage calibrations.

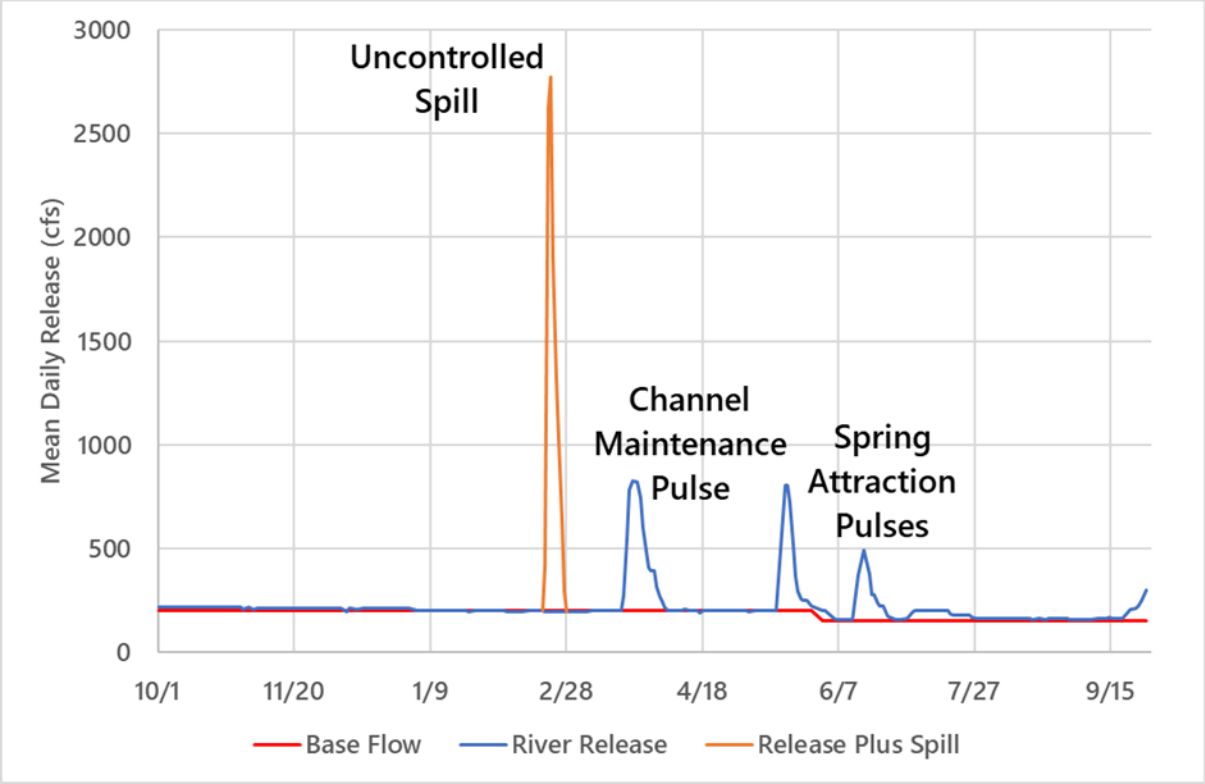

Figure 5. Mean daily flow from Whiskeytown Dam to Clear Creek during WY 2024, reported by Reclamation.

This figure shows a line graph of mean daily flow from Whiskeytown Dam to Clear Creek during WY2024. The y-axis shows the mean daily release in cfs, from 0 to 3000, and the x-axis shows states from 10/1 through 9/15. There are three lines depicted. One line is Base Flow, one line is River Release, and the third line is Release Plus Spill. Peaks indicate Uncontrolled Spill, Channel Maintenance Pulse, and Spring Attraction Pulses.

Water Temperature Management

Objective: *To reduce thermal stress to over-summering steelhead and spring-run during holding, spawning, and embryo incubation.*

Action: *"Reclamation proposes to manage Whiskeytown releases to meet a daily average water temperature of:*

1) *60°F at the Igo gauge from June 1 through September 15; and*
2) *56°F at the Igo gauge from September 16 to October 31.*

Reclamation may not be able to meet these temperatures in Critical or Dry water year types. In these years, Reclamation will operate to as close to these temperatures to the extent possible."

Results: In WY 2024, water temperature criteria were met at Igo gauge with varying levels of compliance. It was not possible to meet the water temperature criteria through all WY 2024, as Whiskeytown Reservoir's cold-water pool was depleted. During two periods in 2024, CVO provided additional water from Whiskeytown Dam to improve water temperature conditions in Clear Creek. Even with the additional water, difficulties were encountered in meeting the mean daily water temperature criteria in late September 2024.

During the summer and fall months, water temperature management on Clear Creek is highly dependent of trans-basin deliveries of cold water from the Trinity River. Similar to WY 2023, CVO prioritized re-building Trinity Reservoir storage. The Carr water diversions and Spring Creek tunnels were curtailed during much of WY 2024. Reduced diversions can cause water temperature issues for Clear Creek, as evident in the water temperature exceedances in September-October 2024.

Mean daily water temperatures at Igo gauge remained below 60°F for 100% of the 107-day adult spring-run Chinook Salmon holding period (June 1–September 15, 2024; Table 2 and Figure 4). These temperatures were delivered to Clear Creek via a 50:50 mix of water from the upper and lower guard gates. This configuration was changed to 100% lower guard gates, providing the coldest possible water from Whiskeytown Reservoir, on September 15 in preparation for the 56°F criteria period.

On July 6, 2024, Redding California reached an air temperature of 119 °F, the hottest the city has ever recorded. CVO provided additional water to Clear Creek via Whiskeytown Dam in July 2024, as this heat wave gripped Northern California. Base flows were increased from their normal 150 cfs, to approximately 200 cfs from July 3 to July 26 to maintain cool water temperatures in Clear Creek. On July 26, releases were returned to 150 cfs after climatic conditions returned to normal.

The mean daily water temperature criterion transitions from 60°F to 56°F for the spawning/egg incubation period of September 16 to October 31. It is important to note that the 56°F mean daily water temperature criteria period crosses water years. In October 2023, the 56°F criteria were met for 30 of 31 days (97%). From September 16 through September 30, 2024, the 56°F criteria were met for 0 of 15 days (0%). Overall, in WY 2024, the 56° F criteria were met for 30 of 46 days (65%; Table 2). For Fall of 2023 (Calendar year), which crosses water years, the 56°F criteria were met 23 of 46 days (50%; Table 3, Figure 6).

CVO provided additional flow in late September 2024 to support water temperatures in Clear Creek. Releases from Whiskeytown Dam were increased to 275 cfs for a period (which extended into WY 2025) to cool water temperatures. As climatic conditions improved, flows were again returned to 200 cfs in October 2024.

The Oak Bottom Temperature Control Curtain remained in place and operational during WY 2024. This curtain discourages the mixing of cold water coming from the Carr Tunnels with the warm epilimnion of Whiskeytown Reservoir, helping to extend the cold-water pool resource through the summer months (Figure 7). Reclamation is aware of deterioration at both curtains, and replacements and repairs are anticipated in the future.

Table 2. Proportion of days that water temperatures at Clear Creek IGO gauge met the criteria, during water years. Note: that the September 16 to October 31 temperature criteria crosses water years in a single spawning season.

Water Year	Spawning Temperature ≤56°F October 1-31	Holding Temperature ≤60°F June 1– September 15	Spawning Temperature ≤56°F September 16- September
WY 2011	44% (12 of 27 days)*	100% (107 of 107 days)	0% (0 of 15 days)
WY 2012	94% (29 of 31 days)	100% (107 of 107 days)	33% (5 of 15 days)
WY 2013	81% (25 of 31 days)	100% (107 of 107 days)	93% (14 of 15 days)
WY 2014	100% (31 of 31 days)	100% (107 of 107 days)	0% (0 of 15 days)
WY 2015	0% (0 of 31 days)	100% (107 of 107 days)	0% (0 of 15 days)
WY 2016	0% (0 of 31 days)	98% (105 of 107 days)	33% (5 of 15 days)
WY 2017	6% (2 of 31 days)	100% (107 of 107 days)	100% (15 of 15 days)
WY 2018	100% (31 of 31 days)	99% (106 of 107 days)	100% (15 of 15 days)
WY 2019	87% (27 of 31 days)	99% (97 of 98 days)*	13% (2 of 15 days)
WY 2020	94% (29 of 31 days)	99% (103 of 104 days)*	33% (5 of 15 days)
WY 2021	94% (29 of 31 days)	100% (105 of 105 days)*	47% (7 of 15 days)
WY 2022	97% (30 of 31 days)	93% (100 of 107 days)	20% (3 of 15 days)
WY 2023	10% (3 of 31 days)	100% (107 of 107 days)	100% (15 of 15 days)
WY 2024	97% (30 of 31 days)	100% (107 of 107 days)	0% (0 of 15 days)

*Data missing due to gage malfunctions or vandalism

Table 3. Proportion of days that water temperatures at Clear Creek IGO gauge met the criteria, during calendar years.

Calendar Year	Holding Temperature ≤60°F June 1-September 15	Spawning Temperature ≤56°F September 16–October 31
2011	100% (107 of 107 days)	63% (29 of 46 days)
2012	100% (107 of 107 days)	65% (30 of 46 days)
2013	100% (107 of 107 days)	98% (45 of 46 days)
2014	100% (107 of 107 days)	0% (0 of 46 days)
2015	100% (107 of 107 days)	0% (0 of 46 days)
2016	98% (105 of 107 days)	15% (7 of 46 days)
2017	100% (107 of 107 days)	100% (46 of 46 days)
2018	99% (106 of 107 days)	91% (42 of 46 days)
2019	99% (106 of 107 days)*	67% (31 of 46 days)
2020	99% (106 of 107 days)*	72% (33 of 46 days)
2021	100% (107 of 107 days)*	80% (37 of 46 days)
2022	93% (105 of 107 days)	15% (7 of 46 days)
2023	100% (107 of 107 days)	98% (45 of 46 days)
2024	100% (107 of 107 days)	50% (23 of 46 days)

*Data missing due to gage malfunctions or vandalism

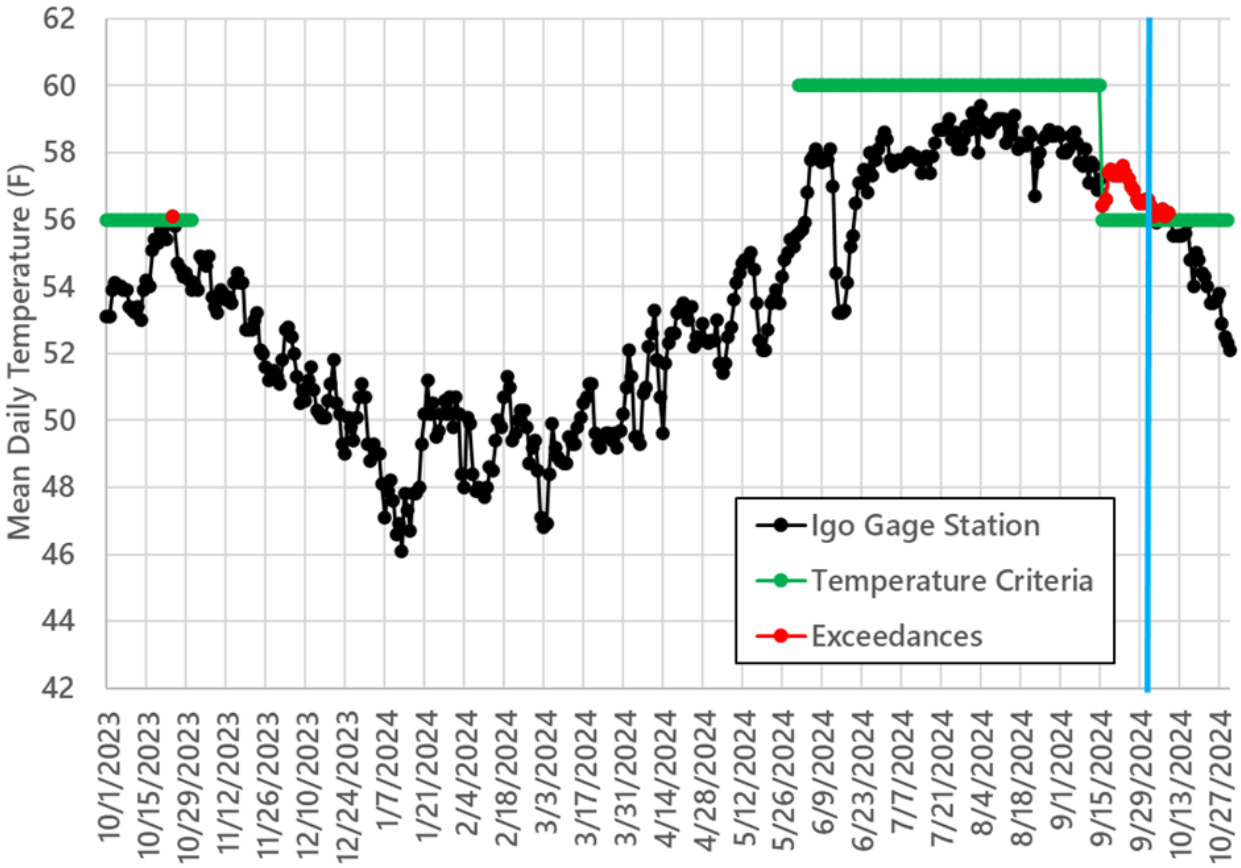

Figure 6. Mean daily water temperature on Clear Creek at the Igo gaging station in Water Year 2024 compared to the mean daily temperature criteria for spring-run Chinook Salmon holding (60°F from June 1 to September 15) and spawning and incubation (56°F from October 1 to 31 and September 16 to September 30). Red dots highlight days of temperature criteria exceedances. The Blue line represents the end of WY 2024 (September 30).

This figure shows a line graph of the mean daily water temperature on Clear Creek at the Igo gaging station. The y-axis shows mean daily temperature in degrees Fahrenheit, and the x-axis shows dates 10/1/2023 to 10/27/2024. The graph also depicts Temperature Criteria, and Exceedances.

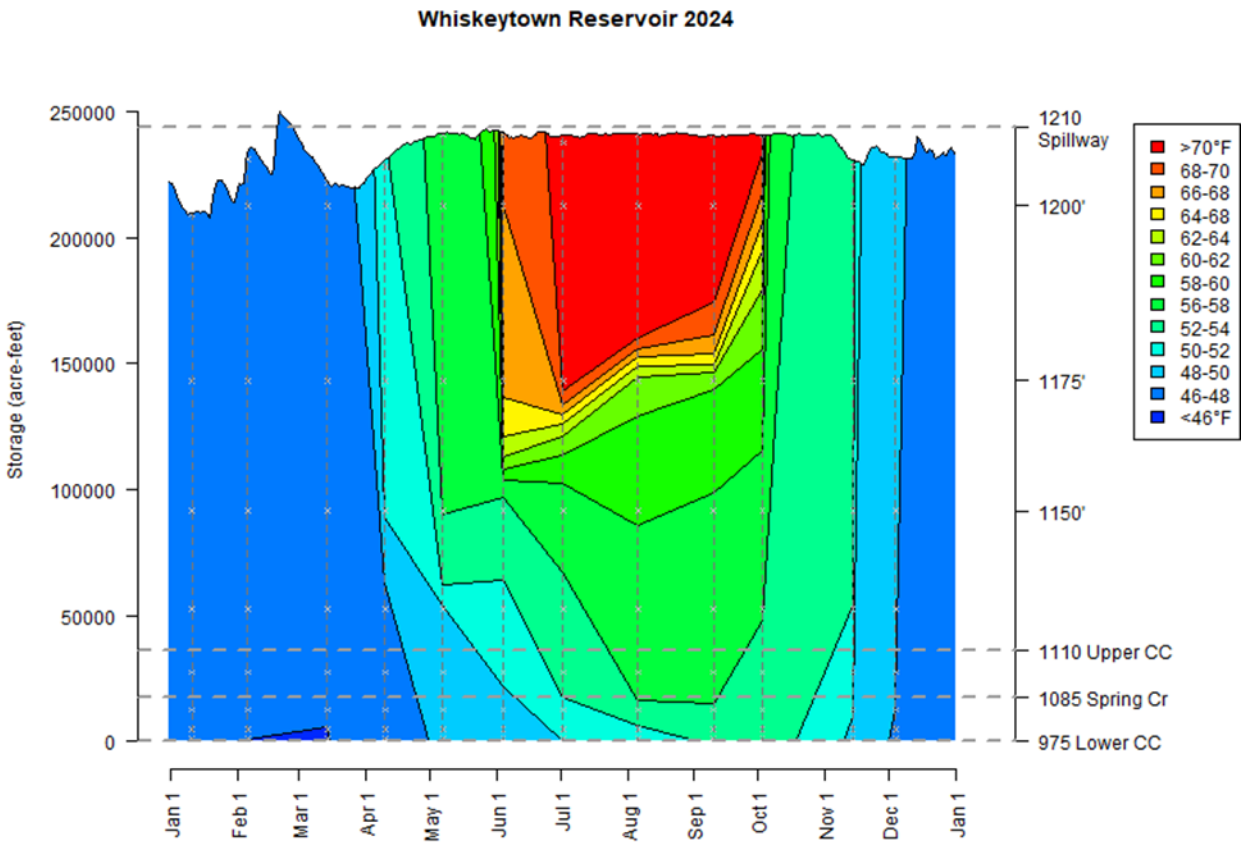

Figure 7. The isothermobath from Whiskeytown Reservoir in 2024.

A chart showing Whiskeytown Reservoir isothermobaths with storage in Acre-Feet from 0 to 250,000; with dates Jan 1 - Jan 1. The chart also depicts measurements at Lower CC (975), Spring Cr (1,085), Upper CC (1,110), and Spillway (1,210).

Spring Attraction Flows

Objective: *Encourage spring-run migrate to upstream Clear Creek habitats for holding and spawning.*

Action: *"For spring attraction flows, Reclamation would release 10 TAF (measured at the release), with daily release up to the safe release capacity (approximately 900 cfs, depending on reservoir elevation and downstream capacity), in all year-types except for Critical year-types to be shaped by the Clear Creek Implementation Team in coordination with CVO. In Critical [Dry] years, Reclamation would release one spring attraction flow of up to the safe release capacity (approximately 900 cfs) for up to 3 days." (Section 4.10.2.4. of the PA).*

Results: The CCTT produced an annual proposal for spring pulse flows for implementation of the flow requirements on Clear Creek. The CCTT deliberated on the timing and peak(s) of the pulse flow(s) actions and produced a set of pulse flows for different water year designations with

their formal proposal to CVO. The intent of the spring pulse flow(s) is to encourage spring-run Chinook Salmon to enter Clear Creek and ascend into the upstream-most reaches of the system.

With the final "Above Normal" water year type determination, 10,000 acre-feet of water volume was available to use towards spring pulse flows in Clear Creek. The CCTT-recommended spring pulses flow change timings were slightly changed in WY 2024 to accommodate NCAO's operators' schedules (Figure 8).

Adult spring-run Chinook Salmon enter Clear Creek from late April through early July, with peak migration in May and June. In WY 2024, two pulses provided from Whiskeytown Dam were developed to coincide with previously observed peak adult spring-run Chinook Salmon migration into Clear Creek and replicate the spring-run Chinook Salmon attraction success observed during past pulse flows.

Two spring pulse flows were released in WY2024. The first pulse will begin on May 16 and reached a peak of 800 cubic feet per second May 17. Flow rates was reduced to 200 cfs by May 28. The first pulse utilized 4,715 acre-feet of water volume. The second pulse begin on June 13 and reached a peak of 500 cfs of June 14. The second pulse ended on June 25 with Whiskeytown Dam releases dropping to 150 cfs summer base flows. The second pulse utilized 4,184 acre-feet of water volume. Combined the two pulses utilized 8,899 acre-feet of water, considerably less than the 10,000 acre-feet limit.

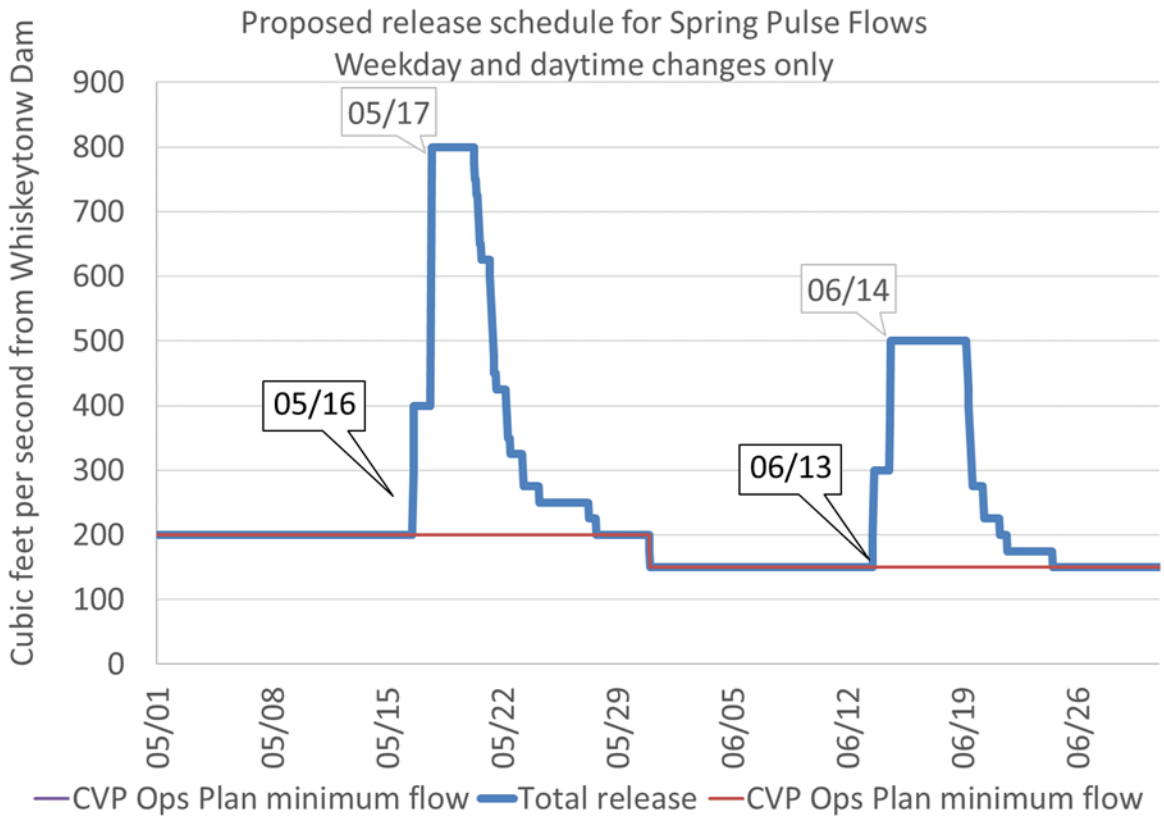

Figure 8. Proposed release schedule for 2024 spring pulse flow from Whiskeytown Dam.

This figure shows a line graph of the proposed release schedule for 2024 spring pulse flow from Whiskeytown Dam in cubic feet per second; with dates 05/01-06/26. The graph depicts peaks at 05/17, and 06/14.

The rapid increase in flows associated with any pulse flow action on Clear Creek can be disturbing to unknowing public users. The CCTT has previously received criticisms from users that were caught unaware of the flow changes. As such, the CCTT aims to improve communications with the public about all future pulse flows. The CCTT produced posters describing the pulse flow and timing. These posters were then posted at all the popular access points and trailheads on Clear Creek. Also, the CCTT has added a small flow bench (300 or 400 cfs) to the pulse flow to act as a warning that flows are increasing. The cold water and increased turbidity occurring with this flow bench should discourage recreation in the creek.

Snorkel surveys were conducted by the USFWS before and after each pulse flow to help determine the response of spring-run Chinook Salmon to the flow action. These surveys provided an index of abundance of adult spring-run Chinook Salmon and spatial information on the distribution of adults within Clear Creek (see CHAPTER 4).

Channel Maintenance Flows

Objective: *Provide pulse flows that will induce desirable geomorphic processes, which build and maintain fish habitat.*

Action: *"Reclamation would release 10 TAF from Whiskeytown, with a daily release up to the safe release capacity, in all year-types except for Dry and Critical year-types (based on the Sacramento Valley index) to be shaped by the Clear Creek Implementation Team in coordination with CVO. Pulses would be scheduled with CVO. No channel maintenance flows would be scheduled before January 1. For each storm event that results in a Whiskeytown Gloryhole spill of at least 3,000 cfs for 3 days, Reclamation will reduce the channel maintenance flow volume for this year or the following year by 5,000 acre-feet. If two Gloryhole spills occur that meet this criterion in a year, additional channel maintenance flows would not be released in that year. In Critical years, Reclamation would release one spring attraction flow of up to the safe release capacity (approximately 900 cfs) for up to 3 days and would not release any channel maintenance flows. Reclamation could instead, or in addition, use mechanical methods to mobilize gravel or shape the channel if needed to meet biological objectives." (Section 4.10.2.4. of the PA).*

Results: The CCTT developed a plan for implementation of geomorphic flows in WY 2023 (Figure 9). The total allowable water volume for this pulse was 10,000 acre-feet. This marked the second year where a channel maintenance pulse was implemented on Clear Creek (along with WY 2023).

Within the CCTT's WY 2024 flow proposal, the channel maintenance pulse was not given a specific release schedule. Rather, the plan was to release the pulse with a significant precipitation event in hopes that the pulse and tributary accretions would combine to produce flows capable of causing geomorphic evolution.

In late March 2024, a significant precipitation event was forecasted to occur, and it triggered the channel maintenance pulse. The pulse began on March 22 and ended on April 4. The implementation of the pulse with a precipitation event was successful in increasing the peak flows downstream. The peak instantaneous flow at Igo reached a reported 1,150 cfs on March 23, which was 310 cfs above the peak 840 cfs dam release as measured at the dam. The total water volume utilized for this pulse was 9,986 cfs.

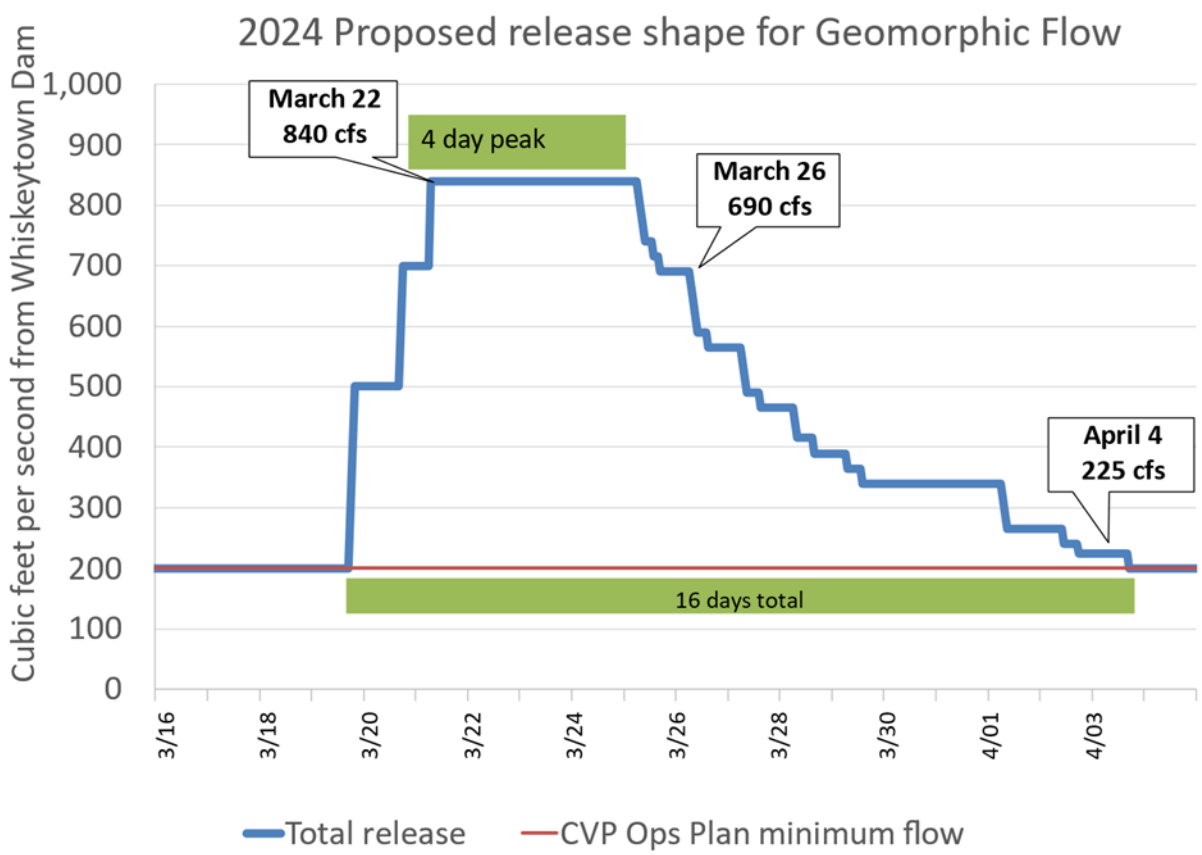

Figure 9. Proposed release schedule for 2024 channel maintenance pulse flow from Whiskeytown Dam. This pulse flow was scheduled to coincide with a significant precipitation event.

This figure shows a line graph of the proposed release schedule for 2024 channel maintenance pulse flow from Whiskeytown Dam in cubic feet per second; with dates 3/16-4/03. A 4-day peak is represented on March 22 at 840 cfs. 690 cfs is highlighted on March 26, and 225 cfs is highlighted on April 4.

Fish Habitat Restoration and Management

Objective: *Enhance and maintain previously degraded habitat for anadromous salmonids, through the placement of desirable materials such as coarse sediment ("gravel") and large wood.*

Action: *"Reclamation and DWR propose to continue channel maintenance under the Clear Creek Restoration Program."*

Results: In WY2024, the Fish Habitat Restoration and Management was completed. Implementation of the gravel augmentation project was set as a CCTT priority, as it had been two years since the project was implemented. Gloryhole spill events in WY 2023 and 2024 had

fully evacuated all the gravel augmentation sites on Clear Creek. In WY 2024, the CVPIA awarded a grant for restoration projects for Clear Creek to the Yurok Tribe.

The Yurok Tribe, in coordination with Reclamation, competed the 2024 Clear Creek gravel augmentations. Four augmentations were completed, which included, Whiskeytown Dam (1,509 tons), Clear Creek Road Bridge (1,137 tons), Reading Bar (1,516 tons), and Phase 2A/Gold Dredge (3,020 tons; Figure 10). Boulders and large wood were incorporated into the Reading Bar and Phase 2A/Gold Dredge sites. In total, 7,182 tons of coarse sediment, 10 boulders (Figure 11), and 10 large wood pieces (Figure 12) were placed in Clear Creek in WY 2024.

Figure 10. Riffle supplementation implementation at the Phase 2A/Gold Dredge gravel augmentation site in WY 2024.

Two tractors in a shallow creek among piles of rocks.

Figure 11. Boulders placed in 2024 at the Reading Bar gravel augmentation site.

Two large boulders in a shallow creek. Significant water turbulence is visible around the boulder closer to the center of the creek.

Figure 12. Large wood placements at the Gold Dredge augmentation site in 2024.

A tractor adjacent to a creek, carrying large logs.

Fisheries Monitoring

Objective: *Monitor and evaluate the response of fisheries to the restoration actions occurring in Lower Clear Creek.*

Action: *The USFWS monitors salmonid habitat and adult and juvenile life history of salmonid populations in Clear Creek. The CDFW monitors the escapement of fall-run in Clear Creek.*

Juvenile Production Monitoring

The USFWS operates rotary screw traps at two locations on Clear Creek, at RM 8.4 (Upper Clear Creek [UCC]) and RM 1.7 (Lower Clear Creek [LCC]). The UCC trap produces a juvenile spring-run Chinook Salmon passage index (JPI), while the UCC trap captures all anadromous salmonid species of Clear Creek. The juvenile passage indices for fall-run Chinook Salmon, late-fall run Chinook Salmon, and O. mykiss (Rainbow Trout/steelhead) are calculated from the catch at the LCC trap. In WY 2024, LCC started operations on October 20, 2023, and UCC on October 21, 2023. LCC ceased operation on June 26, 2024, and UCC on June 30, 2024. LCC was put back into operation on September 4, 2024, but did not operate for much of that time because flows were too low to rotate the cone. UCC was put back into operation on August 30, 2024, and was in continuous operation until October 31, 2024.

The preliminary brood year 2023 juvenile passage estimates at LCC were: fall-run Chinook Salmon was 771,597 fish (Figure 12), O. mykiss was 20,188 fish (Figure 13). The adjusted passage index for redds below LCC was 32,430. The brood year 2023 juvenile spring-run Chinook Salmon passage index at UCC was 51,020 fish (Figure 14). There were no redds observed above the separation weir and below the UCC trap. The UCC trap did not operate for part of the spring-run Chinook Salmon out-migration period, so the JPI is most certainly lower than the actual passage (Figure 15). Similarly, the LCC trap did not operate for parts of the fall-run Chinook Salmon out-migration (Figure 16). The USFWS's Clear Creek Brood Year 2023 Juvenile Report is in progress.

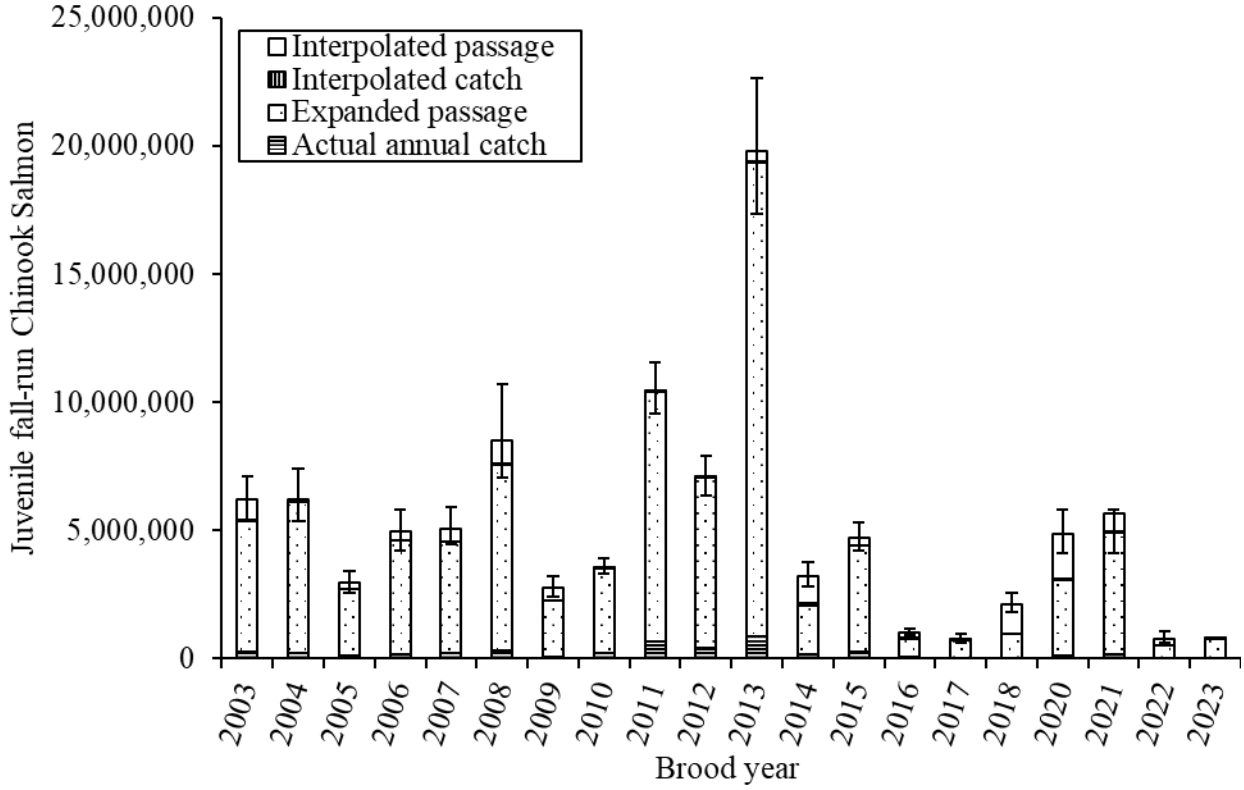

Figure 13. Annual passage indices of juvenile fall-run Chinook Salmon by brood year at the lower Clear Creek rotary screw trap from 2003 to 2023.

A bar graph showing passage indices of juvenile fall-run Chinook Salmon from 0-25,000,000; with years 2003-2023. The graph also depicts interpolated passage, interpolated catch, expanded passage, and actual annual catch.

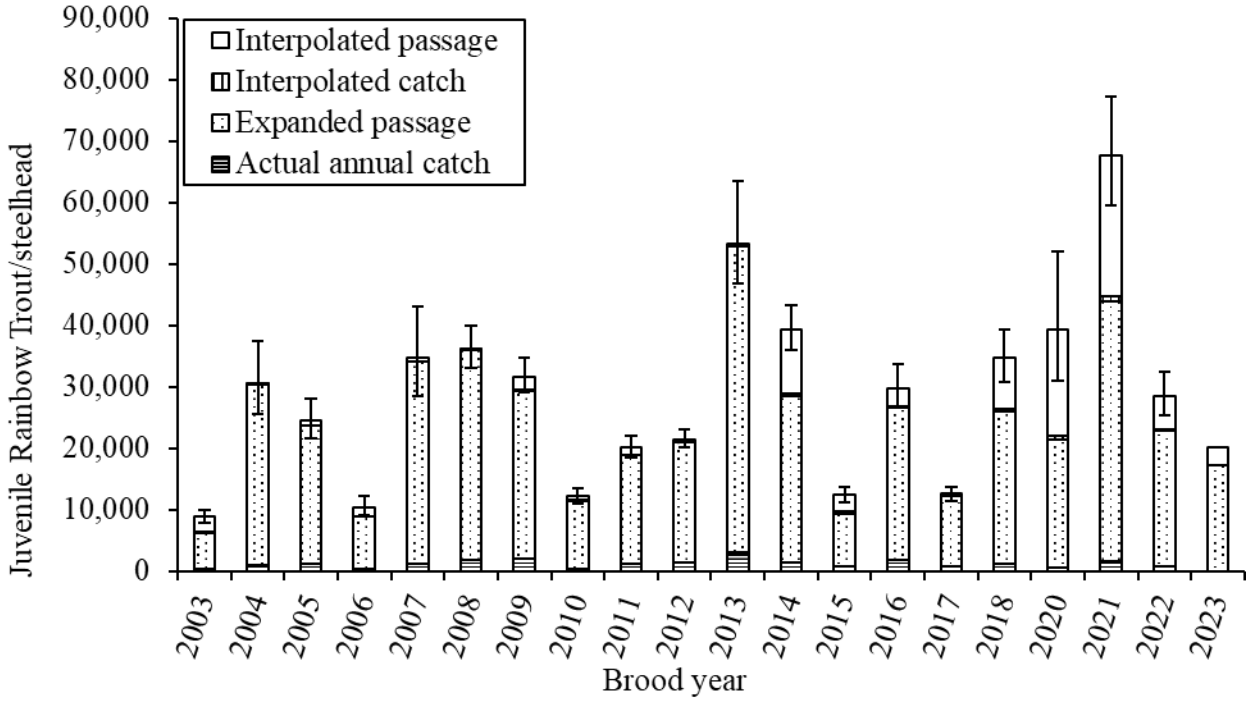

Figure 14. Annual passage of juvenile Rainbow Trout/steelhead by brood year at the lower Clear Creek rotary screw trap from 2003 to 2023. There is no passage index for brood year 2019.

A bar graph showing passage indices of juvenile Rainbow Trout/steelhead from 0-90,000; with years 2003-2023. The graph also depicts interpolated passage, interpolated catch, expanded passage, and actual annual catch.

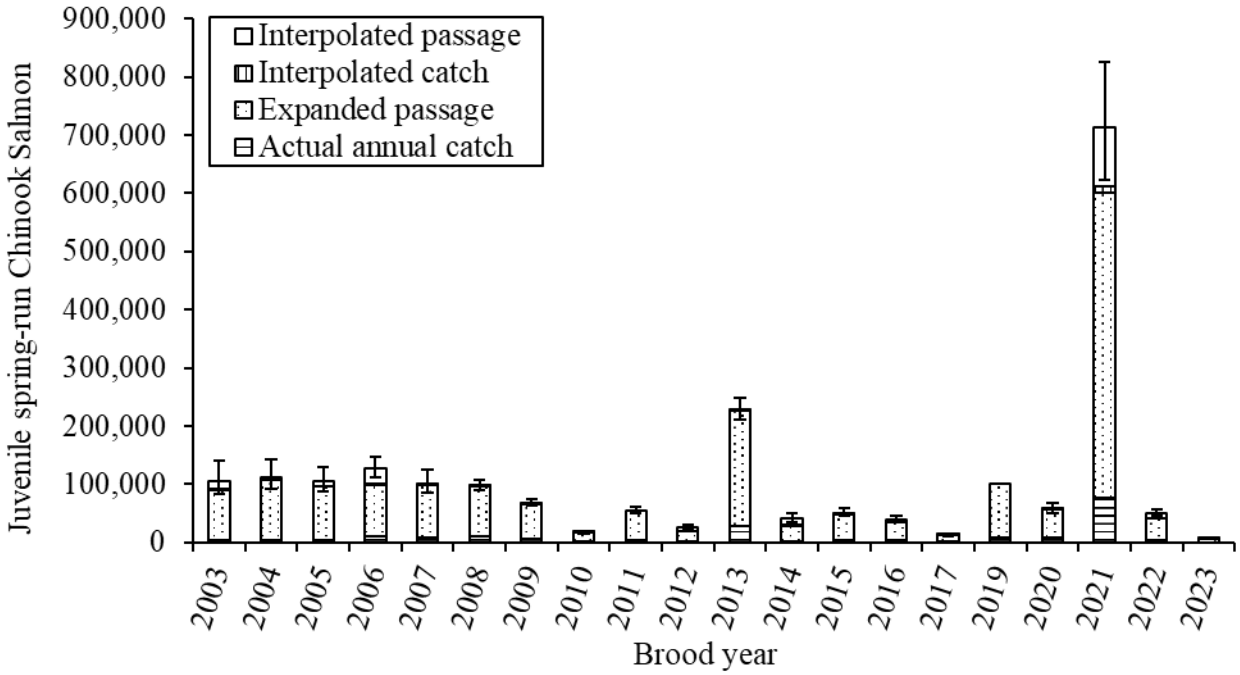

Figure 15. Annual passage of juvenile spring-run Chinook Salmon by brood year at the upper Clear Creek rotary screw trap from 2003 to 2023.

A bar graph showing passage indices of juvenile spring-run Chinook Salmon from 0-900,000; with years 2003-2023. The graph also depicts interpolated passage, interpolated catch, expanded passage, and actual annual catch.

Adult Escapement

The USFWS and CDFW jointly operate a video weir at the mouth of Clear Creek (RM 0.1). In WY 2024, CDFW operated the weir from the start of the water year (October 1, 2023) to December 19, 2023. The USFWS operated the weir from December 20, 2023, to August 12, 2024. The CDFW operated the weir again from August 13, 2024, through the end of the water year (September 30, 2024).

Spring-run Chinook Salmon

Adult spring run Chinook Salmon upstream passage into Clear Creek is monitored at a video station near the confluence with the Sacramento River and sometimes estimated via snorkel survey when weir data are insufficient. Figure 16 shows the adult population estimates from 2000 through 2024. Video data are being evaluated by the Red Bluff USFWS office to characterize spring run Chinook Salmon passage through the entire emigration period and to look for a detectable response to the spring pulse flows. The final spring-run Chinook Salmon return estimate for BY 2023 was zero fish. For BY 2024 we estimate a net of six spring-run Chinook Salmon returned to spawn.

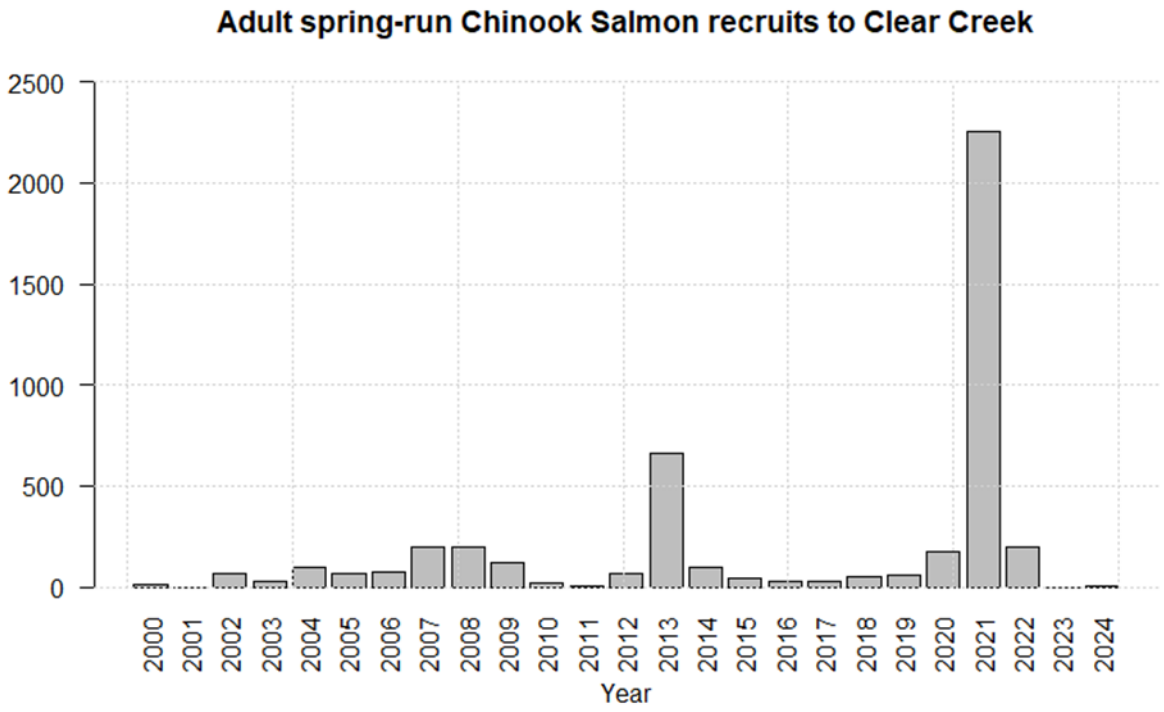

Figure 16. Clear Creek spring run Chinook Salmon escapement reported to GrandTab for the years 2000 through 2024 (Azat 2024).

A bar graph showing Adult spring-run Chinook Salmon recruits to Clear Creek from 0-2,500; with years 2000-2024.

Fall-run Chinook Salmon

The adult fall run Chinook Salmon estimate is produced by CDFW based on the Clear Creek video weir passage. CDFW reported 1,110 fall-run Chinook Salmon entered Clear Creek in 2023 (Azat 2023, Figure 18). CDFW preliminarily estimates 1,068 fall-run Chinook Salmon entered Clear Creek in 2024. The 2023 and 2024 fall run adult returns are the lowest returns of this run to Clear in over 30 years.

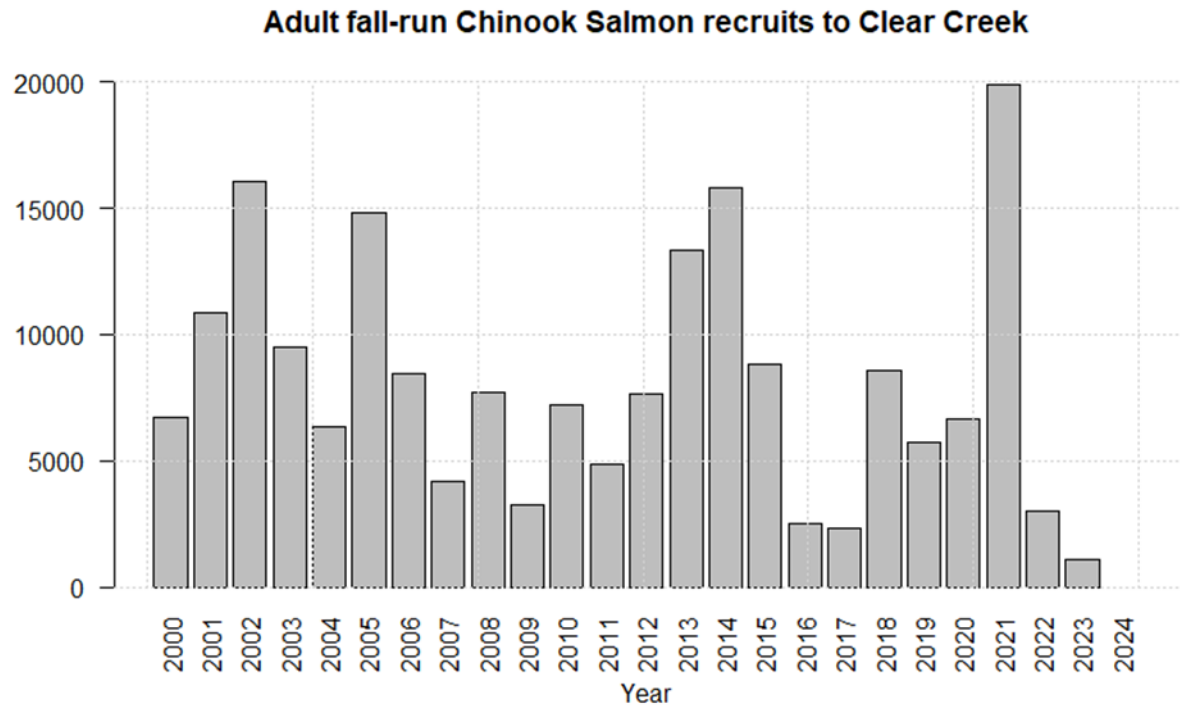

Figure 17. Clear Creek Fall-run Chinook Salmon escapement reported to GrandTab for the years 2000 through 2024 (Azat 2024).

A bar graph showing Adult Fall-run Chinook Salmon recruits to Clear Creek from 0-2,000; with years 2000-2024.

Late-fall run Chinook Salmon

The estimated late fall-run Chinook Salmon population was 83 adults (Figure 18). This number was calculated by applying an expansion factor of 2.75 on the 30 1ate-fall run Chinook Salmon redds that were observed during the survey season (December 18, 2023–April 5, 2024). However, due to hydrologic conditions during the survey period only ~43% of surveys were completed. The USFWS report detailing this analysis is in progress.

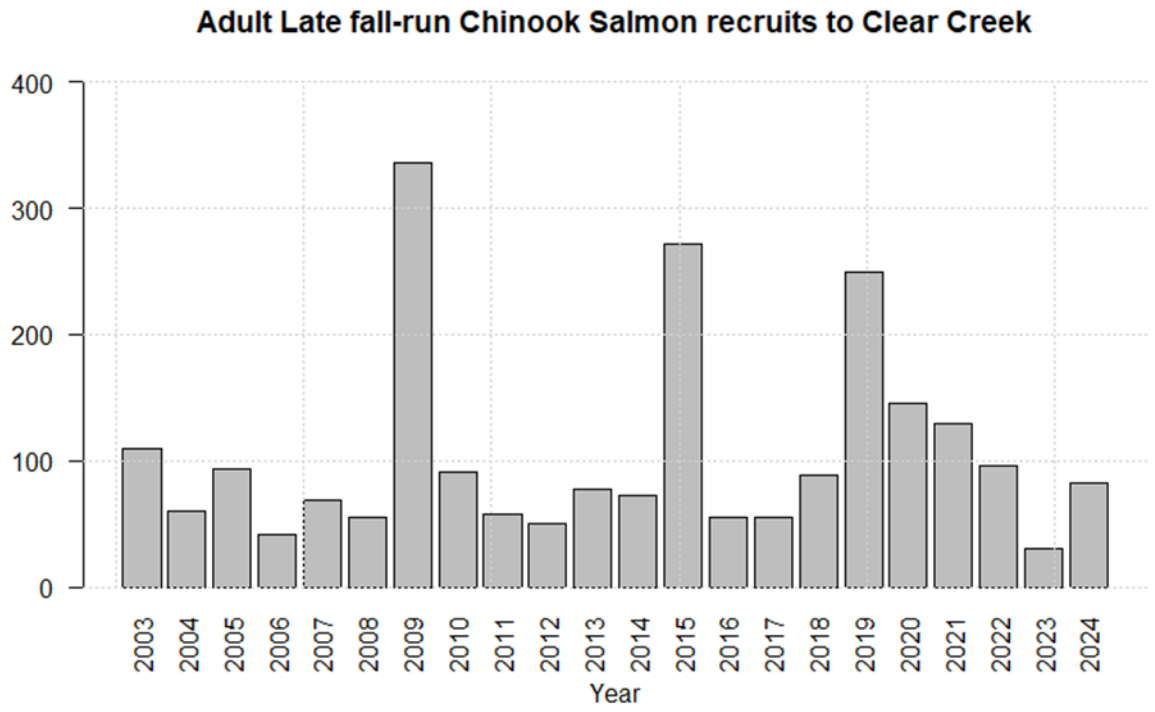

Figure 18. Clear Creek Late-fall run Chinook Salmon escapement reported to GrandTab for the years 2003 through 2024 (Azat 2023). Missing values denote years when no comparable estimate was submitted to Grandtab.

A bar graph showing Adult Late Fall-run Chinook Salmon recruits to Clear Creek from 0-400; with years 2000-2024.

Steelhead

The resolution for adult "steelhead" numbers in Clear Creek is poor due to complicated O. mykiss life histories. CDFW estimates a net gain of >16-inch fish into Clear Creek during their operation period (August to December). During the USFWS monitoring period (December to August) more >16-inch fish leave the system than enter (post-spawn runbacks). CDFW has been monitoring life history dynamics of Clear Creek via acoustic tag and radio antennae equipment since 2020 and has shared some preliminary results during CCTT meetings. A final report is pending.

Separation Weir

The USFWS operated a separation weir at RM 7.82 to prevent fall-run Chinook Salmon from negatively impacting spring-run Chinook Salmon upstream of the weir. The weir is typically operated from the end of August through the beginning of November. In 2024, the weir was installed on August 15 and closed to upstream fish passage on August 27. The weir remained

fish-tight throughout the season until November 6, when a storm broke several pickets and one A-frame. The weir was removed on November 7 following the completion of spring run Chinook Salmon spawning surveys. Five spring-run Chinook Salmon carcasses were retrieved from the weir during its operation; three were identified as male, one as female, and one as unknown sex.

Spawning Habitat Evaluations

The USFWS completes an annual survey of Clear Creek's potential spawning habitat available to salmon and steelhead. Data collected in July 2024 indicate significant changes in the spawning habitat in Clear Creek. Much of the change is attributable to the historic and protracted discharge event in January 2023. Some areas of the creek still retained sand, perhaps indicating a continued "recovery" of spawning habitat area following the fine sediment inundation from the 2018 Carr Fire. In general, gravel injection sites in the upstream reaches of Clear Creek were depleted of gravel, and much of the suitable spawning attributable to the gravel was found farther downstream. Sand continued to accumulate in the lower reaches of Clear Creek, although there is some evidence it is transporting out of the key spawning areas in "Renshaw Riffle" (RM 5–5.5). From 2021 to 2023, a decrease in total spawning area was mapped in Clear Creek (2023- 710,840 ft2, 2022- 837,560 ft2, 2021- 907,569 ft2 (Figure 19). In 2024, this trend continued, and we measured only 425,383 ft2. The habitat is smaller in area than what was mapped in 2019 following the Carr fire (573,051 ft2) and is the lowest measurement since 2011. In Reach 1, there was a measured reduction in spawning habitat in most 1000-ft breaks. The spawning gravel that was previously in these areas was pushed to downstream locations. At the top end of Reach 2 and downstream of the Guardian Rock gravel augmentation site, a noted reduction in habitat was found, similar to what was seen upstream in Reach 1. Lower in Reach 2 and into the canyon reach, mapped spawning habitat appeared in a new location (RM 14.6-RM 14). It is likely this is the resting place for the injection gravel transported from upstream. Little habitat was mapped in Reach 3, despite the downstream extent of this reach (above old Placer Bridge) having been an area with growing spawning area over the last few years (RM 11.2). Spawning gravel was transported out of this area, and no sizeable spawning area was mapped here in 2024. In Reach 4, there was a sizeable reduction in spawning area in the upstream areas and below the Placer Bridge gravel augmentation site. Near the downstream most area of Reach 4, just upstream of the Clear Creek Road Bridge, there was a dramatic increase in spawning habitat, again likely the resting spot of the transported gravel from upstream. A few changes were noted in the downstream reaches of Clear Creek which area primarily used by fall-run Chinook Salmon for spawning. "Renshaw Riffle" (RM 5–5.5) continues an increasing trend of spawning habitat following the Carr Fire, though still far shy of the historical spawning habitat that used to persist there. From the Restoration Reach and downstream, there was much less spawning habitat area than in recent years. It appears much of the decomposed granite that was released from the Clear Creek tributaries following the Carr fire has transported to these reaches where there is less stream power to move it out.

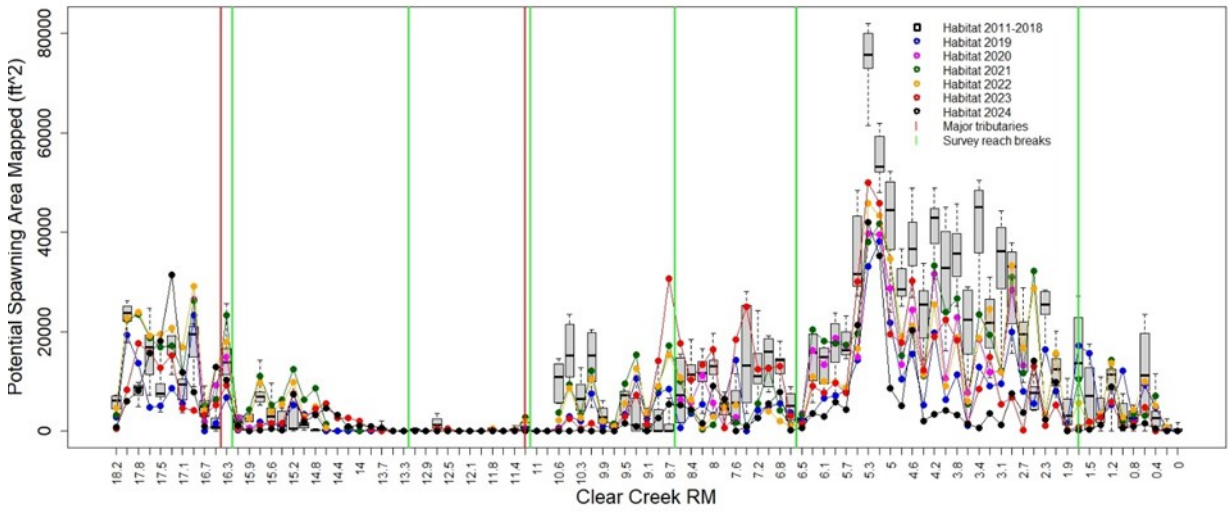

Figure 19. Anadromous fish spawning habitat mapped on Clear Creek 2011–2024. The X-axis indicates river mile breaks of roughly 1,000 ft. The Y-axis indicates the magnitude of habitat within each break. Years 2011–2018 are displayed by boxplot, 2019-2024 are presented as points. In 2020 only a subset of reaches was completed. USFWS-Red Bluff unpublished data.

A line graph showing Anadromous fish spawning habitat mapped on Clear Creek with Potential Spawning Area Mapped (square feet); with Clear Creek RM from 18.2-0. The graph depicts Habitat 2011-2018, Habitat 2019, Habitat 2020, Habitat 2021, Habitat 2022, Habitat 2023, Habitat 2024, Major Tributaries, and Survey reach breaks.

The USFWS conducts annual Spawning Area Mapping (SAM) surveys to detect and map fallrun Chinook Salmon redds on Clear Creek. Surveys are carried out in October and December to capture early and late spawning of fall-run Chinook Salmon along the downstream reaches, where spawning primarily occurs. In comparison to 2008-2020 SAM data from the Clear Creek Gorge to the USFWS lower rotary screw trap (RM 6.5 – 1.7), all SAM surveys since 2022 have begun above the Gorge starting at the Clear Creek Road Bridge and finished at the confluence with the Sacramento River (RM 8.6 – 0). Spawning activity was defined as the area where substrate had been moved by salmon in the process of constructing a redd.

Spawning area for each dataset was calculated for 1,000-foot analysis reaches within the study area. For 2024, the total October-survey SAM area was 50,229 ft2, and the total December-survey SAM area was 7,102 ft2 (Figure 20). While the spawning area mapped in 2024 was far less than in many other years, fall-run Chinook Salmon recruitment into Clear Creek this year was very low. Other factors that could explain differences in the spawning area per adult include geomorphological changes due to increased storm severity and frequency, drought, and lasting effects from the 2018 Carr fire.

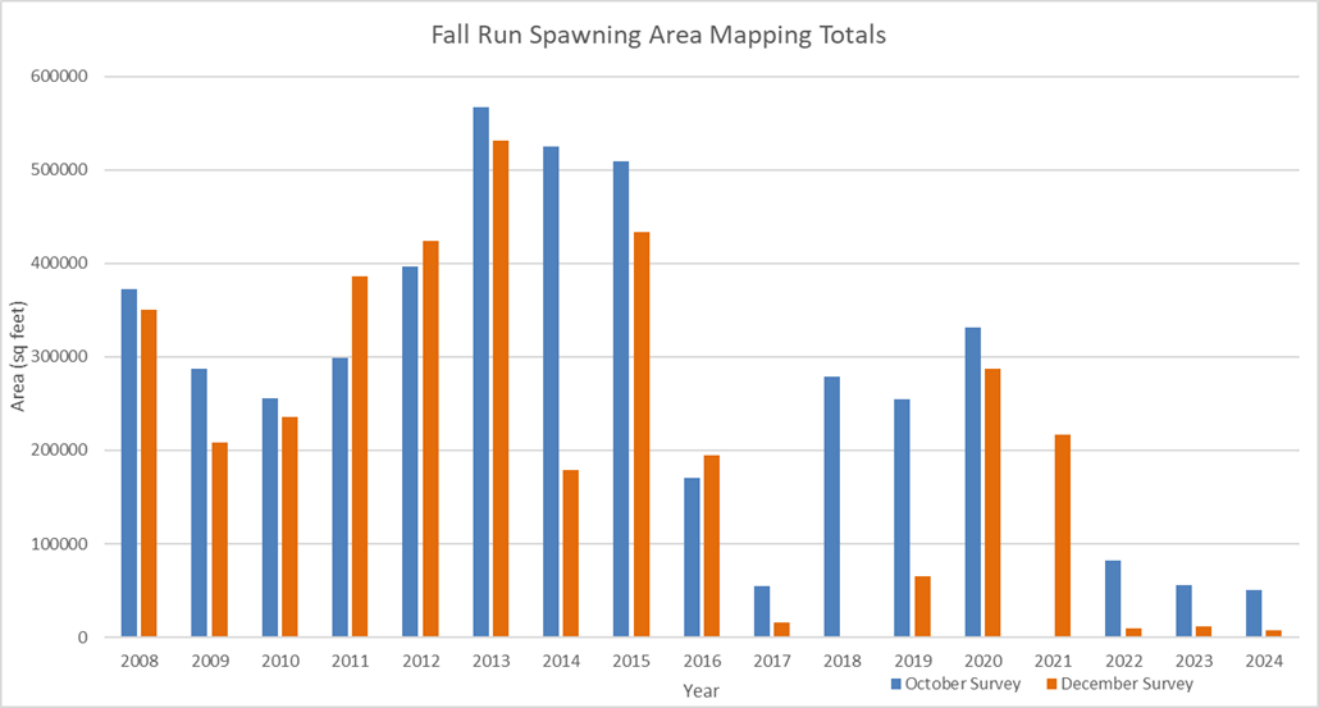

Figure 20. Area of fall run Chinook Salmon spawning by calendar year. The spawning area mapped in October is represented by blue bars. The spawning area mapped in December is represented by orange bars.

A bar graph showing Fall Run Spawning Area Mapping Totals in area (square feet); with years 2008-2024. The graph depicts results from an October survey, and results from a December survey.

The gravel augmentation program's influence on spawning habitats in Clear Creek is assessed empirically by (1) identifying the habitat used by spring run Chinook Salmon and CCV steelhead for spawning, and (2) by annually surveying the amount of habitat available for spawning by these runs/species. Data from 2013 through 2024 show the proportional use of injected gravels vs. native gravels has increased for both spring-run Chinook Salmon and CCV steelhead (Figure 21).

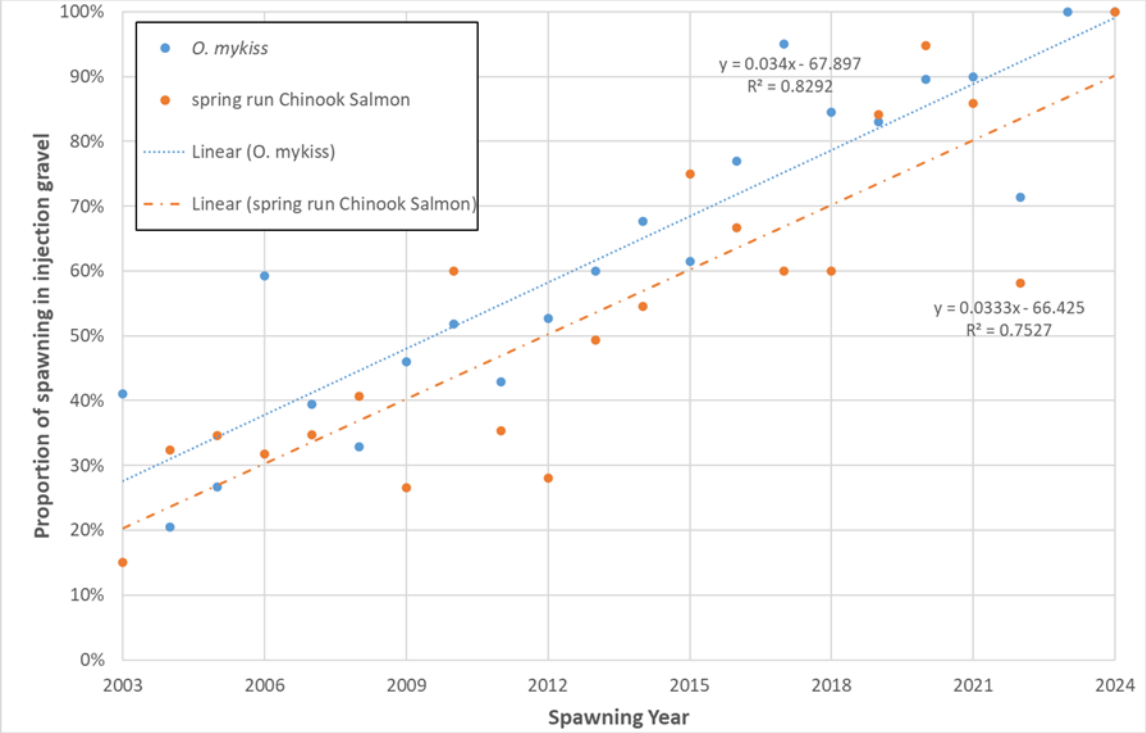

Figure 21. Annual proportion of spring run Chinook Salmon and steelhead spawning in injection gravels, 2003–2023. Results limited to Clear Creek upstream of the spring and fall run Chinook Salmon segregation weir. USFWS-Red Bluff unpublished data.

A scatter plot showing the proportion of spawning in injection gravel from 0%-100%; with Spawning Years 2003-2024. The plot depicts O. mykiss and Spring-run Chinook Salmon.

Spawning Surverys

The USFWS completes two spawning surveys on Clear Creek annually. The "kayak" spawning survey with the intent of quantifying late-fall run Chinook Salmon and O. mykiss spawning and the "snorkel" spawning survey with the intent of quantifying spring run Chinook Salmon spawning. In the 2023-2024 kayak season, three full creek survey and four partial creek surveys were completed between mid-December 2023 and the first week of April 2024. The surveys observed 30 late-fall and 46 O. mykiss redds. Additionally, six late-fall run Chinook Salmon carcasses were retrieved, one of which was identified to be marked (adipose fin absent). The head from adipose absent carcasses will be processed to extract the coded wire tag and determination of hatchery of origin.

During the 2024 snorkel season, surveyors conducted four creek-length spawning ground surveys between September 10 and October 25. Four Chinook Salmon redds were recorded upstream of the separation weir where spawning activity is attributed to spring-run Chinook Salmon. where successful spawning was thought to have occurred with high confidence (Figure

22). Additionally, one spring-run Chinook Salmon carcass was retrieved during the survey period, for which the adipose status and sex were unable to be determined due to predation.

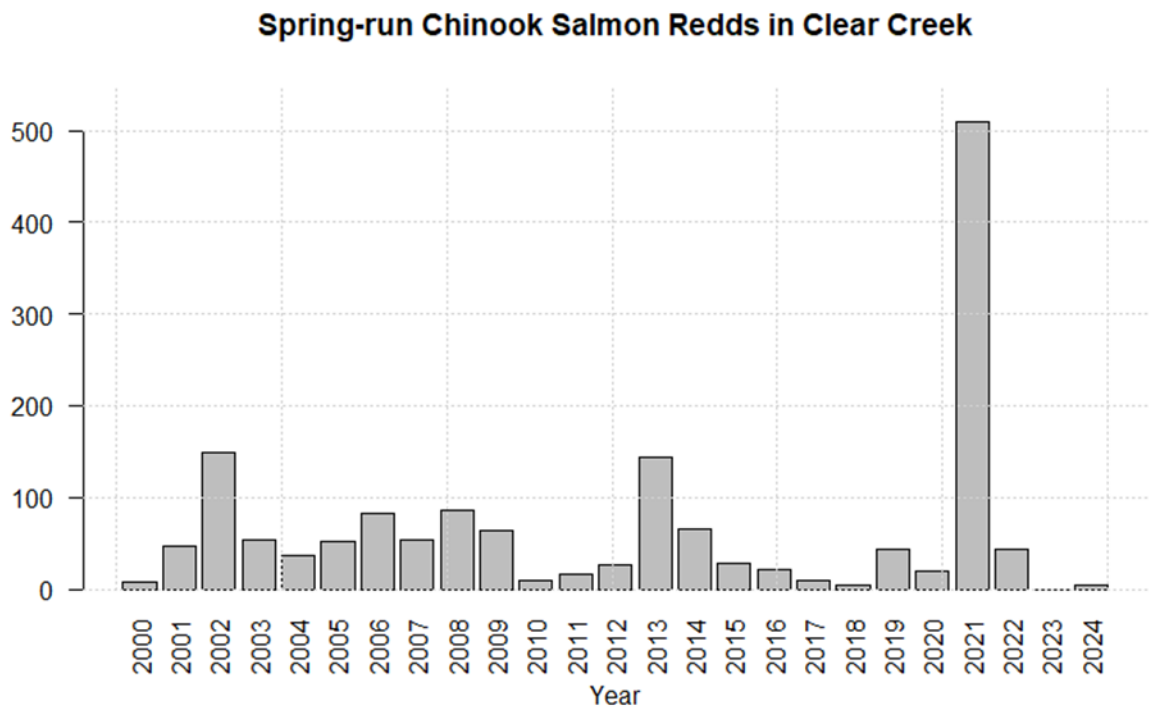

Figure 22. Number of spring run Chinook Salmon redds observed above the segregation weir on USFWS spawning surveys from 2000- 2024. USFWS-Red Bluff unpublished data.

A bar graph showing Spring-run Chinook Salmon Redds in Clear Creek from 0-500; with dates 2000-2024.

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