2023-2024 Annual Report for the Alameda Creek Fish Ladder Operations and Water Stewardship (FLOWS) Monitoring Program

Submitted to

National Marine Fisheries Service North-Central Coast Office, Attention: San Francisco Bay Branch Supervisor, 777 Sonoma Avenue, Room 325, Santa Rosa, California, 95404-6528.

Submitted by

Alameda County Water District
Alameda County Flood Control and Water Conservation District

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ACRONYMS AND ABBREVIATIONS

ACWD	Alameda County Water District
ACFCD	Alameda County Flood Control and Water Conservation District
ACWQMS	Alameda Creek Water Quality Monitoring Station
ARIS	Adaptive resolution imaging sonar
BART	Bay Area Rapid Transit
BiOp	National Marine Fisheries Service Biological Opinion No. SWR-2013-9696
C	Celsius
CCC	Central California Coast
CDFW	California Department of Fish and Wildlife
CFS	Cramer Fish Sciences
cfs	Cubic feet per second
cm	centimeters
Districts	ACWD and ACFCD
DMP	Data Management Plan
DO	Dissolved Oxygen
EBRPD	East Bay Regional Park District
F	Fahrenheit
FDX	Full Duplex
FLOWS	Fish Ladder Operations and Water Stewardship
ft	Feet
ft/s	Feet per second
HDX	Half Duplex
in	Inch
ISI	Intake Screens, Inc
MAMP	Monitoring and Adaptive Management Plan
mi	Mile
mm	Millimeters
NMFS	National Marine Fisheries Service
NTU	Nephelometric turbidity unit
NOAA	National Oceanic and Atmospheric Administration
O&M	Operations and maintenance
OWG	Operations Working Group
PIT	Passive integrated transponder
QA/QC	Quality assurance and quality control
QR	Quick response
R	Correlation coefficient
RD1	Rubber Dam 1
RD2	Rubber Dam 2
RD3	Rubber Dam 3
RF	Random forest
SCADA	Supervisory Control and Data Acquisition
SD	Standard deviation
SFPUC	San Francisco Public Utilities Commission
SNR	Signal-to-noise
SWP	State Water Project
TBF	Tail beat frequency
USGS	U.S. Geological Survey
Vs	Sweeping velocity
Va	Approach velocity
WSE	Water surface elevation

GLOSSARY OF TERMS

Term	Definition
Adaptive Management Process	A structured, iterative process of decision-making in the face of uncertainty, with an aim to reduce uncertainty over time via system monitoring and hypothesis testing.
Anadromous	A term that describes fish born in freshwater who spend their adult lives in saltwater and return to freshwater to spawn. This includes species such as salmon and steelhead.
Anthropogenic	Relates to an effect or object resulting from or induced by human activity.
ARIS sonar camera	Adaptive Resolution Imaging Sonar (sound navigation and ranging) uses sound waves to detect fish, including estimating size and swimming direction.
Biological Opinion	A Biological Opinion is a document issued by a federal agency that determines whether a proposed action is likely to jeopardize a listed species or adversely modify its critical habitat.
Bypass	An alternative route for downstream moving fish, allowing them to bypass anthropogenic river barriers. Designed to be a safer and more benign route than that of the bulk flow of the river (e.g. where majority of water may pass over concrete spill).
Bypass flows	Flood Control Channel minimum flow requirements designed to work within the confines of ACWD's water rights and ensure the withdrawal of water from Alameda Creek does not substantially impair downstream flow conditions for steelhead migration when the diversions are operating.
Chinook Salmon	Chinook Salmon are the largest species of Pacific salmon and are anadromous, using both fresh water and marine habitats to complete their life cycle. Chinook Salmon in California display a wide array of life history patterns that allow them to take advantage of the diverse and variable riverine and ocean environments. Central Valley fall and late-fall-run Chinook Salmon are a Species of Concern under the federal Endangered Species Act.
Creek Facilities	ACWD facilities within the Flood Control Channel.
Critical riffles	Riffles are habitat units in streams and rivers and are characterized by relatively shallow depths and increased velocities and gradients. Critical riffles tend to be the shallowest riffles in streams that may hinder fish passage under low flows.
Discharge	Discharge (also called "streamflow" or "flow") is the quantity of water passing by a location, expressed as a rate in terms of volume per unit time (e.g., cubic feet per second). See flow.
Ecosystem	A biological community of interacting organisms and their physical environment.
Effectiveness	A qualitative concept used to describe whether a fish passage structure is capable of passing its target species within the range of environmental conditions observed during the migration period (Larinier and Marmulla 2004).
Emigration	Referring to the movement of organisms out of an area. See immigration and migrating.
Enhancement	The application of biological and technical knowledge and capabilities to increase the productivity of fish stocks. It may be achieved by altering habitat attributes (e.g., habitat restoration) or by using fish culture techniques (e.g., hatcheries, production spawning channels).
Estuary	The inlet of the sea, where the ocean and the river meet. A site where fresh water and saltwater meet.
Fish ladder	Water-filled staircase that allows migrating fish to swim upstream around a dam or obstacle.
Fish screen	A screen designed to prevent the entrainment or impingement of fish.
Fishway	A physical structure designed to allow fish to move over or around a barrier during migration.

Flood Control Channel	A natural or artificial watercourse with a definite bed and banks which periodically or continuously conducts flowing water.
Flow	Flow (also called "streamflow" or "discharge") is the quantity of water passing by a location, expressed as a rate in terms of volume per unit time (e.g., cubic feet per second). See discharge.
Forebay	Water that builds up behind the dam when the dam is up.
Freshet	The occurrence of a water flow resulting from sudden rain or melting snow.
Fry	The early life stage of salmonids. Typically, juveniles that can swim and catch their own food. Next life stage after alevin, and before smolt. The third freshwater stage of salmonid development; when egg mass is no longer present, and fish develop characteristic markings.
Gate	A valve used for regulating the flow of water.
Groundwater recharge	The process of diverting and storing surface flows so that it may naturally percolate into the subsurface to refill groundwater aquifers.
Habitat	An area that provides the resources (e.g. food, space) necessary for the existence of an organism or life-stage.
Immigration	Referring to the movement of organisms into an area. See emigration and migrating.
Juvenile (fish)	Fish from approximately one year of age until sexual maturity.
Kelt	Steelhead that return to the sea after spawning and may return to natal streams to spawn again.
Lamprey or Pacific Lamprey	Pacific Lamprey are eel-like in form and anadromous, using both fresh water and marine habitats to complete their life cycle. Pacific Lamprey are a California State Species of Special Concern.
Life history	The events that make up the life cycle of an animal, including migration, spawning, incubation, and rearing. There is typically a diversity of life history patterns both within and between populations. Life history can refer to one such pattern or collectively refer to a stylized description of the 'typical' life history of a population.
Listed species	Species, subspecies, or distinct vertebrate population segments that have been added to federal or state lists of endangered and threatened species.
Migration	The progressive seasonal movement of fish and other aquatic organisms up or down a watercourse as part of their life cycle. It does not include the day-to-day movement of fishes in search of food and habitat.
Mitigation	An action intended to reduce the adverse impact of a specific project, development, or activity.
Monitoring	Making systematic geo-referenced observations of the environment, such as measuring water level or counting trees. It is essential to detect changes in ecosystems over time.
Native species	A species of fish indigenous to a particular region.
Operations and maintenance	General procedures to operate and maintain the ACWD Creek Facilities, including making repairs and preventative maintenance.
Passage	The movement of migratory fish through, around, or over dams, reservoirs, and other obstructions in a stream or river.
Passive integrated transponder (PIT) tag	Tags used for identifying individual fish for monitoring and research purposes. This miniaturized tag consists of an integrated microchip that is programmed to identify individual fish. The tag is inserted into the body cavity of the fish and decoded at selected monitoring sites.
Performance measures,	Performance measures are metrics that are monitored and evaluated relative to performance standards (benchmarks) and performance targets (longer-term goals) to assess progress of actions and inform future decisions.

standards, and targets	
Piscivorous	Fish-eating
Population	A group of organisms belonging to the same species that occupy a well-defined locality and exhibit reproductive continuity from generation to generation.
Pool and weir	One of the oldest fish ladder design styles. Uses series of small dams and pools to create a long, sloping channel for fish to travel around an obstruction. The channel acts as a fixed lock to gradually step down the water level; immigrating fish must jump over or through a hole in each weir.
Pulse flow	A controlled release of water during dry and critically dry years which is intended to facilitate emigration of steelhead smolts and kelts.
Population	A group of organisms belonging to the same species that occupy a well-defined locality and exhibit reproductive continuity from generation to generation.
Rake system	Used to remove debris from the trash rack on the upstream end of the fishway to maintain open access for fish passage.
Reservoir	A body of water collected and stored in an artificial lake behind a dam.
Resident	Collectively referring to all freshwater salmonid life histories strategies in contrast to anadromy. Fish that spend their entire life cycle in freshwater.
Riffle	Riffles are habitat units in streams and rivers and are characterized by relatively shallow depths and increased velocities and gradients. They are the predominate stream area used by salmonids for spawning.
Rubber dam	Inflatable rubber dams are cylindrical rubber fabrics placed across channels, and act as a weir or dam to raise the upstream water level when inflated.
Salmonid	A fish of the Salmonidae family, which includes soft-finned fish such as salmon, trout, and whitefish. Referring collectively to steelhead or salmon.
Smolt	A juvenile salmon or steelhead migrating to the ocean and undergoing physiological changes (smoltification) to adapt its body from a freshwater to a saltwater existence, typically in its second year.
Spawn	The act of fish releasing gametes for the purpose of reproduction.
Steelhead	Steelhead are a species of Pacific salmon and are the anadromous form of Rainbow Trout (*Oncorhynchus mykiss* or *O. mykiss*), using both fresh water and marine habitats to complete their life cycle. The Central California Coast distinct population segment is threatened under the federal Endangered Species Act.
Stranding	Any event in which fish are restricted to poor habitat because of physical separation from a main water body. This phenomenon is caused by natural and anthropogenic processes that generally result in rapidly falling water levels.
Stream gage	A structure installed beside a stream or river that contains equipment to measure and record the water level (called gage height or stage), and often the flow (discharge) of the stream.
Trash rack	An apparatus fitted to the upstream end of the fishway that prevents debris from entering and clogging the fishway.
Turbidity	A measure of light penetration in a body of water. Higher turbidity indicates “murkier” water conditions.
Velocity	The speed of water flowing by a location, expressed in terms of length per unit time (e.g., feet per second).
Watershed	An area of land that drains into a particular point, water body, or channel reach.

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EXECUTIVE SUMMARY

The Alameda County Water District (ACWD) and the Alameda County Flood Control and Water Conservation District (ACFCD) have undertaken the Joint Lower Alameda Creek Fish Passage Improvements Project (Project) to reestablish passage of federally threatened Central California Coast Distinct Population Segment steelhead (*Oncorhynchus mykiss* or *O. mykiss*) at ACWD's Rubber Dam 1 (RD1) and the BART Weir (or ACFCD Drop Structure or Drop Structure) and Rubber Dam 3 (RD3) within the Alameda Creek Flood Control Channel (or Flood Control Channel) in lower Alameda Creek. This Project allows fish to access miles of spawning habitat upstream of these previously inaccessible barriers. To permit this Project, ACWD and ACFCD (hereinafter Districts will be used for simplicity) received a Biological Opinion (BiOp) from the National Marine Fisheries Service (NMFS) dated 5 October 2017 (NMFS No. SWR-2013-9696) describing their analysis of the effects of the construction and operation of the Project on *O. mykiss*. The BiOp sets forth several requirements (Section 2.9.4) including the following requirements for the annual report as described in Section 2.9.4 of the BiOp.

This document is the annual report for the general reporting period 1 September 2023 – 31 August 2024, to be submitted to NMFS. ACWD has confirmed with NMFS that an electronic submittal is permitted, and that submittal of this year's annual report is permitted to be submitted on 15 April 2025. In the event that the annual report contains requirements that conflict with the BiOp, the BiOp requirements shall govern.

This annual report provides extensive detail on the operations, maintenance, and monitoring of this new fisheries program. The report concludes with a list of adaptive management actions that were implemented during the 2023-2024 monitoring season based on recommendations made in the previous annual report (ACWD and ACFCD 2023), as well as a discussion of adaptive management actions recommended for future monitoring seasons. Some highlights of the findings and contents of the 2023-2024 Annual Report include:

Operations and Maintenance

Monitoring of the physical condition and operation of the facilities included daily monitoring by staff of all facilities and components as well as the extensive use of Supervisory Control and Data Acquisition (SCADA) systems which provide continuous monitoring and automation of the facilities, confirming that operations remained within both engineering and biological specifications.

ACWD was in compliance with the BiOp 100% of days in the 2023-2024 compliance year. Bypass target flows were met or exceeded for all but one day, 5 September 2023, when flow fell below target by ~1 cfs. This day is within the "outside of peak migration" period of bypass requirements, when total flows are typically low in the creek.

Biological Monitoring

Biological monitoring included visual surveys and the use of sophisticated passive monitoring techniques including imaging sonar and Passive Integrated Transponder (PIT) technology. Migratory target species observed included *O. mykiss*, Chinook Salmon (*O. tshawytscha*), and Pacific Lamprey (*Entosphenus tridentatus*) during their assumed immigration (in-migration) and emigration (out-migration) periods. Chinook Salmon and Pacific Lamprey were definitively identified by the imaging sonar and 51 PIT-tagged *O. mykiss* were detected by the antenna array, including one detection as late as 3 July 2024.

Potential salmonid and lamprey predators observed included avian, fish, and mammal species. Most of the predators were avian species that were observed in September and October, prior to the assumed migration period for migratory target species. Most of these predators were observed at RD1. Fish species stranded as a result of Project operations included *O. mykiss* (10), Pacific Lamprey (1), and black bass (*Micropterus* spp; 3).

Operational and monitoring successes during the second year of fish passage facilities operations include the detection of 51 PIT-tagged *O. mykiss*, improvements in ARIS file processing using a hydroacoustic data processing computer program, and continued documentation of migration and use of the fish passage facilities by *O. mykiss*, Chinook Salmon, and Pacific Lamprey. These findings are supported by data from the monitoring equipment and visual surveys conducted by ACWD staff. The second year of operation and biological monitoring provided additional experience for ACWD staff under less extreme wet year conditions than the exceptionally high flow events in 2023. Several adaptive management actions have been identified to further improve Project success during future monitoring years, such as removing sediment in the fish passage facilities downstream of the BART Weir; improving sonar imagery species identification; continuing to monitor for predators near fish passage facilities; monitoring of off-season habitat conditions around fish passage facilities; and refining SCADA controls of the fish passage facilities. Effective collaboration and communication among the Operations Working Group (which includes the Districts, NMFS, and CDFW) and other Alameda Creek watershed interested parties supports the continued success of this Project.

1. INTRODUCTION

1.1. BACKGROUND

Alameda County Water District (ACWD) and the Alameda County Flood Control and Water Conservation District (ACFCD) (hereinafter referred to as "Districts") have undertaken the Lower Alameda Creek Fish Passage Improvement Project (Project) to provide Central California Coast (CCC) steelhead (*Oncorhynchus mykiss* or *O. mykiss*) and other native fish species unimpeded passage through the Alameda Creek Flood Control Channel (or Flood Control Channel) while maintaining flood protection capacity and the ability to divert water from Alameda Creek. *O. mykiss* exhibit high plasticity in life history patterns, with fish emigrating to the ocean at a broad range of ages (steelhead) or remaining in freshwater as residents and maturing at varying ages (Rainbow Trout). In this report, all observations of *O. mykiss* are referred to by the species' scientific name unless there is clear evidence indicating that an individual is a steelhead (i.e., has migrated from the ocean). Facilitating successful upstream (immigration) or downstream (emigration) fish passage at an in-river impediment is a dynamic integration of fish behavior, physiology, and biomechanics with hydraulic analysis, hydrologic study, and engineering. Installing a fish passage structure does not constitute providing satisfactory fish passage unless all the above components are adequately factored into the design and operation. Successful passage must also consider the dynamic conditions, including hydrologic and other physical, biological, temporal, and spatial variability, occurring within a watershed, the passage facility, and a healthy fish population.

The Districts received a biological opinion (BiOp) from the National Marine Fisheries Service (NMFS; 5 October 2017; NMFS No. SWR-2013-9696) describing their effects analysis of the Alameda Creek fish passage facility construction and operations for *O. mykiss*. The BiOp also requires an annual report that addresses the following:

> (1) Fishway and fish screen monitoring and inspections (this annual report covers the reporting period of 1 September 2023 through 30 September 2024);
>
> (2) Streamflow monitoring and bypass flows (this annual report covers the reporting period of 1 September through 31 August);
>
> (3) Results of biological monitoring and adaptive management actions (this annual report covers the reporting period of 1 September through 31 August).

For purposes of this annual report, the term "reporting period" is defined to be the date ranges listed above beginning in 2023 and ending in 2024. Also, per the BiOp, on an ongoing basis, ACWD operates, monitors, and adaptively manages its water supply facilities along Alameda Creek and coordinates program activities with other watershed interested parties. More specifically, Districts' goals are to:

1. Provide adequate conditions for immigrating (from 1 January through 31 March) and emigrating (from 1 April through 31 May) *O. mykiss*;
2. Improve fish passage for other native fish such as Pacific Lamprey (*Entosphenus tridentatus)* and Chinook salmon (*O. tshawytscha*); and
3. Improve physical and biological components, such as water quality, that will benefit *O. mykiss*, Chinook, lamprey, and other native fishes, and reduce the negative impacts of non-native species.

ACWD has developed the Fish Ladder Operations and Water Stewardship (FLOWS) program. The Alameda Creek FLOWS Program is a voluntary, environmental resources management program implemented by ACWD staff which will function in perpetuity to support the successful restoration of the federally threatened *O. mykiss* in Alameda Creek while maintaining groundwater recharge activities essential to ACWD's water supply. The FLOWS Program provides the ongoing continuity and coordination needed to manage ACWD's environmental responsibilities and water supply, including regulatory compliance elements (required by the NMFS BiOp), interagency coordination, water supply planning, groundwater recharge operations, and community engagement and outreach. Development and implementation of the program is one of the major strategic initiatives identified in ACWD's Strategic Plan adopted 8 March 2018. The FLOWS Program includes tasks such as authoring regulatory reports, while providing subject-matter expertise and coordination support to other teams responsible for directly carrying out other functions such as groundwater recharge operations and public outreach. The FLOWS Program goal is as follows:

"ACWD seeks to enhance fish passage on Alameda Creek while maintaining water supply goals. On an ongoing basis, ACWD will operate, monitor, and adaptively manage its creek facilities in accordance with the National Marine Fisheries Service biological opinion and coordinate program activities with other watershed stakeholders."

To support the FLOWS Program, and in response to the BiOp, ACWD has committed, in a coordinated effort with ACFCD, to develop and implement a Monitoring and Adaptive Management Plan (MAMP) to ensure that bypass flows and operation of ACWD facilities in the Flood Control Channel meet project objectives related to fish passage through the channel. The adaptive management program has established management objectives and utilizes the results of the MAMP to measure the effectiveness of ACWD's operations with respect to fish passage. Ongoing monitoring and learning through the MAMP is meant to be used to recognize differences in the consequences of various actions, which will, in turn, offer the opportunity to evaluate and improve management strategies. By comparing different actions, ACWD will be able to refine its operations and choose the best action to meet water supply goals and passage for anadromous fish.

The Districts prepared and submitted the draft Monitoring and Adaptive Management Plan to NMFS, and MAMP implementation was initiated in November 2022. A final draft is currently being prepare for submittal to NMFS. The purpose of this document is to provide a report to NMFS on the MAMP and associated 7-Day Pulse Releases Framework. Specifically, this document provides annual information on reasonable and prudent measures identified by NMFS to minimize the take of *O. mykiss* associated with the project that were identified in the MAMP:

1. Monitor operation of Project facilities in the Alameda Creek Flood Control Channel to ensure the fish passage facilities are functioning properly;
2. Monitor operation of Project facilities in the Alameda Creek Flood Control Channel to ensure bypass flow requirements are fully achieved;
3. Prepare and submit annual reports to NMFS regarding operation of Project facilities, fish bypass flows, biological monitoring, and adaptive management actions.

Most of the fish passage facilities' construction and commissioning activities were completed by November of 2022 and the passage program was initiated on 1 January 2023. The FLOWS Program undertook a start-up test of the Project facilities in November and December of 2022 to initiate the adaptive management process identified in the BiOp (Figure 1.1).

This annual report marks the second year of the MAMP operations, maintenance, and monitoring of the Project facilities and encompasses the period of 1 September 2023 through 31 August 2024. This annual report provides a description of the Project "Action Area" and a summary of results of the operations and maintenance of the fish passage facilities, environmental (i.e., physical) conditions, and results of qualitative and quantitative biological monitoring. The purpose of the annual report is to communicate information that directly improves current understanding of the Project and informs the adaptive management process.

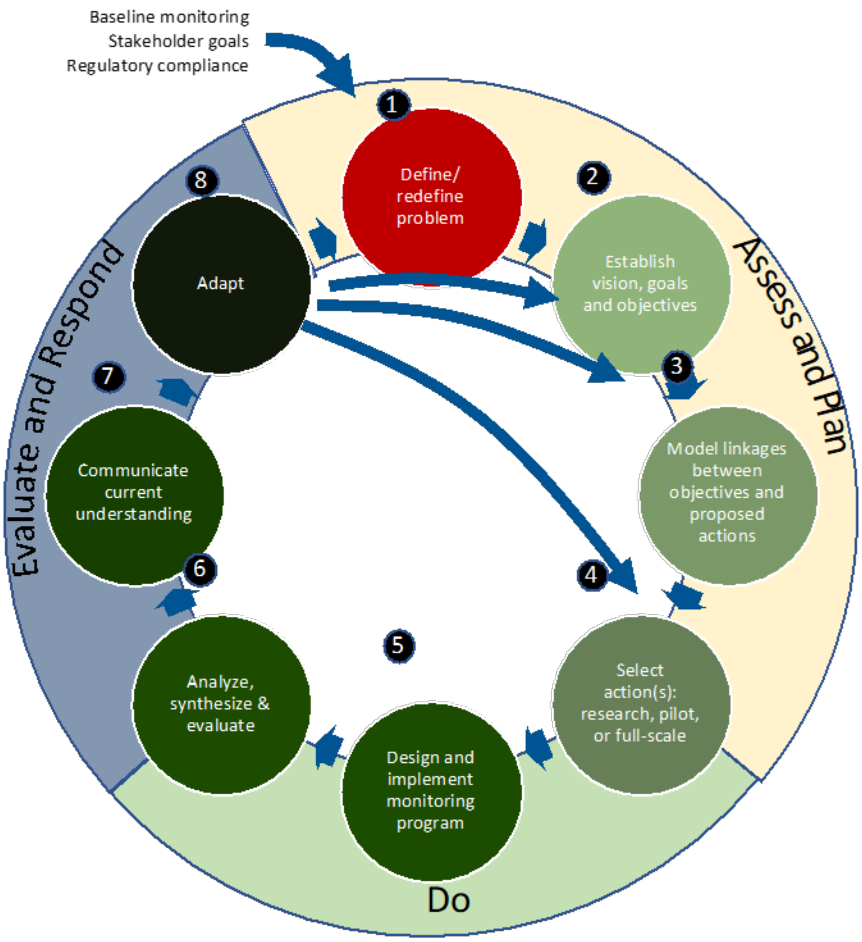

Figure 1.1: The Adaptive Management Cycle. Revised from the Delta Stewardship Council, Delta Plan (2019). Each step of the cycle contributes to the continual reduction of uncertainty around management actions, which ultimately leads to better-informed decision-making, creating a management-science feedback loop (Copps et al. 2007).

1.2. PROJECT ACTION AREA - ALAMEDA CREEK FLOOD CONTROL CHANNEL

The Flood Control Channel is a highly engineered section of the Alameda Creek Watershed, including two fish passage facilities and several fish screening operations with the primary goal of successful passage (immigration to and emigration from the Alameda Creek Watershed) of listed *O. mykiss* while facilitating water diversion and flood protection (NMFS 2017).

"Action Area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The approximately 11.3-mile (18,200 meters) Action Area for this project consists of the Alameda Creek Flood Control Channel from the upstream end of the Rubber Dam 3 (RD3) impoundment near Mission Boulevard (see Reach V description below) to the mouth of Alameda Creek at San Francisco Bay (Figure 1.2). This area contains all ACWD's facilities within the Flood Control Channel and reaches where streamflow is affected by ACWD's water diversions, including the Project's new fish passage facilities, as described below.

1.2.1. Action Area Regions

In regulated streams, environmental conditions (e.g., flow) and salmonid characteristics (e.g., size) have a strong influence on observed mortality and this can vary substantially between stream reaches (Zeug et al. 2019). Therefore, to facilitate planning, coordination, and monitoring of passage management associated with the MAMP and 7-Day Pulse Releases Framework, the Action Area is divided into five (5) reaches:

Reach I – The approximately 15,400 meters (9.6 miles) stretch from Estuary mouth (37°35'38.69"N; 122° 8'47.12"W) to pool at the bottom of Larinier Fishway (37°34'5.93"N; 121°59'20.97"W).

Reach II – The approximately 208 meters (0.13 miles) from the bottom pool of the Larinier Fishway to the upstream fish ladder exit within the Rubber Dam 1 (RD1) impoundment (37°34'10.27"N; 121°59'17.03"W).

Reach III – The approximately 1,588 meters (~1 mile) RD1 impoundment from RD1 (37°34'9.29"N; 121°59'17.47"W) to the base of RD3 (37°34'22.29"N; 121°58'18.95"W).

Reach IV – The approximately 75.3 meters long (0.05 mile) RD3 Fish Ladder, from the downstream entrance pool (37°34'23.58"N; 121°58'20.05"W) just downstream of RD3, to the upstream fish ladder exit (37°34'24.28"N; 121°58'19.22"W) within the RD3 Impoundment.

Reach V – The RD3 Impoundment, from RD3 (37°34'22.47"N; 121°58'18.88"W) approximately 1,135 meters (0.7 miles) to the upstream extent of RD3 (37°34'50.12"N 121°57'53.81"W); somewhere between the Old Canyon Rd Bridge (37°34'42.08"N 121°58'7.04"W) and the USGS Niles Stream Gage (37°35'14" N; 121°57'35" W) referenced to North American Datum of 1927, in NW 1/4 sec.15, T.4 S., R.1 W., Alameda County, CA, Hydrologic Unit 18050004, Mt. Diablo meridian, on right bank, 0.3 mi downstream from the railroad bridge, 1.2 mi northeast of Niles, and 8.3 mi downstream from James H. Turner Dam on San Antonio Creek).

1.2.2. Action Area Key Features

Specific features and facilities within the Action Area called out in the BiOp and meaningful to passage planning are listed below and marked in Figure 1.2. These features are more fully described below:

1. USGS stream gage station 11179100 at Sequoia Road Bridge (Sequoia Gage) (37°33'59.54"N; 122° 0'5.28"W). To implement bypass stream flows, the total stream flow through the Flood Control Channel is measured as an average daily flow downstream at the Sequoia Gage. This stream gage is used to document flows in the Flood Control Channel and for compliance with bypass requirements. Bypass stream flow amounts are based on Alameda Creek flow upstream of ACWD's facilities and measured upstream of Mission Boulevard in the Niles Canyon at USGS Station 111790000 (Niles Gage). ACWD ensures their operations are compliant with the Project's Alameda Creek streamflow bypass requirements by monitoring streamflow at the Sequoia Gage and the Niles Gage. Water quality data collected at the Niles Gage (currently water temperature, turbidity, and suspended sediment) are monitored. Auxiliary flow in the RD1 and BART Weir fish passage facility, described below, is measured using a flow meter, and a stage-discharge is used to measure flow through the RD1 vertical slot fish ladder.

2. Larinier Fishway within the foundation of RD2 (37°34'5.93"N; 121°59'20.97"W) is a baffle fishway constructed at the site of the former RD2 in 2019. This is a passive passage facility designed to provide low-flow passage over the former RD2 foundation. The foundation is passable at higher flow rates.

3. The RD1 and BART Weir fish passage facility (37°34'7.17"N; 121°59'20.62"W) & (37°34'7.82"N; 121°59'18.52"W) includes the vertical slot fish ladder, transition pool, vortex pool and chute fish ladder,

guide wall, and plunge pool. The RD1 and BART Weir fish passage facility is located in the Flood Control Channel, approximately 10 miles upstream from the Alameda Creek entrance to San Francisco Bay. The weir is a 15-foot flood control drop structure that was completed as part of the flood control channel in 1972. RD1 was constructed just upstream (37°34'9.01"N; 121°59'16.87"W). Both structures are fish barriers and require fish passage facilities to migrate *O. mykiss* upstream. The Flood Control Channel at the RD1 and BART Weir fish passage facility is bordered by 20-25 ft high levees with steep rock riprap and/or concrete faces. When fully inflated, RD1 operates to approximately 13 feet in height (NMFS 2017). The dam sits on a reinforced concrete slab foundation about 210 feet across between the toes of the Flood Control Channel banks (fully inflated top width is longer) and 35 feet wide (NMFS 2017). When inflated, RD1 impounds water for ACWD's Shinn and Kaiser ponds diversion intakes and provides in-channel groundwater recharge. RD1 is raised and lowered by filling and draining with water from the adjacent Shinn Pond.

The RD1 and BART Weir fish passage facility has been modified to provide fish passage with a vertical slot fish ladder, transition pool, vortex pool and chute fish ladder, guide wall, and plunge pool, meant to enable *O. mykiss* and Chinook Salmon migration past the RD1 and BART Weir fish passage facility. The RD1 and BART Weir fish passage facility was installed along the rip-rap bank and concrete wall of the north levee. The RD1 and BART Weir fish passage facility includes modifications to the drop structure and other channel hardscapes. The upper segment of the RD1 and BART Weir fish passage facility is a vertical slot ladder design, including an auxiliary flow screen and associated piping. The RD1 vertical slot fish ladder includes a sluicing pipe system to help remove sediment buildup within the RD1 vertical slot fish ladder's exit channel. The sluice piping is adjacent to the RD1 and BART Weir fish passage facility and discharges near the entrance to the vortex pool and chute fish ladder. The screened auxiliary discharge is in the middle the RD1 and BART Weir fish passage facility to enhance attraction flow. Trash racks on the upper segment of the vertical slot fish ladder's exit channel prevent larger debris from entering. A control cabinet installed on the channel's upper embankment houses automation equipment for facility monitoring and control.

Modifications to the existing drop structure concrete apron were made to construct the middle of the RD1 and BART Weir fish passage facility segment, concrete transition pool, and vortex pool and chute fish ladder downstream of the transition pool. The vortex pool and chute fish ladder construction required modifications to rock riprap on the embankment and within the channel. A guidewall was constructed across the channel to guide fish to the vortex pool and chute fish ladder entrance. Downstream of the guidewall, an existing scour pool was enhanced and must be maintained as the interface between the vortex pool and chute fish ladder and the downstream earthen channel. RD1's foundation and the downstream grouted rock were modified to include a stream-wide plunge pool, about 2.5 feet deep, immediately downstream of RD1. Additionally, renovation to the RD1 control building was made to accommodate new RD1 and BART Weir fish passage facility control equipment and controls used to inflate/deflate RD1. The new permanent facilities associated with the RD1 and BART Weir fish passage facility has a footprint of about 0.9 acres within the channel and along the rock rip-rap embankment.

O. mykiss have been observed unsuccessfully attempting to swim up the drop structure concrete sloping face, which is too steep and shallow for *O. mykiss* to traverse. To prevent *O. mykiss* from attempting to swim up the drop structure's apron, a 2-foot-tall by 2-foot-wide concrete sill was built along the downstream edge of the apron. The sill spans the entire channel from the transition pool to the south bank. Riprap was rebuilt downstream of the concrete apron to raise the sill height. This provides any stray fish swimming up the riprap apron a means of swimming over the sill and onto the backwatered apron. Fish will then move laterally towards the transition pool and vertical slot fish ladder entrance. To accommodate fish migrating along the south bank, a 0.5-foot-deep notch was placed in the sill near the south side of the Flood Control Channel to attract and guide fish toward the upstream end of the sill and enable them to move laterally towards the vertical slot fish ladder entrance.

4. Shinn Fish Screen facility (37°34'12.01"N; 121°59'14.91"W). The Shinn Fish Screens are positive barrier, retractable, self-cleaning, cylindrical fish screens made from wedge wire by Intake Screens, Inc (ISI). ACWD has a standardized ISI design for all fish screen locations, varying only in size. The Shinn Fish screens include a total of 6 cylindrical screens providing a combined 230 cfs of diversion capacity from the north levee of the RD1 impoundment to Shinn Pond. Four additional screens are planned for future construction, which would bring the combined diversion rated capacity of 425 cfs. The Shinn Fish Screens occupy an area approximately 300 feet long by 75 feet wide along the levee of the flood channel; a track-mounted configuration with winches that raise the screens out of the water when not in use, most often during high-streamflow events. Flow is controlled by slide gates mounted under the screens with stems that extend to allow for gate control from the top of the bank. The screens are cleaned by rotating against stationary internal and external brushes. The screens prevent the entrainment and impingement of *O. mykiss* as water from Alameda Creek is diverted through pipelines in the levee to off-channel recharge basins. The fish screens are designed to provide a maximum approach velocity of 0.33 cfs which allow the smallest life stages of O, mykiss to freely swim away from the face of the screen (i.e., avoid impingement). The screen mesh has openings no larger than 1.75 mm (~0.07 in) which prevent the entrainment of all life stages of *O. mykiss* into the diversion system. Screen facility designed to operate effectively in an environment with minimal-to-no sweeping flow and in an environment that is affected by intermittent periods of high flow events with heavy debris loads. The cylindrical screens include self-cleaning brush systems and can easily be removed from the channel for inspection or repair without special equipment.

5. Kaiser Fish Screen facility (37°34'17.67"N; 121°58'50.24"W), using the same ISI design as the Shinn Fish Screens. The Kaiser Fish Screens include a total of two cylindrical screens providing a combined 50 cfs of diversion capacity from the south levee of the RD1 impoundment to Kaiser Pond.

6. RD3 fish passage facility (37°34'22.44"N; 121°58'18.79"W) - is designed for downstream and upstream migrating *O. mykiss* and other fish when RD3 is inflated and the impoundment is partially full or filled to capacity. The vertical slot fish ladder entrance pool is located immediately downstream of RD3 and is connected to a plunge pool at the base of RD3 so that fish migrating upstream through the center or southern portion of the channel can find the entrance after encountering RD3. The entrance is an automated wing gate that controls the water surface elevation within the entrance pool. RD3 does not have to overcome as much elevation as RD1, and so the vertical slot fish ladder is much shorter. The RD3 plunge pool is backwatered to the impoundment caused by RD1.

7. Mission Fish Screen facility/Alameda Creek Pipeline (37°34'27.46"N; 121°58'15.48"W) use the same ISI design as the Shinn Fish Screens. The Mission Fish Screens include a total of four cylindrical screens providing a combined 150 cfs of diversion capacity from the north levee of the RD1 impoundment to Shinn Pond, via the Alameda Creek Pipeline.

8. RD1 impoundment (37°34'15.07"N; 121°59'9.93"W) is created when RD1 is partially or fully inflated. When the rubber dams are inflated, they create large, upstream ponds that allow water to flow by gravity through diversion pipelines into off-channel recharge ponds. Except during periods of high flow (in excess of about 1,200 cfs) or when maintenance is required, rubber dams are maintained in the “up” or “raised” position, and, thus, can be used to divert the natural flow of Alameda Creek and water released from upstream State Water Project (SWP) facilities. When inflated, RD1 and RD3 physically block *O. mykiss* immigration. This large pond of slow-moving water provides poor habitat conditions for *O. mykiss* due to low water velocities, lack of riffle habitat, thermal warming, high summer temperatures, and substrate with a large silt component. Upstream extent of RD1 impoundment inundation (at 10 ft elevation) is at RD3.

9. RD3 impoundment (37°34'24.96"N; 121°58'15.30"W) is created when RD3 is inflated. When the rubber dams are inflated, they create large ponds that allow water to flow by gravity through diversion pipelines

into off-channel recharge ponds. Except during periods of high flow (in excess of about 1,200 cfs) or when maintenance is required, rubber dams are maintained in the “up” or “raised” position, and, thus, can be used to divert the natural flow of Alameda Creek and water released from upstream SWP facilities. When inflated, RD1 and RD3 physically block *O. mykiss* immigration. This large pond of slow-moving water provides poor habitat conditions for *O. mykiss* due to low water velocities, lack of riffle habitat, thermal warming, high summer temperatures, and substrate with a large silt component.

10. Upstream extent of RD3 impoundment inundation (at full 13 ft elevation) is at about 37°34'50.12"N 121°57'53.81"W, upstream of the Old Canyon Road Bridge within the Niles Canyon Staging Area.

11. Bunting Fish Screen facility (37°34'21.63"N; 121°58'17.24"W) use the same ISI design as the Shinn Fish Screens. The Bunting Fish Screens include a total of two cylindrical screens providing a combined 28 cfs of diversion capacity from the south levee of the RD3 impoundment to Bunting Pond.

12. USGS stream gage station 11179000 in Niles Canyon (Niles Gage) - stream flow amounts are based on the flow in Alameda Creek upstream of the fish passage facilities and measured upstream of Mission Boulevard at the Niles Gage (37°35'14" N; 121°57'35" W).

13. ACWD water quality monitoring station (ACWQMS; 37°34'51.83"N; 121°57'52.88"W) - ACWD collects water quality data at this monitoring station.

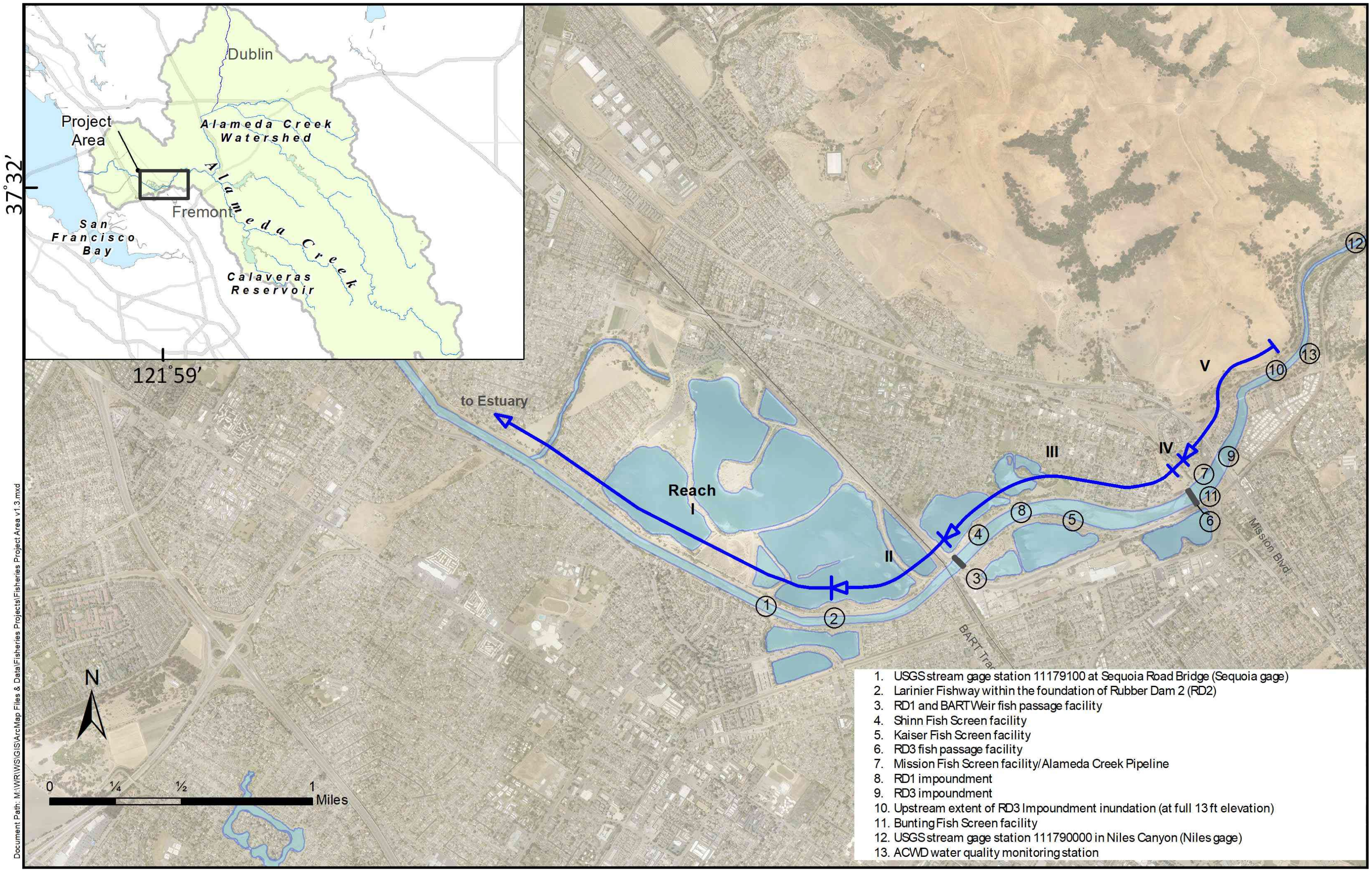

Figure 1.2: Alameda Creek Flood Control Channel Project Area including associated fish passage facilities in relationship to the Alameda Creek Watershed (upper left).

2. 2023-2024 REPORTING PERIOD OPERATIONS, MAINTENANCE, AND MONITORING

2.1. GENERAL BACKGROUND ON COMPLIANCE CONDITIONS

The Districts are responsible for performing operations and maintenance procedures at the fish passage facilities to provide continued performance within established criteria. Such processes include preventive and corrective maintenance procedures, inspections and reporting requirements, maintenance logs, and documentation. Experience and data gained from the Districts' operational experience and annual reporting will support the continued improvement to normal and corrective operations and maintenance activities. These procedures are based on the functional design of the facilities, unless subsequent design changes are agreed to by NMFS and with voluntary coordination with CDFW. All passage facilities (juvenile and kelt emigration and adult immigration) will be operated as designed to function properly through the full range of hydraulic conditions expected during fish migration periods and will account for debris and sedimentation conditions that may occur.

The Districts provide periodic inspections and corrective actions, when necessary, should the passage conditions become impaired because a facility is damaged or inoperable. At a minimum, operation and maintenance items include:

- Specifying what entity is responsible for the daily operation and maintenance of the various elements or portions of the Districts' jointly managed RD1 and BART Weir fish passage facility.
- Annual, seasonal, and/or daily operating activities necessary to confirm proper function of the fish passage facilities.
- Inspecting the fish passage facilities at regular intervals to confirm it is operating within design criteria.
- Cleaning trash racks and debris collectors and remove debris accumulations regularly.
- Adjusting gates, orifices, valves, or other control devices as needed to regulate flow and maintain fish passage facilities within operating criteria.
- Periodically checking staff gages or other flow metering devices for accuracy.
- Annually inspecting the fish passage facilities for structural integrity and disrepair.
- Inspecting gate(s) and valve seals for damage.
- Replacing worn or broken stoplogs, baffles, fins, or other fish passage facility structural components.
- Removing sediment accumulations from within/around the fish passage facility structures, where applicable.

Additionally, to confirm if the minimum bypass flows are being maintained, ACWD maintains an operations log with a date and time for each major operational event, such as raising or lowering the dams, and initiation and termination of diversions and transitions between the flow schedule periods. A summary of the operations log and streamflow at compliance points (i.e., USGS gages) shall be provided annually in compliance with the BiOp.

As mentioned in the MAMP, ACWD is responsible for hydraulic monitoring and operation of the two fish passage facilities, and ACWD and ACFCD have shared responsibilities for environmental regulatory monitoring, maintenance, and reporting for the RD1 and BART Weir fish passage facility. The Districts have entered into an agreement to delineate these responsibilities for the RD1 and BART Weir fish passage facility. The operations, maintenance, and monitoring of the RD1 and BART Weir and RD3 fish passage facilities are described in the subsequent sections.

2.1.1. Vertical Slot Fish Ladders

The upper portion of the RD1 and BART Weir fish passage facility includes a vertical slot fish ladder, which begins downstream with a wing gate. The vertical slot fish ladder has 20 pools from the entrance pool just upstream of the wing gate (Pool 1) to the upper most exit pool (Pool 20). There are five upward-opening exit gates at the upstream end. There is also a downward-opening juvenile spillway gate that allows water to flow from the exit channel into Pool 10. There is an auxiliary bypass system that allows water to enter a pipeline via a fish screen in the exit channel and be discharged downstream into Pool 1 without contributing to the flow through the vertical slot fish ladder. The vertical slot fish ladder also includes a downward-opening low-flow gate adjacent to Exit Gate 5 that allows water to flow from the exit channel into Pool 20 under certain low flow conditions (ACWD, in prep.).

The RD1 and BART Weir fish passage facility's vertical slot fish ladder includes an auxiliary water system used to supplement flow through the vertical slot fish ladder entrance pool to improve fish attraction to the fish ladder and augment flows to minimize water spilling water over RD1 or exceeding criteria for immigration in the RD1 and BART fish passage facility. The vertical slot fish ladder operation will select the appropriate exit gate to use to provide the appropriate flow rates to achieve fish passage through the vertical slot fish ladder during the immigration season, and the screened auxiliary flow system will be used to convey the additional flow around the dam (ACWD, in prep.).

The RD3 fish passage facility utilizes the same vertical slot fish ladder design and has a wing-gate style entrance gate, 15 pools, and five exit gates. The RD3 fish passage facility also has a juvenile spillway for use during the emigration season and outside of peak migration seasons. Because of the simpler and smaller design of the RD3 fish passage facility, compared to the RD1 and BART Weir fish passage facility, the RD3 fish passage facility does not have as many components as the RD1 and BART Weir fish passage facility. The RD3 fish passage facility does not have an auxiliary bypass system or a low flow gate (ACWD, in prep.).

For the vertical slot fish passage facilities, the various flow regulatory components, such as slide gates at the exit gate openings or juvenile spillway openings at the upstream portion of the ladder, baffles which can be inserted into vertical slot fish ladder openings between pools, auxiliary bypass valves within the auxiliary bypass pipeline, and the adjustable “saloon” style gates at the downstream entrance, are used for controlling the discharge or the head differences between the pools throughout the operable run of the fish ladder. ACWD Water Supply staff monitor these components of the vertical slot fish ladders each day of the year to confirm they are functioning properly when in use.

Water levels at several specific points in and around the fish passage facilities (e.g., upstream, downstream, specific pools, etc.) are measured and recorded. For example, within the RD1 and BART Weir fish passage facility's vertical slot fish ladder, water levels and head differences are monitored and recorded at the RD1 impoundment and at each pool immediately downstream of an exit/entrance gate, at the juvenile spillway, and at the entrance pool and transition pool located upstream and downstream, respectively, of the exit/entrance gate. ACWD’s Supervisory Control and Data Acquisition (SCADA) system monitors and records these measurements, which vary depending on upstream and downstream water levels as well as gate position. It should be verified that both the flow pattern and the level of turbulence at various points in the vertical slot fish ladders remain compatible with the specific demands of the various species, such as plunging or streaming flows at each cross-wall between pools, or the presence of large recirculation areas in the pools.

When ACWD Water Supply staff observes that components are not functioning properly, they first determine if there are minor operational or SCADA settings that can be adjusted or reset to restore functionality. If components are broken or unresponsive to minor corrective measures, ACWD Water Supply staff will notify the ACWD Facilities Maintenance Division to request technical or mechanical support. If critical components need major repair, ACWD Water Supply staff will coordinate with ACWD Facilities Maintenance Staff or Engineering staff, as appropriate, to develop a contingency plan to temporarily support continued operational compliance while repairs are affected. All mechanical components, including valves, are fully cycled (operated from fully closed to fully open, then back to fully closed) as part of an annual preventative maintenance program. ACWD Water Supply staff will fully cycle each valve and, at least annually, inspect valve condition for any additional maintenance, such as lubrication or sealants. If needed, Water Supply staff will request support from Facilities Maintenance Division staff for additional maintenance as needed. Below are specific details related to the daily Operations and Maintenance logs for mechanical parameters for the Annual Report Period.

Particular attention is paid to any obstructions caused by drifting debris, which may hinder fish passage in certain critical areas (communication between pools, the water intake of the fish ladder, etc.), or may reduce the attraction of the fish ladder (screen clogging for filtering the auxiliary water system inlet). Either might occur without necessarily showing any obvious disturbance to the flow. ACWD Water Supply staff carefully and regularly check the fish ladder trash rack, and submerged orifices, including vertical slots, exit and spillway gates, and the auxiliary water system are checked regularly and carefully daily. Below are specific details related to the daily operations and maintenance logs for passage obstruction and blockage parameters for the Annual Report Period.

Preventative maintenance of the fish ladders includes, at least annually, full inspection of the fish ladder pools and surrounding concrete structural elements; all mechanical equipment such as slide gates, valves, trash rakes, fish screening components; and all biological monitoring equipment.

2.1.2. Fish Ladder Inspection

Background of Physical Inspections

Routine inspection and maintenance work is contained within the Alameda Creek Flood Control Channel and levees from Mission Boulevard downstream to the RD1 and BART Weir fish passage facility. This includes routine fish ladder and fish screen inspections performed at RD1 and the RD1 fish ladder, RD3 and RD3 fish ladder, and all screened water intakes operated within the Alameda Creek Flood Control Channel to determine their condition and required maintenance.

The following components, where applicable, of each facility are inspected on a daily basis by ACWD Water Supply staff: (1) upstream access and channels; (2) downstream access and channels; (3) culverts; (4) baffles/pools; (5) pool/chute structures; (6) entry and terminal pools; (7) weirs; (8) bypass channels; (9) gates; (10) trash rakes; (11) control systems; (12) screen faces; and (13) screen cleaning systems.

Inspections are performed to confirm if sediment, debris, and/or algal growth impaired the functionality of the facilities. Inspections are also performed to determine if any components of the facility are loose, broken, missing, or present sharp edges that could injure fish and/or wildlife within the Project passage channels.

For fish screens, inspections are performed to determine if screens are firmly attached and to ensure that no gaps, tears, rips, or holes are present. Activities include (where existing permitting allowed):

- Removal and disposal of sediment, trash, and woody debris from the fish ladders, plunge pools, and associated trash raking systems; typically using hand tools, small cranes and lifts, hoses and suction pumps, and similar small equipment;

- Inspection of moving parts and lubrication, painting, sealing, cleaning, and replacement of moveable parts;
- Inspection, repair, and/or replacement of instrumentation and monitoring devices including sensors and flow meters;
- Patching damaged concrete and grouted rock (generally following periods of high flow and damage from debris); and
- Periodic repair and replacement of rubber dams.

The fish ladders were designed to include grate openings in the fish ladder metal decking for inspection for obstructions at all vertical slot openings, a sluice pipe system for flushing sediment, and a trash rake and crane for debris removal. Due to delays in the sourcing and installation of some crane components, the crane for debris removal was installed in November 2023, during the second year of facility operations. During testing, ACWD Engineering identified additional electrical components and repairs were needed, and the final testing and commissioning of the crane was completed on 24 April 2024.

Districts implemented several measures from the BiOp that were designed to avoid and minimize impacts to *O. mykiss* associated with maintenance including, where possible, scheduling maintenance activities during the period of June through October, isolation of maintenance work sites from the waters of Alameda Creek whenever feasible, and regular notification and coordination with agency staff.

Daily Inspections and Significant Operational Events

During the reporting period, between 1 September 2023 and 31 August 2024, ACWD performed daily inspections of the fish ladder facilities and screened diversion facilities in Alameda Creek. As part of regular daily inspections, and along with routine operation of the facilities to maintain the minimum bypass flow, ACWD staff also maintained an operations log with date and time for each major operational event, such as raising the dams, lowering the dams, initiation and termination of diversions, transitions between flow schedule periods, and any major problems with the fish ladder facilities that might affect operational performance and compliance. A report of the daily streamflow at compliance points (i.e., USGS gages) and a summary of the operations log are provided annually as part of the reporting requirements and are included in Appendices A and B, respectively.

In this reporting period, there were some significant repairs at and around the RD3 fish passage facility, some of which were related to the storm damage from 2023. As noted in last year's report, on 21 January 2023, the RD3 bladder failed, rendering the facility inoperable for the remainder of the last reporting period. In September 2023, ACWD Water Supply and Planning staff used a hydraulic model to investigate alternative methods for improving fish passage conditions at RD3 if RD3remained inoperable during the following immigration season. Two methods were analyzed: 1) increasing the normal operating height of RD1, and 2) narrowing the Flood Control Channel by confining water using sandbags. The modeling results from the first alternative (increasing the normal operating height of RD1 from 10 to 12 feet) indicated that by impounding additional water above RD1 could provide the required water depth over RD3, while also providing flow velocities within the recommended range for *O. mykiss* fish passage. While initial modeling of the second alternative (narrowing the Flood Control Channel by confining water using gravel-filled bags) appeared feasible, additional analysis would be necessary to validate flow conditions for various gravel bag configurations. Therefore, the first alternative was identified as the most feasible to implement if needed in 2024. While this analysis was completed to identify feasible options which could be implemented in case alternative methods of fish passage were needed at RD3, ultimately none of the alternative methods was required during the reporting period.

ACWD Project Engineering staff applied for and received the permits necessary to remove sediment – which had deposited on top of the RD3 bladder, in the area immediately downstream of the RD3 bladder in front of the RD3 fish passage facility entrance gate and surrounding the base of the Kaiser Fish Screen facility – and to repair the RD3 bladder. In November 2023, ACWD commenced maintenance activities to remove accumulated sediment around RD3 and affected multiple subsequent repairs of the bladder material.

While in operation, the RD3 fish passage facility had no observable issues with mechanical components, gate valve operations, passage constraints, or debris accumulation during the daily observations. However, the computerized program logic controlling RD3 gate operations did experience a failure 9 May 2024 that immediately closed the RD3 fish ladder exit gates, which resulted in the unexpected dewatering of the fish ladder. ACWD Water Supply staff responded to the unexpected operations by deploying the site, conducting a stranding survey of the ladder pools, and restarting the fish ladder operations. No fish were observed to be stranded in the RD3 fish ladder due to this gate control failure. Further analysis of data trends discovered the over-oscillation at Exit Gate 3, and the gate actuator was replaced during the summer. ACWD Facilities staff are investigating the program logic controller system to determine how these events occurred. Due to the lack of water flows to recreate the same operational conditions as when this failure occurred, ACWD staff will continue monitoring the RD3 fish passage facility operations for these potential conditions in the fall and winter of next reporting period.

At the RD1 and BART Weir fish passage facility, ACWD Water Supply Staff daily inspections records documented various electrical issues related to mechanical components, such as the control valves for the auxiliary bypass pipeline and entrance gates, and for the trash rake. Water Supply staff observed the auxiliary bypass pipeline control valve was not operable on 9 February 2024. Subsequent investigation by ACWD Facilities Maintenance staff discovered that water intrusion had flooded the vault containing this control valve, resulting in permanent damage to the electrical valve controls. The vault was pumped out, the potential routes for water intrusion were sealed, and the valve actuator was repaired by 22 February 2024. The RD1 vertical slot fish ladder entrance gate was observed to be inoperable on 13 March 2023. By August 2024 the cause was identified as a fault in the electrical wiring providing power to the actuator which operates the gates. ACWD Facilities staff work to replace the wiring was still underway at the end of the reporting period.

During the reporting period, ACWD Water Supply staff conducted physical inspections of the vertical slot fish ladders to observe for any accumulation of sediment or debris that might inhibit fish passage. ACWD Water Supply staff periodically operated the sluice pipe to remove sediment deposits in the RD1 vertical slot fish ladder forebay as a preventative measure. During brief periods of dewatering the RD1 vertical slot fish ladder for testing or maintenance-related activities, water would drain from Pools 5 through 20. ACWD staff observed filamentous algae on the walls and floors in wetted portions of the ladder, but there was no significant accumulation of sediment within these vertical slot pools.

A discussion of sediment downstream of the RD1 vertical slot fish ladder entrance gate is provided below, in Section 2.1.3.

On 30 April 2024, ACWD Water Supply staff received notification that an individual had entered the RD1 impoundment and disappeared into the water. ACWD Water Supply arrived at RD1 to assist first responders and county rescue personnel preparing to perform dive searches in the water. To aid the rescue efforts, ACWD Water Supply staff closed the RD3 fish passage facility and then began fully deflating RD1 to lower the water levels in the search area. Only after the recovery efforts were concluded on the morning of 1 May 2024 could ACWD Water Supply staff conduct a thorough stranding survey of the RD1 fish passage facility, where one *O. mykiss* carcass was located within the vertical slot fish ladder. ACWD Water Supply staff immediately contacted both NMFS and CDFW to convey this information.

On 11 May 2024, ACWD Water Supply staff observed the RD3 fish passage facility was over-oscillating an exit gate in automatic operation. The facility was switched to manual operation to prevent further over-oscillation, and ACWD Facilities Maintenance staff assessed the exit gates and controls. After ruling out any mechanical or control system problems, the facility was restored to automatic operation. However, there were more instances of exit gate over-oscillation later that month. ACWD Engineering staff that designed the automatic operational programming reviewed the data and advised that certain RD3 impoundment elevations may provide hydraulic conditions that the automatic programming cannot resolve. In those instances, the automatic programming was designed to wait a period of time for the conditions to change (e.g., impoundment height increases or decreases) before resuming operations. As there was no clear cause or remedy to this behavior in the automatic programming, ACWD Water Supply staff began more closely monitoring the facility performance when it was set in automatic operations.

RD1 Fish Passage Facility Operations, Maintenance, and Monitoring

During both the immigration and emigration seasons, the RD1 vertical slot fish ladder was passable 86% of the time. The vertical slot fish ladder is considered passable for immigration when RD1 is inflated and the dam crest is at minimum 45 feet elevation, and flow in the fish ladder is between 20 and 45 cfs. Exit gate head drop during automatic operation of the fish ladder generally met the 1-foot head drop criteria.

There are brief periods of time during exit gate transition or when switching from manual to automatic operation, when head drops may exceed 1-foot, but this is expected by design, and those periods typically only last several minutes.

RD3 Fish Passage Facility Operations, Maintenance, and Monitoring

During both the immigration and emigration seasons, the RD3 fish passage facility was passable 41% of the time. The fish passage facility is considered passable for immigration when the RD3 dam is inflated, and flow in the ladder is between 20 and 45 cfs. Exit gate head drop during automatic operation of the fish ladder generally met the 1-foot head drop criteria, except for five periods during this reporting period when there was a problem with the automatic function of the fish ladder, as noted above. During these times exit gate 3 was cycling open to closed, which caused a fluctuation in head drop. Exit gate 3 was also observed over-oscillating, which caused the fish ladder to shut down. Upon further investigation, the Facilities Maintenance Division staff replaced the exit gate 3 actuator head to address these problems.

Similar to the operation of the RD1 vertical slot fish ladder, the RD3 fish passage facility had brief periods of time during exit gate transition or when switching from manual to automatic operation, when head drops may exceed 1-foot, but this is expected by design, and those periods typically only last several minutes.

Test Video Inspection of Fish Ladder Screens and Fish Ladder Function

Underwater video is a potentially safe alternative to physical access of fish passage facilities by staff and can reduce the need to lower water levels during critical passage periods to visually inspect facility operations.

ACWD utilized a video camera system to test its performance for routine inspections of the fish ladders. The underwater video system consisted of a GoPro video camera in waterproof housing attached to a ~15 ft extendable pole with a camera mount.

The GoPro camera was used to record video images. The camera set-up was deployed at each pool within the RD1 vertical slot fish ladder within the RD1 and BART Weir fish passage facility and within the RD3 fish passage facility to perform routine maintenance inspections. This included access through grate openings in the fish ladder metal decking to look for sedimentation and debris within the ladder bays, along trash rake surfaces to search for blockage by debris, and to inspect the facility components for any lose or missing components or signs of needed maintenance. The camera has a waterproof case, which allows it to be used for underwater applications. Video data were exported and backed up to cloud storage at the end of the day for later review. These video cameras were used for performing routine inspections of the vertical slot fish ladder facilities at RD1 and RD3 in September 2024.

September 2024 Video Survey

ACWD Water Supply conducted a video survey using a GoPro camera mounted on an extension pole for observing conditions within the RD3 and RD1 vertical slot fish ladders. The survey did not identify any structural flaws, plant or algal growth, obstructions, sharp edges, or significant sediment deposits. The lack of observed obstructions or flaws suggests fish passage was unimpeded in the ladders. Figure 2.1(A)-(E) below are representative of conditions observed during the video survey.

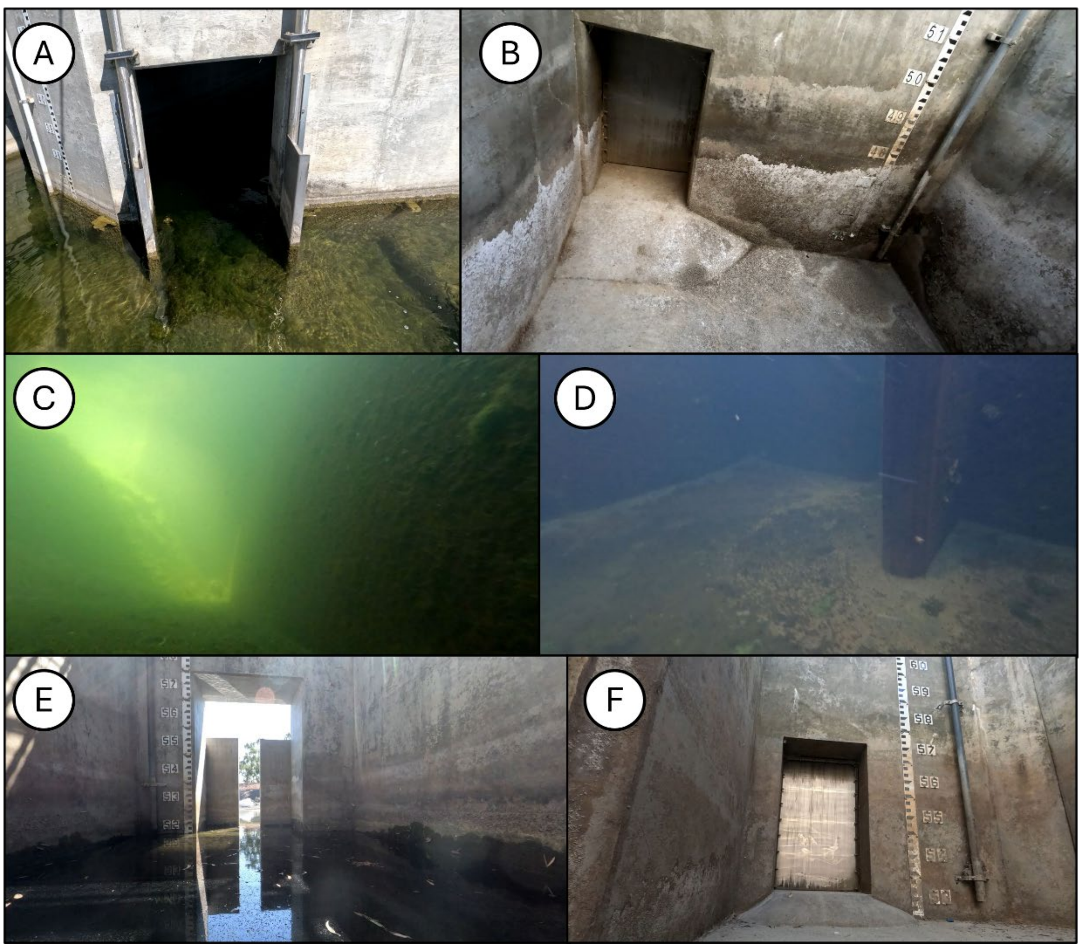

Figure 2.1: Video survey images of A) the RD1 vertical slot fish ladder entrance (downstream) gates, B) RD1 vertical slot fish ladder exit gate 3 (downstream face/inside ladder face) and interior of pool 16, C) RD1 vertical slot fish ladder pool 1 looking downstream to entrance gates, D) RD1 vertical slot fish ladder pool 5, E) RD3 fish passage facility entrance gates (interior view looking downstream), F) RD3 fish passage facility exit gate 1 (interior view, looking upstream).

2.1.3. Debris Management and Removal

During the reporting period, ACWD Water Supply staff would conduct daily inspections of the fish passage facilities to observe for any debris or obstructions that could impede fish passage. At the RD1 and BART Weir fish passage facility in 2023, the Districts documented the extent of the sediment deposits throughout the entire lower pool and chute fish ladder and into the transition pool area. As ACFCD was unable to secure the necessary permitting to remove the sediment in 2023 and during this reporting period, sediment deposition remained a potential concern. A subsequent analysis, described below, was required to determine if the sediment was creating a barrier for fish passage until it could be removed. Refer to Section 4.6 for more details on the RD1 and BART Weir fish passage facility sediment analyses.

2.1.4. Fish Screens

Screening diversions can serve multiple objectives such as fish protection and debris and sediment management (USDA 2013). ACWD operates a total of 12 cylindrical screens installed at four separate locations along Alameda Creek. The Shinn Fish Screens facility currently includes six cylindrical fish screens, while the Mission Fish Screens facility has four cylindrical fish screens. Both the Bunting Fish Screen and Kaiser Fish Screen facilities have one cylindrical fish screen. All fish screen facilities were designed to include a track-mounted configuration with winches that raise and lower the screens for maintenance, avoid debris impact, and to store out of flow when not in use. Flow through the fish screens is controlled by slide gates mounted under the screens with stems that extend to allow for gate control from the top of the bank. The screens are cleaned by rotating against stationary internal and external brushes. The screens are designed to prevent *O. mykiss* and other fish entrainment and impingement as Alameda Creek water is diverted through pipelines in the levee to off-channel recharge basins. The screens are designed to provide a maximum approach velocity of 0.33 ft/sec, allowing the smallest life stages of *O. mykiss* to freely swim away from the face of the screen (i.e., avoid impingement). The screen mesh <1.75 mm (~0.07 in) prevents entrainment of all life stages of *O. mykiss* into the diversion system. The screen facilities are designed to operate effectively in an environment with minimal to no sweeping flow and that is affected by intermittent periods of high flow events with heavy debris loads. The screens include self-cleaning brush systems and can easily be removed from the channel for inspection or repair without special equipment.

Debris Management and Removal

Each ACWD screened diversion is equipped with state-of-the-art cylindrical fish screens which include active debris management and anti-fouling processes. The screens include internal and external brushes that clean the entire circumference of the fish screen cylinder on a regular schedule. SCADA system monitors and records the cleaning intervals and displays an alarm to notify ACWD Water Supply staff if the cleaning interval threshold is exceeded. On at least a daily basis, ACWD Water Supply staff will monitor the cleaning operations daily to confirm optimal screening performance. If there is any question about performance, ACWD Water Supply staff may close the diversion and retract the fish screen to physically inspect the screen for debris and cleaning.

Understanding Fish Screen Hydraulics

Flow velocity measured perpendicular to the screen surface is referred to as screen approach velocity (Va). This is the velocity a fish must swim against to avoid impinging on the screen mesh. Flow velocity measured parallel to the screen surface is referred to as screen sweeping velocity (Vs). This is the velocity that carries a fish swimming against the approach velocity away from the screen. Creating a strong sweeping flow is a highly desirable feature for transporting fish and debris away from the screen. In the absence of a strong sweeping flow, fish are more likely to swim against flow entering the screen until exhaustion impairs their ability to avoid impingement. The time it takes for a particle carried by sweeping flow to pass the length of the screen can be thought of as approximately the duration that a fish will be in danger of impingement. For small screens, this duration should be relatively short. Therefore, NOAA small screen criteria (applies to screen lengths <4 ft) allow screens to be set at any angle to the stream and bypass flow. Although not required under NOAA's small screen criteria, establishing a strong sweeping flow across a small screen is recommended and will benefit fish protection and debris and sediment management.

Minimizing fish impingement risk also requires that the approach velocity (Va) to the screen is less than the fish's swimming ability for short periods referred to as the fish's sustained swimming speed (Castro-Santos 2005). Sustained swimming speed can vary widely between fish species and age class (body size) (NOAA, 1997) salmonid fry criteria for screens with active cleaning systems require a screen approach velocity of ≤ 0.4 ft/s for canals and ≤ 0.33 ft/s for rivers, streams, and lakes based on total area of screen fabric. For fingerling-sized salmonids and larger, an approach velocity ≤ 0.8 ft/s is allowed.

As part of the draft Operations and Maintenance Plan, ACWD is developing an evaluation strategy using physical and biological field data to determine whether the fish screen sites comply with the intent of the fish protection criteria. In 2024, ACWD evaluated various techniques for collecting physical field data for fish screen velocities at the Bunting Fish Screen. Details of these experiments are provided in Section 4.7.

In addition to the daily inspections of the screened diversions, ACWD Water Supply staff conducted an annual inspection of all fish screens and diversions to document their conditions. These inspections included noting the conditions of the channel around the screens, screen track, diversion structure, protective plates, grating, slide gates, control systems, screen faces, and screen cleaning systems. Staff noted if there were any signs of impairment due to sediment, debris, algal growth, or if there were other conditions that could compromise functionality. The screens were inspected to confirm they were firmly attached and had no gaps, holes, rips or tears. Facility components were inspected for any loose, broken, or missing components, or for sharp edges. All facilities appeared to be satisfactory, and no subsequent repair work was identified due to the inspections. The following images in Figure 2.2(A)-(G) are representative of conditions observed during the inspections.

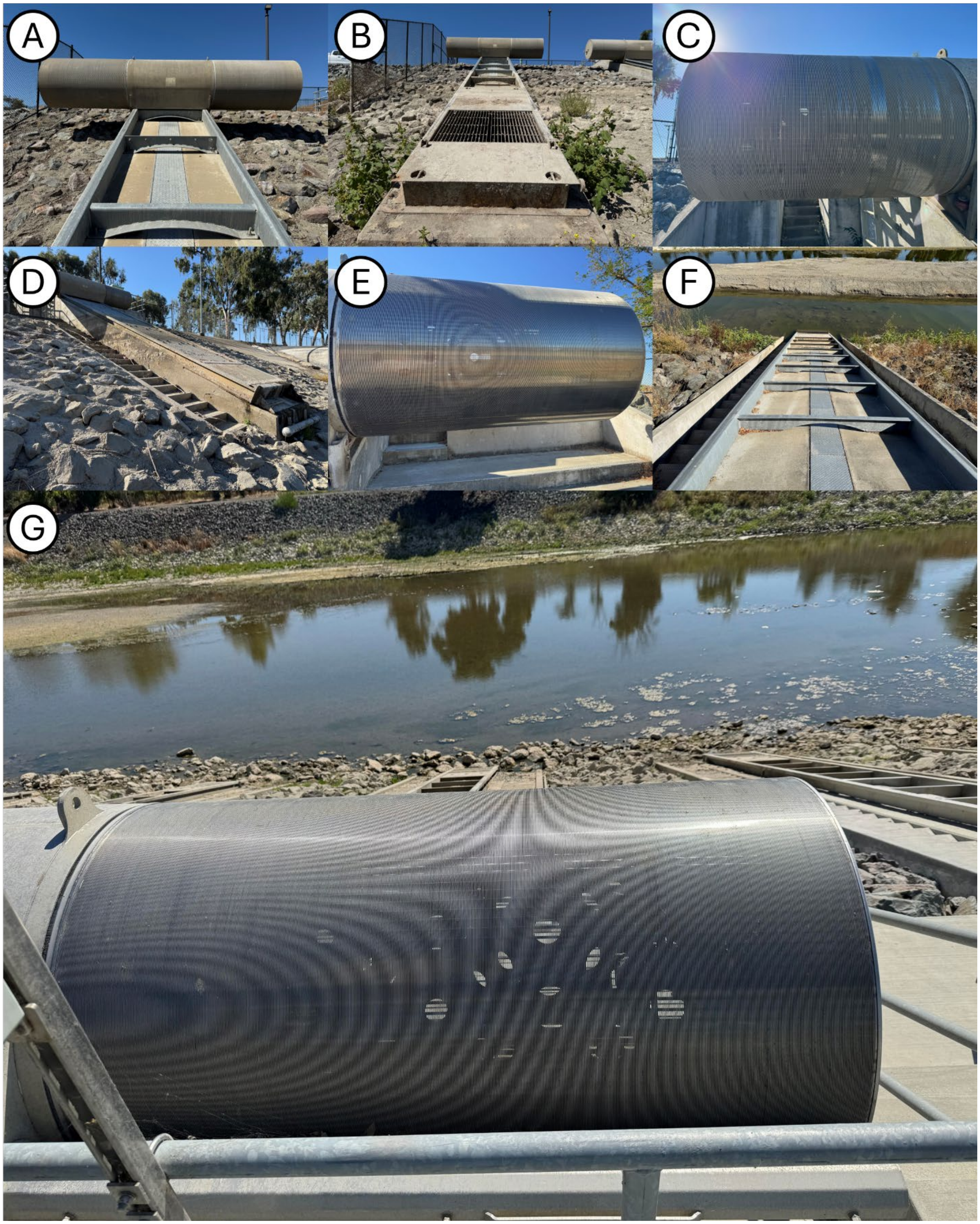

Figure 2.2: Images taken during the fish screen inspections. Featured are the A) Mission facility fish screen, B) Mission facility fish screen track, C) Bunting facility fish screen, D) Bunting facility fish screen track, E) Kaiser facility fish screen track, F) Kaiser facility fish screen track, G) Shinn fish screen facility showing one screen and three tracks.

2.2. SAFETY PROGRAM

The Districts prioritize safety in the operation and maintenance of these fish passage facilities. With new facilities, new standard operating procedures must be developed to identify potential hazards and to mitigate those identified hazards associated with work tasks at the new facilities.

After the commissioning of the new facilities in 2022, ACWD identified several safety improvements that were recommended to provide either administrative or engineering controls to mitigate potential hazards. Additionally, ACWD utilized a third-party contractor to conduct a safety evaluation of the new facilities, including the RD1 upgrades, the RD1 vertical slot fish ladder, and the Shinn Screened Diversions, to thoroughly review expected routine operational and maintenance activities at these facilities. The safety evaluation identified which activities required entry into confined spaces and suggested several safety improvements to make work in and around the facilities safer for staff and contractors. ACWD's Health and Safety Officer has completed a review of the safety evaluation and has finalized recommendations for both administrative and engineering controls to ensure staff safety at these facilities.

During the reporting period, ACWD Project Engineering staff, responsible for the design, construction, and commissioning of the new facilities, continued making safety improvements at the RD1 and BART Weir fish passage facility to enhance worker safety during routine operation and maintenance tasks. However, a number of additional safety improvements are still outstanding and are anticipated to be deployed in 2025.

As the Districts gain operational experience during continued operation of the new facilities, they are identifying new safety considerations associated with completion of routine operations and maintenance activities. For example, the new vertical slot fish ladders and the new pressure relief structure at the RD1 and BART Weir fish passage facility are both considered confined spaces which require routine operations or maintenance activities. ACWD has developed standards and protocols to conduct safe entry into these confined spaces to affect repairs or conduct routine maintenance. Through repeated safe entries in the reporting period, ACWD has continued to refine these protocols to conduct the safe entries for routine maintenance of the sonar camera and associated equipment located within the RD1 vertical slot fish ladder in Pool 10. These refinements also allow ACWD staff to complete the maintenance work in less time, which lowers the cost of the maintenance activities and reduces the duration of the fish ladder shutdown. While the sonar camera manufacturer documentation noted that the design of the camera includes ports to allow water to flow within the camera body and around the camera lens, and that, depending on the water quality conditions, routine maintenance may be required to perform periodic cleaning around the camera lens to remove accumulated silt deposits, the frequency of the cleaning would be determined through evaluation of image quality during actual use. In this reporting period, ACWD staff performed one cleaning of the ARIS camera on 17 April 2024. Further discussion of the ARIS maintenance is provided in Section 4.3.

Where appropriate, and in some cases such as a contingency plan to avoid the need for safe entry protocols, ACWD staff utilized GoPro cameras to collect still images and/or video imagery to reduce crew exposure to confined spaces and/or need to access flowing water. This equipment also reduced the need to alter flow for fish passage facilities inspection.

2.3. DATA MANAGEMENT

A Data Management Plan (DMP) is currently being developed as part of the MAMP to identify and document requirements and responsibilities for managing, using, and archiving environmental information as needed. Sufficient details will be provided in the DMP to clearly define what data types will be generated and the use, who is responsible for the various activities related to information management, how data will be managed, and when data exchanges will occur and between whom. The DMP will be reviewed and updated as necessary.

The DMP only pertains to the management of environmental information. Environmental information includes electronic or hard copy records obtained by the Project that describe environmental processes or conditions; both physical and biological. Information generated by the Project (e.g. analytical results from Project samples) and obtained from sources outside the Project (e.g. historical data) fall within the scope of the DMP. Certain types of information, such as personnel or financial records, are outside the scope of the DMP. Key DMP aspects include:

- Data Policy, ownership, custodianship.
- Database design and implementation.
- Standardized datasheets.
- Storage, backup and archiving.
- Access and security.
- Data management.
- Data modeling.
- Data acquisition.
- Quality assurance and quality control (QA/QC).
- Data sharing process.

Additional details will be provided in the finalized MAMP.

2.4. PHYSICAL CONDITIONS

To assess the physical conditions of the fish passage facilities, RD1 impoundment, and Lower Alameda Creek, ACWD employed several measurement systems, including continuous water temperature and dissolved oxygen (DO) monitoring using HOBO MX2201 temperature sensors (Onset HOBO® Bluetooth Pendant Temperature Data Logger MX2201) and HOBO dissolved oxygen sensors (HOBO® U26), respectively. Instantaneous turbidity was measured in Nephelometric Turbidity Units (NTU) using a turbidity meter (Hach 2100Q Portable Turbidimeter). Additional samples were collected utilizing an array to gather data at three different depths of the RD1 impoundment. Downstream of the RD1 and BART Weir fish passage facility, ACWD installed seven temporary temperature sensors to assess downstream creek temperatures. The fish passage facilities were also further assessed for physical barriers for salmonid passage such as large head drops in the ladder, high-velocity flow, and sediment deposition or debris jams. Figure 2.3 provides a map of water quality sensor locations. Refer to Section 4.6 for more detail regarding these additional potential physical barriers.

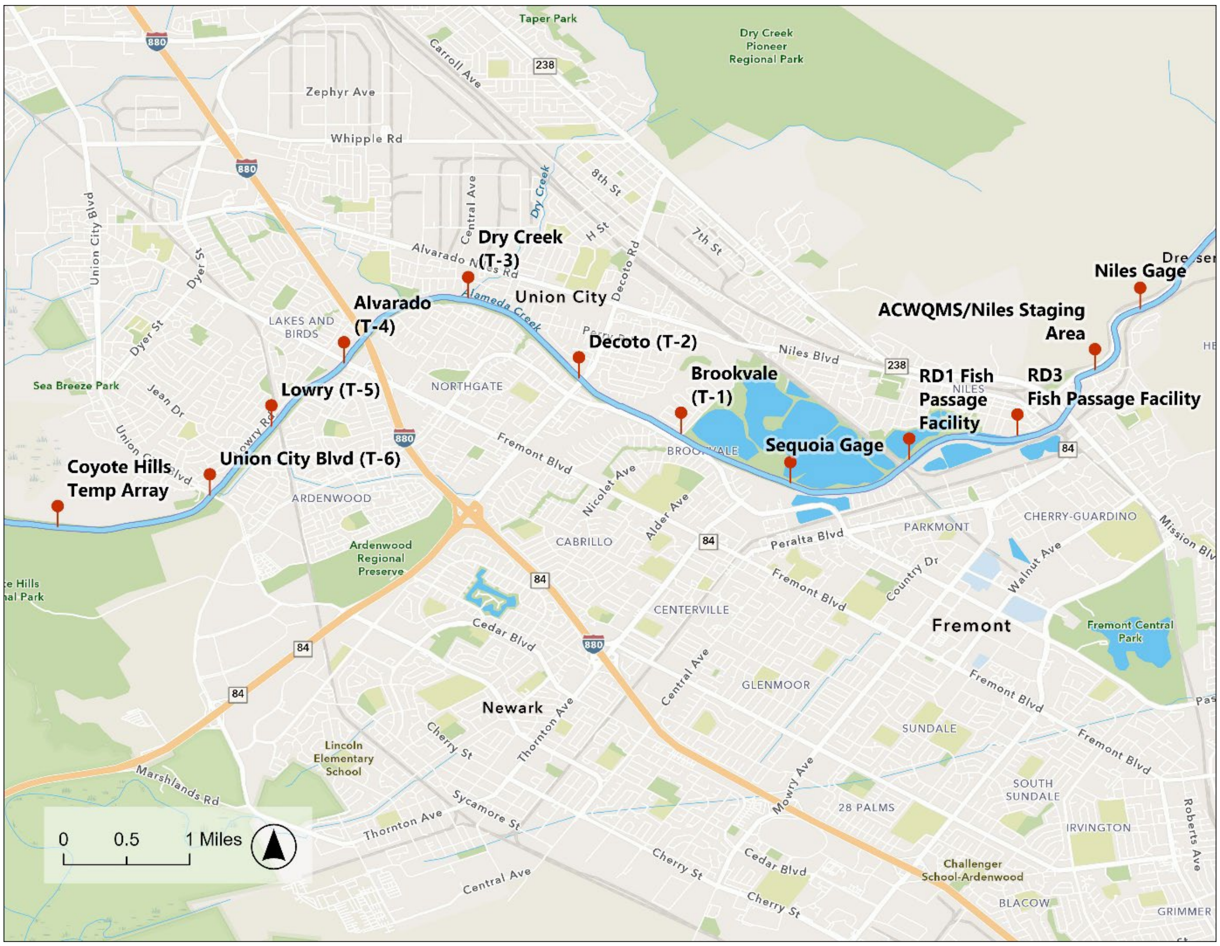

Figure 2.3: Map of dissolved oxygen and temperature sensors, USGS gages, and monitoring. Beginning upstream, there is the Niles Gage which monitors parameters such as DO and temperature. Turbidity samples are collected at the Alameda Creek Water Quality Monitoring Station (ACWQMS) at the Niles Staging Area. At the RD3 fish passage facility, there is one temperature sensor at the exit gate and dissolved oxygen sensor at the RD3 forebay. Within the RD1 vertical slot fish ladder, one sensor is near the entrance gate at the downstream end of the vertical slots, and another upstream at the exit channel of the fish ladder; there is a single DO logger located in the impoundment (approximately mid-water column) near the trash rack of the fish ladder and a DO and temperature array in the middle of the RD1 impoundment. The Sequoia Gage monitors parameters such as DO and temperature. The remaining temperature sensors (T 1-6) are located downstream of the RD1 and BART Weir fish passage facility along the Alameda Creek Flood Control Channel down to a temperature array at the Coyote Hills Estuary.

2.4.1. Temperature

Water temperature is a critical factor affecting fish migration behavior and survival. Excessively high or low temperatures can create unsuitable conditions for *O. mykiss*. Temperature monitoring is conducted to assess how thermal conditions affect fish passage and habitat sustainability for migratory *O. mykiss*. Monitoring for temperature helps ensure that water conditions are within optimal thresholds to prevent thermal stress and impacts on fish migration (ACWD, in prep). **Error! Reference source not found.** provides a summary of flows, in cubic feet per second (cfs), and temperature readings at Niles and Sequoia gages, in relation to ACWD's monitoring operations.

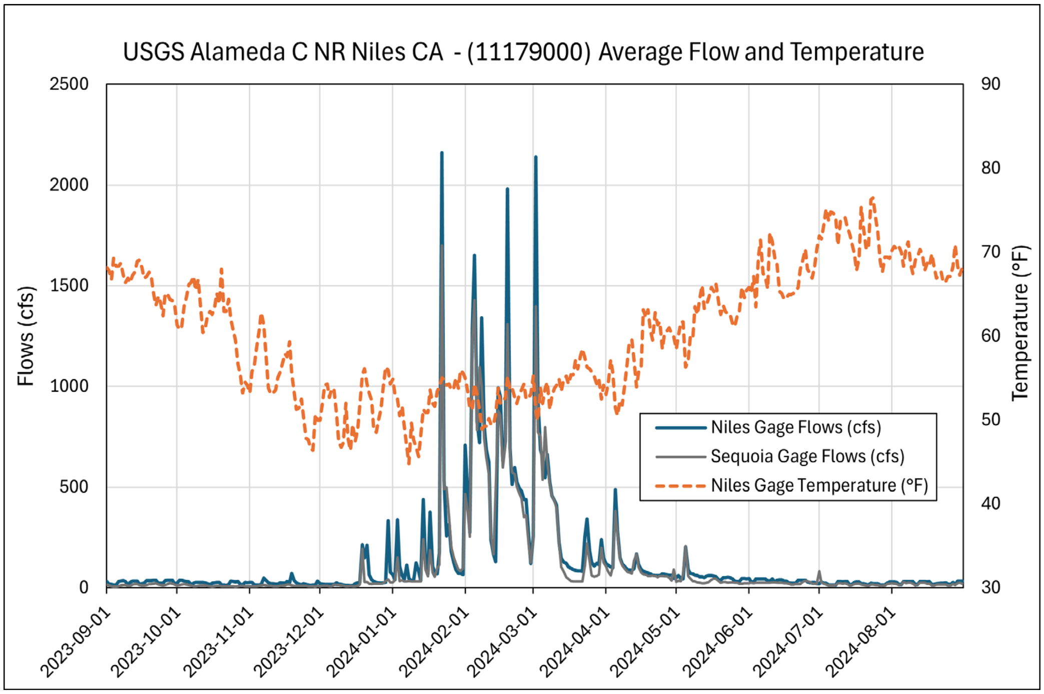

Figure 2.4: Average flows (cfs) at the Niles and Sequoia gages and average surface water temperature (F) at the Niles gage from 1 September 2023 through 31 August 2024.

Two HOBO MX2201 temperature sensors, installed within the RD1 fish ladder in December 2022, remained installed throughout the 2023-2024 reporting period. Two additional temperature sensors were re-deployed within the RD3 fish ladder at the entrance pool and exit channel in December 2022. During high flow events that occurred in late December 2022 and early January 2023, the sensor located at the RD3 entrance pool was buried in several feet of sediment and was not retrievable. As previously described, in January 2023, the RD3 suffered damage and was not in operation for most of 2023. Figure 2.5 provides a summary of temperature data at the RD1 and RD3 fish ladders.

Downstream of the RD1 and BART Weir fish passage facility, eight HOBO MX2201 temperature sensors were installed in the Alameda Creek Flood Control Channel in June 2024. Deployment criteria included finding suitable areas of deep pools to capture temperature fluctuations. The sensors were manually attached to camouflaged casings before deployment to reduce the chance of vandalism. Using a 3/8-inch diameter steel cable, the temperature sensors, within their casings, were secured to steel stakes driven into the channel bed. One downstream temperature sensor, deployed at Union City Blvd (Figure 2.3; T-6) was potentially vandalized and declared lost along with partial data for the month of June 2024. To avoid further loss of data, ACWD re-installed a new temperature sensor at the Union City Blvd monitoring station. Figure 2.6 provides a summary of temperature data from the downstream temperature sensors.

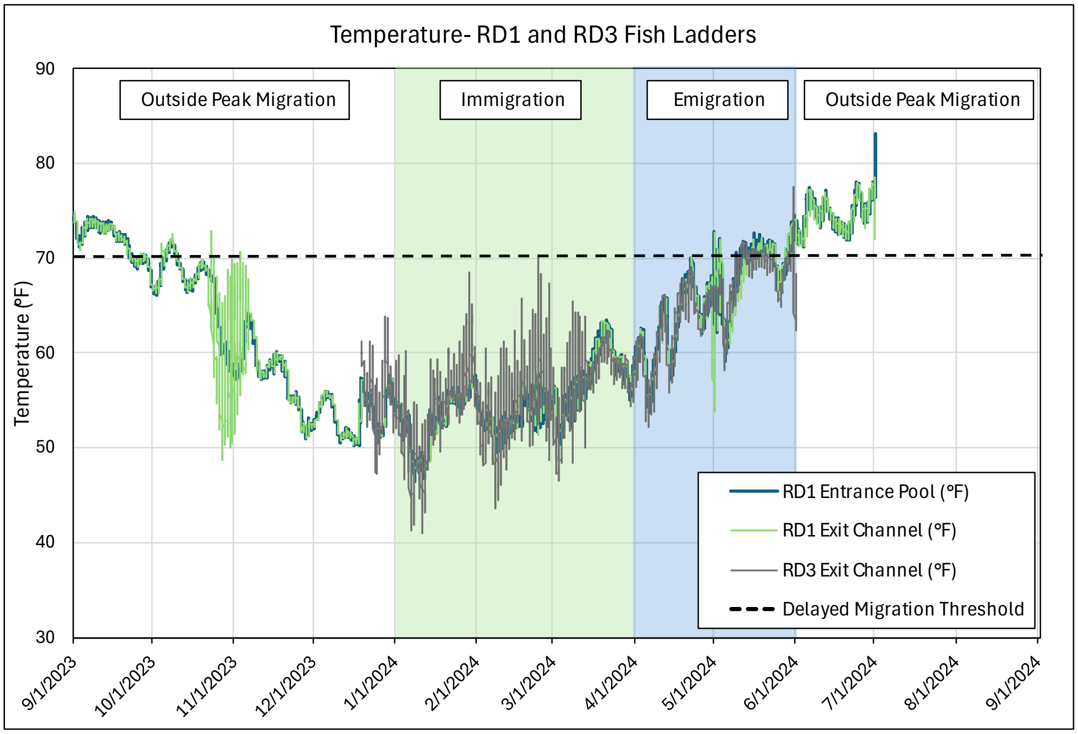

Figure 2.5: Temperature as measured at the upstream exit channel of the RD1 fish ladder (green), downstream entrance pool (blue), and at the upstream exit gate of the RD3 fish ladder (grey. No data was collected from at the RD3 exit channel from 1 September 2023 - 18 December 2023, due to RD3 rupturing in January 2023. RD3 was deflated in June 2024 and the RD1 fish ladder started to be dewatered beginning July 2024, affecting passage and affecting temperature readings within the fish ladder due to low flows. Refer to Section 4.5 for more detail regarding the water quality data in June and July 2024.

Out of the eight sensors, two were deployed as a single array to capture temperature data at the surface and bottom depths of the Alameda Creek Flood Control Channel at the most downstream monitoring location in the Coyote Hills Estuary (Figure 2.3). Due to the close proximity of San Francisco Bay (estimated 4.10 km upstream), the temperature array was designed to adjust to the tidal fluctuations using a 14 ft stainless-steel cable attached to an additional 2 ft of nylon rope (to create some slack) which connected a floatation device at the surface and a mushroom anchor on the bottom of the creek to provide stability. The sensors were placed into two camouflage casings and then attached to the array near the surface and bottom of the creek. Data was downloaded regularly and when it was safe to access the Alameda Creek Flood Control Channel. Figure 2.7 provides a summary of temperature data from the Coyote Hills Estuary temperature array.

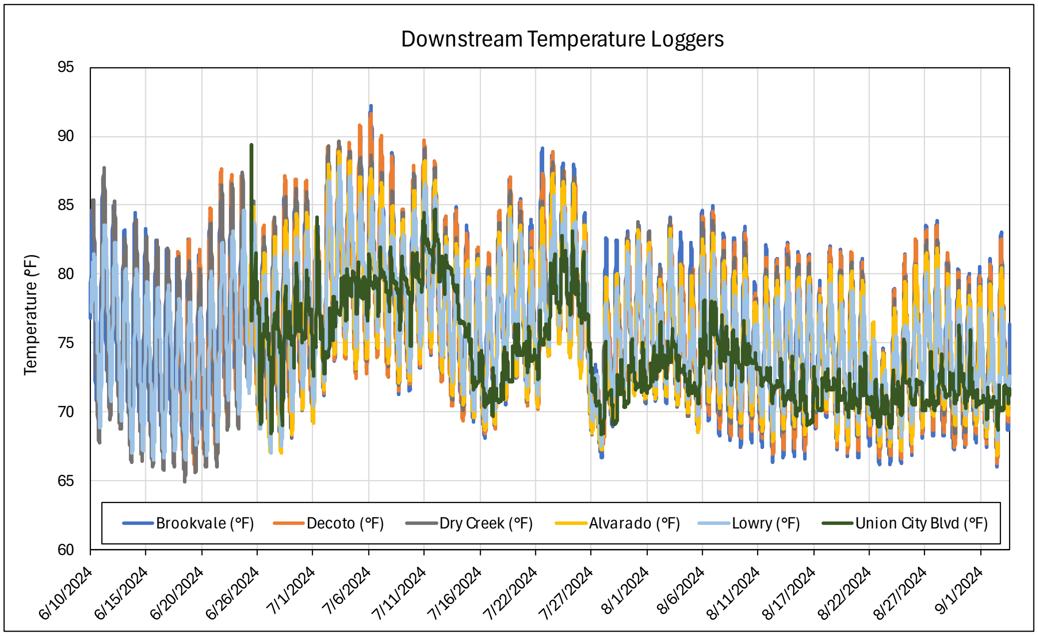

Figure 2.6: Temperature variations recorded by loggers at six downstream locations of RD1 (Figure 2.3; T 1-6) from 10 June through 31 August. The data indicates diurnal fluctuations in temperature with downstream sensors (Lowry and Union City Blvd) recording lower temperatures compared to upstream loggers. This reflects influence on temperature when moving downstream in the Alameda Creek Flood Control Channel and closer to San Francisco Bay.

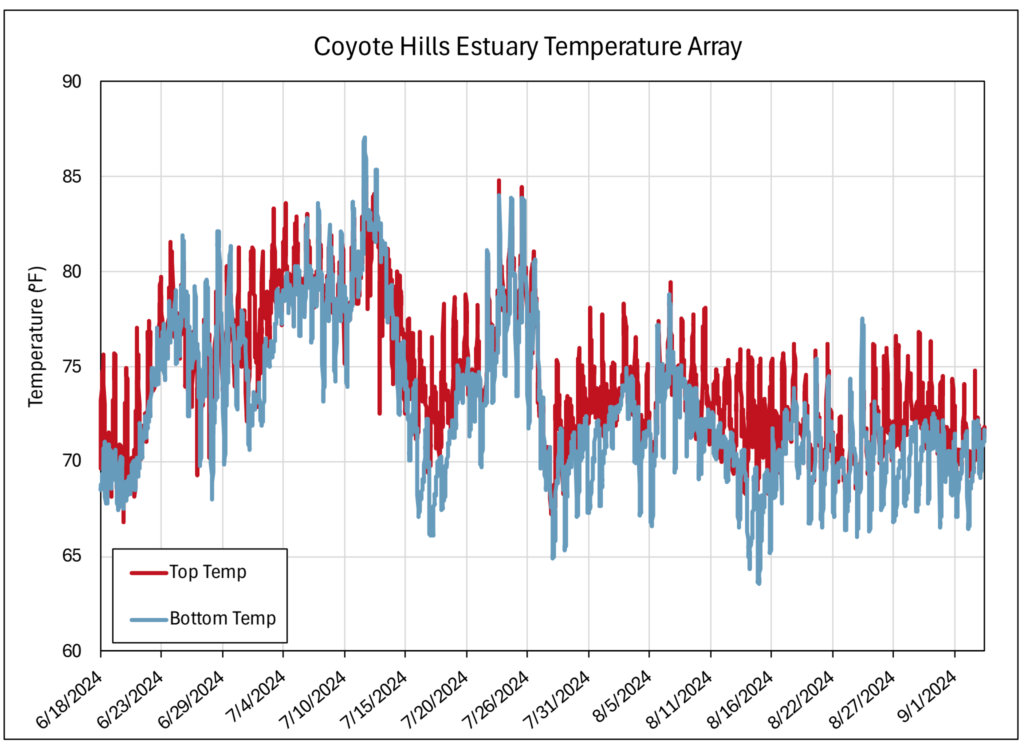

Figure 2.7: Water temperature at the Coyote Hills Estuary from 18 June through 31 August recorded at two different depths: surface (red) and bottom (blue). The data shows diurnal fluctuations with surface temperatures recording slightly higher values than temperatures near the bottom of the Alameda Creek Flood Control Channel.

2.4.2. Dissolved Oxygen

Dissolved oxygen is a primary indicator of water quality, influencing fish respiration, stress levels, and movement (ACWD, in prep.). Maintaining DO levels within acceptable biological thresholds is crucial to prevent fish stress and mortality. Monitoring DO is crucial to identifying potential areas of low oxygen that could hinder fish movement and to support decisions on managing bypass flows and other mitigation measures (ACWD, in prep). Potential avoidance reactions in juvenile salmonids have been found to occur at DO concentrations of < 5 mg/L and potential mortality at constant exposure to concentrations of < 3.9 mg/L (Carter 2005).

To monitor for DO levels, the ACWD had previously installed a DO sensor (HOBO U26) at the RD1 impoundment near the trash racks in the 2022-2023 reporting period that was kept for the 2023-2024 reporting period. An additional DO sensor (HOBO U26) was installed at the RD3 forebay in May 2024. The DO sensors are suspended at approximately the middle of the water column, or about five feet below the water surface. When the RD1 or RD3 impoundment is lowered, the respective DO sensor is removed to prevent it from drying out and malfunctioning. Figure 2.8 and Figure 2.10 provide a summary of the DO data at the RD1 and RD3 impoundments, respectively.

To assess reservoir conditions, ACWD deployed a DO and temperature array to gain a depth profile of the RD1 impoundment. The array consisted of three HOBO U26 DO loggers, a buoy to keep it afloat, a concrete brick to hold it in place on the bottom of the creek, and a 13 ft long stainless-steel chain connecting it all together. The DO sensors were placed equidistant from each other to record DO and temperature data at three different depths: near the surface, middle, and near the bottom of Alameda Creek. Refer to Figure 2.10 for a summary of results of the DO array.

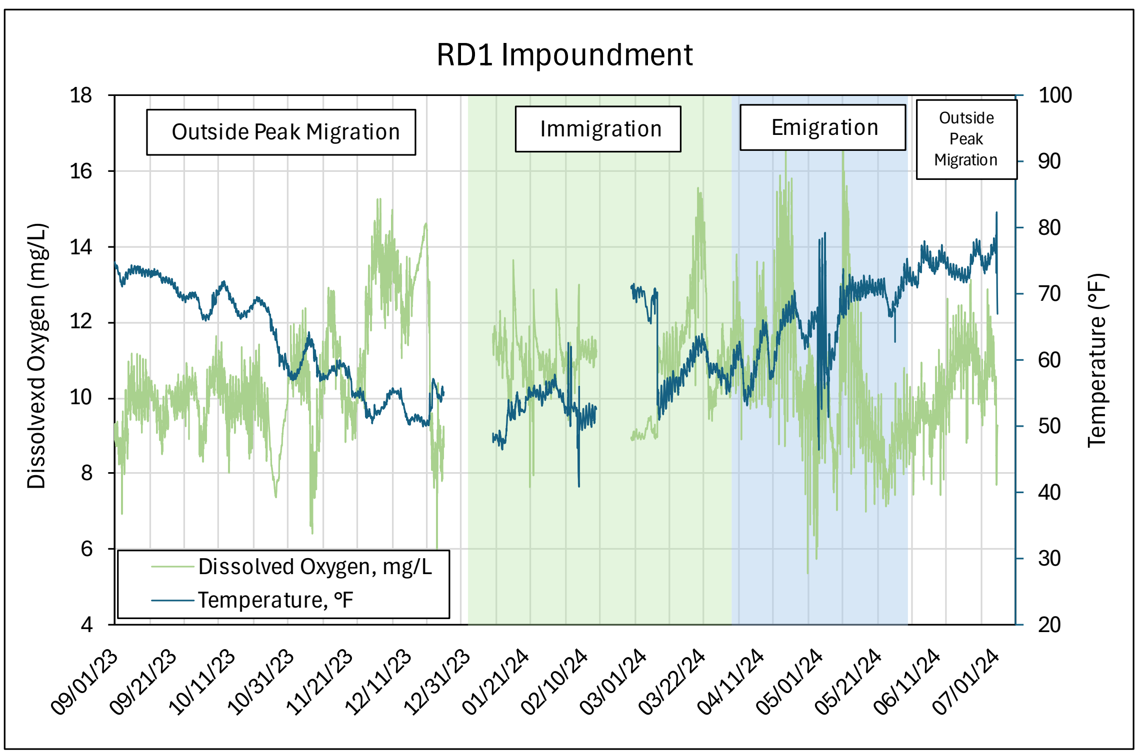

Figure 2.8: DO and temperature levels recorded at the RD1 impoundment near the RD1 trash racks from 1 September 2023 to 2 July 2024. DO sensor was removed while RD1 was deflated from 23 December 2023 to 21 January 2024, 15 February 2024 - 26 February 2024, and 2 July 2024 - 31 August 2024. DO levels remained around a range of 8-14 mg/L and temperature around 50-80°F during the 2023-2024 reporting period.

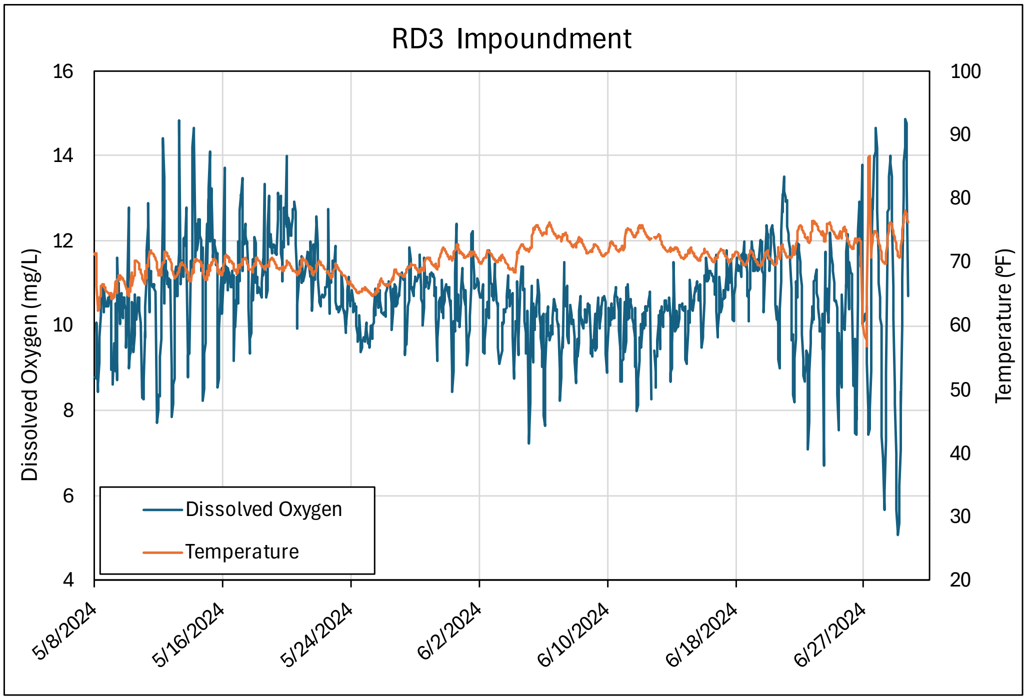

Figure 2.9: DO and temperature levels recorded at the RD3 forebay from 8 May 2024 to 30 June 2024. The DO sensor was removed on 30 June 2024 to avoid damages while RD3 was deflated for maintenance. From May to June, DO levels at the RD3 forebay ranged from about 8-12 mg/L and temperature ranged from about 65-70°F.

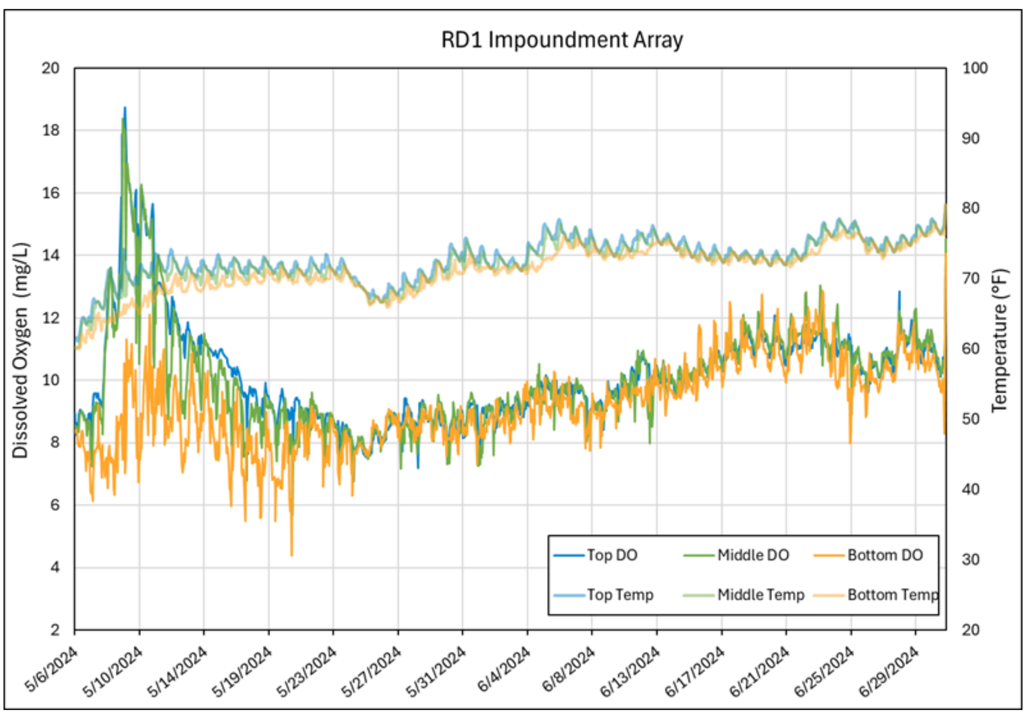

Figure 2.10: DO concentrations (mg/L) and temperature (°F) trends at three different depths within the RD1 impoundment from 6 May 2024 to 1 July 2024. DO concentrations exhibit an initial spike followed by a gradual decline, stabilizing around mid-May. Temperature trends show a steady increase with higher temperatures observed in late June.

2.4.3. Turbidity

High Turbidity can limit fish visibility, impact habitat conditions and disrupt migration patterns (Bjorn & Reiser 1991). Monitoring turbidity levels ensures that fish passage facilities remain effective and that sediment management practices are appropriately adapted as needed (ACWD, in prep). ACWD measured daily turbidity using a Hach 2100Q at the ACWQMS, located upstream of the RD3 fish ladder (Figure 2.3). The average turbidity observed was approximately 21 NTU, but during certain periods, particularly during high-flow, turbidity spiked. These spikes suggest substantial sediment disturbances likely caused by elevated flow rates. Refer to Figure 2 for turbidity levels throughout the season.

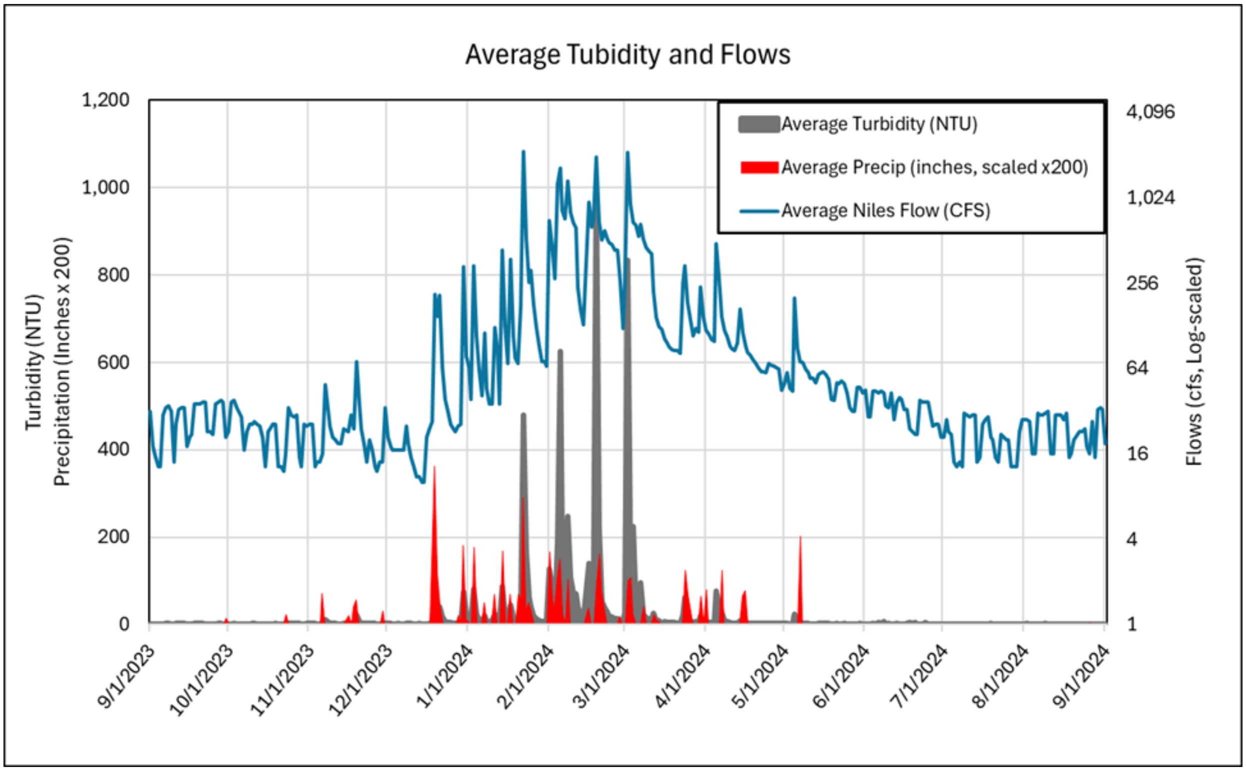

Figure 2.11: Daily average turbidity (NTU) and flows (cfs) at the Niles Gage (Figure 1) from 1 September 2023, through 31 August 2024. Turbidity sampled daily at the upstream monitoring station in Alameda Creek.

2.4.4. Barriers

Physical barriers, including debris accumulation and sediment deposition, can block or impede fish passage. Debris jams, critical riffles, infrastructure, and excessive water velocities may impede migrating fish. Given suitable conditions, salmon and steelhead can get past many obstacles that appear to be barriers (Bjornn and Reiser 1991). Regular monitoring for barriers helps inform maintenance and operations strategies to ensure that fish passage facilities remain functional (ACWD, in prep).

To meet these requirements, on a minimum daily basis, the river channel was surveyed within Reaches II through V from the Alameda Creek Trail downstream of RD1 to the Niles Staging area (Figure 1.2) to look for and flag any obvious passage obstructions for immigrating and emigrating fish. Similarly, ACWD staff, on a minimum weekly basis, surveyed the river channel within Reaches I and II from the Alameda Creek Trail downstream of RD1 and Sequoia Gage, to look for and flag any obvious passage obstructions for immigrating and emigrating salmonids. Staff recorded this information in logs and notified appropriate authorities if warranted. System surveys were also conducted to evaluate fish passage and potential barriers. Refer to Section 4.6 for additional information and details.

Regular maintenance, such as debris removal and equipment inspections, ensures that these facilities remain functional and compliant with the standards outlined in the BiOp. Inspections of fish ladders evaluate water depth, velocity, and potential obstructions, while maintenance logs and visual assessments are conducted regularly. Monitoring key physical parameters provides data to identify conditions that could hinder fish passage or affect ecological health. Temperature, dissolved oxygen, and turbidity measurements help inform adaptive management, particularly during summer months or low-flow conditions. Through a combination of facility inspections, water quality monitoring, and collaboration with regulatory agencies, the program aims to optimize fish passage conditions while maintaining critical water supply. Ultimately, these efforts contribute to the long-term health of native fish populations and the overall resilience of the Alameda Creek ecosystem.

3. STREAMFLOW MONITORING AND BYPASS REQUIREMENTS

ACWD's bypass flow requirements included in the BiOp were based on the structural capability of the rubber dams, diversion requirements of ACWD, and the needs of migratory fish. ACWD's bypass flow requirements were first captured in an agreement among NOAA, CDFW, and ACWD as outlined in the Alameda Creek Steelhead Fisheries Restoration: Alameda County Water District Flow/Bypass Operations Meeting Summary, 27 January 2011. The requirements are based on both time of year and the streamflow measured at the USGS Alameda C NR Fremont CA - (11179000).

The basics of the flow schedule, described in greater detail in subsequent sections, defines three seasonal periods:

1. The anadromous salmonid immigration period is from 1 January through 31 March.
2. The salmonid emigration period is 1 April through 31 May.
3. The outside of peak migration periods for *O. mykiss* is 1 June through 31 December.

3.1. WATER YEAR TYPE AND DETERMINATION METHOD

ACWD's bypass flows for the peak period of juvenile and kelt *O. mykiss* emigration (1 April through 31 May) are determined by water year type calculated on 1 April of each year (NMFS 2017). ACWD determines the water year type based on the cumulative precipitation measured at ACWD's Blending Facility in Fremont, California. The "normal/wet" water year classification is based on a 60% exceedance threshold (i.e., 60% of the emigration seasons [April and May] are expected to be classified as "normal/wet") and the "dry/critical dry" water year classification is also based on the 60% exceedance threshold (i.e., 40% of the emigration seasons are classified as "dry/critical dry"). To facilitate this, ACWD used the 137-year period of record at this location to define normal/wet and dry water year types. Results of this analysis indicate that if cumulative rainfall calculated from 1 October to 31 March is less than 15.3 inches, conditions are considered "dry/critical dry," and if the cumulative rainfall is greater than 15.3 inches, conditions are classified as "normal/wet." Per the BiOp, Figure 3.1 provides a summary of the 7-day pulse release structured decision-making process. As indicated in Figure 3.1, the 7-day pulse release flow process begins with the year-type determination (i.e., whether it is a wet/normal or dry/critical dry year) based on cumulative rainfall during the rain year at the end of each March. ACWD will update the Operations Working Group (OWG), which is comprised of the Districts, NMFS, and CDFW per the BiOp, on cumulative rainfall once a month starting every January. If the cumulative rainfall exceeds 15.3 inches (this is the threshold for year-type determination per the BiOp) before the end of each March, then a year-type determination of "normal/wet" can be made. This determination will be aided by reviewing past years and the most recent fall and early winter season's observed precipitation as well as looking at weather forecasts. If it is determined that the year is dry or critical dry and the Niles gage is less than 25 cfs, the 7-day pulse releases will be triggered in April and May. The 7-day pulse releases may be coordinated with any SFPUC releases, and the timing of the releases may be sequenced so that pulse flow releases follow natural rain freshets (ACWD, in prep.).

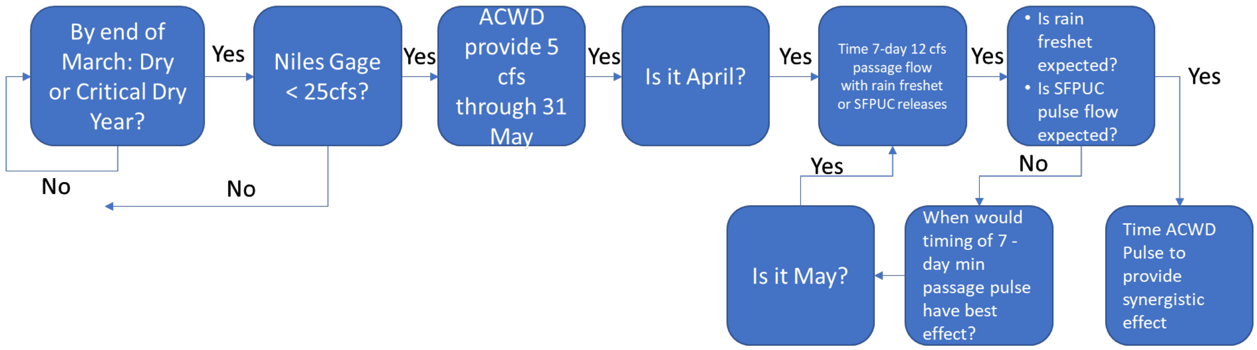

Figure 3.1: Pulse Flow Structured Decision-Making Process (ACWD in prep.)

3.1.1. Watershed precipitation and runoff for the 2023-2024 reporting period

During the reporting period, December 2023 was the wettest month, with a precipitation event of 1.81 inches; June, July, August 2024 were the driest with no rain. The Niles gage flows ranged from 10 cfs in December 2023 to 2,160 cfs in January 2024 (Figure 3.2). The Sequoia gage flows ranged from 0.16 cfs (November 2023) to 4,370 cfs (January 2024).

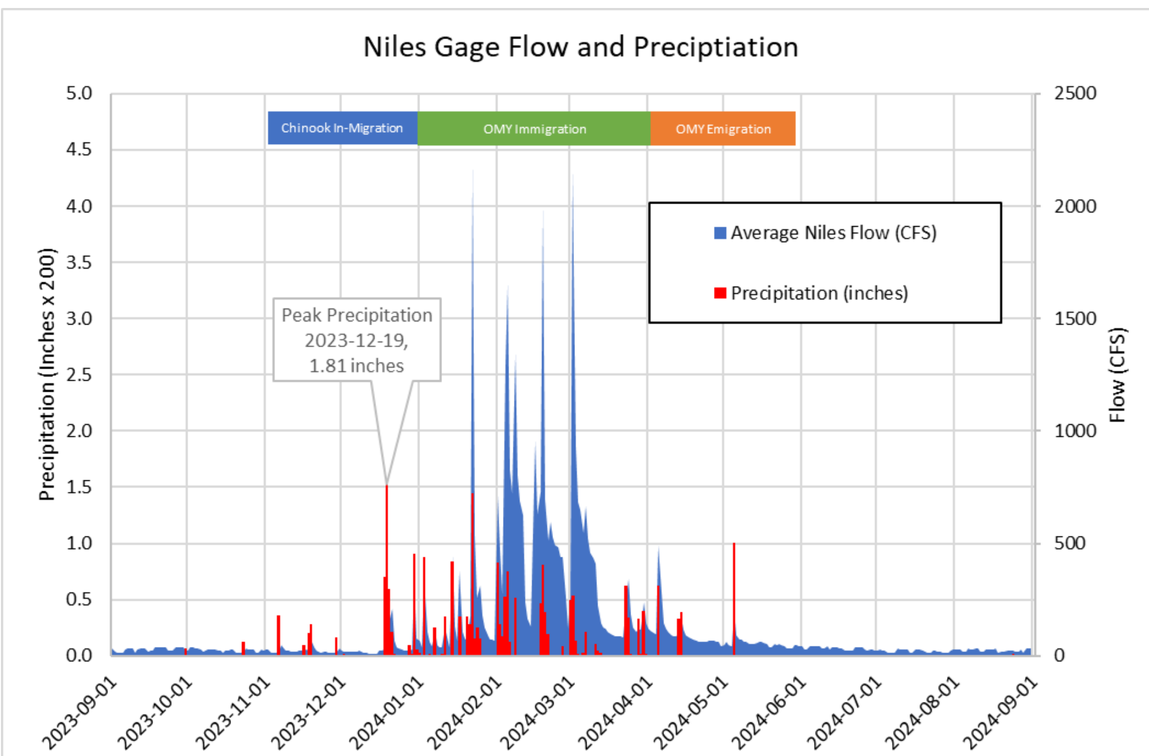

Figure 3.2: Estimated daily precipitation (inches; red bars) plotted against the Niles gage (cfs; blue region) from 1 September 2023 through 31 August 2024. Salmonid migration timing is plotted across the top in blue (Chinook salmon adult immigration), green (O. mykiss adult immigration), and orange (O. mykiss adult emigration). Y-axes are scaled to match the dataset. OMY = O. mykiss.

Daily precipitation accumulation demonstrated the 15.3-inch threshold for normal/wet operations was reached in February 2024 (Figure 3.3). Based on the year determination criteria per the BiOp, this was a normal/wet year. Per the BiOp, for a normal/wet year, the minimum bypass flow at the ACFCD flood control drop structure for O*. mykiss* emigration (from April 1-May 31) requires 12 cfs plus net SFPUC releases that arrive at the Niles gage for all daily average inflow volumes measured at the Niles gage. The normal/wet determination also eliminated the need to prepare for pulse releases in accordance with the 7-Day Pulse Framework[1].

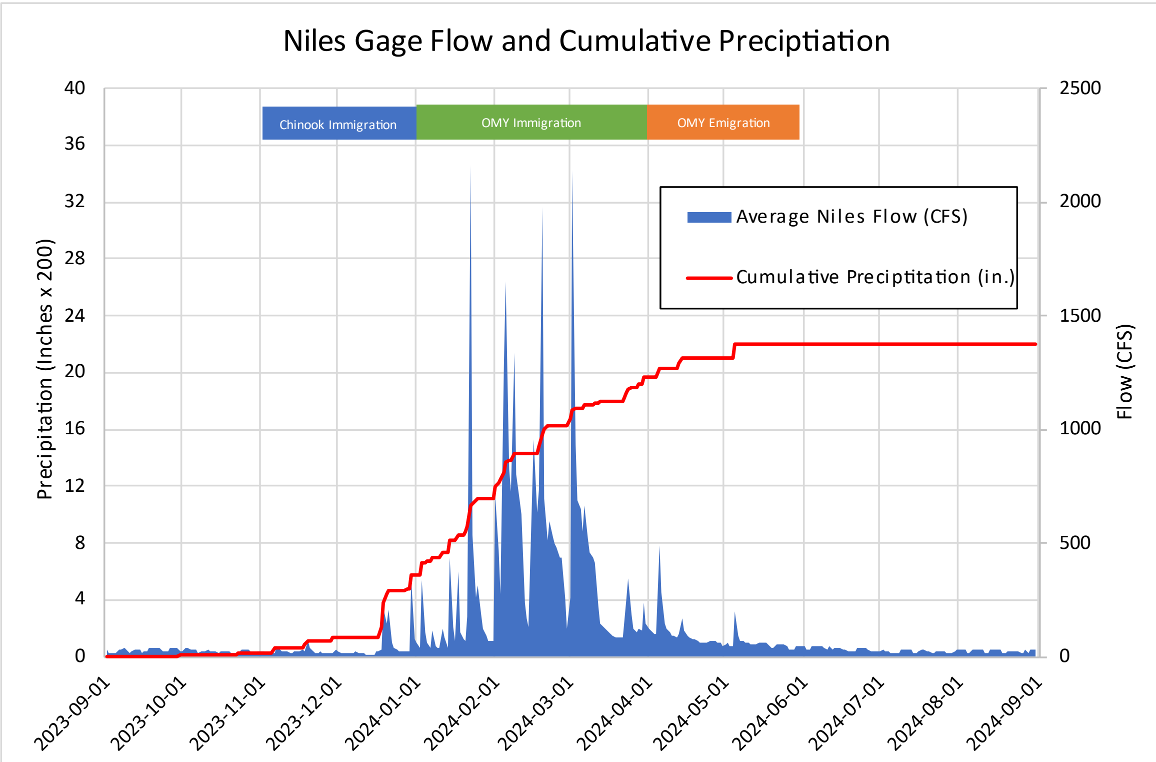

Figure 3.3: Cumulative Precipitation (inches) vs Flow recorded at the Niles gage (cfs). 1 September 2023 through 31 August 2024. Salmonid migration timing is plotted across the top in blue (Chinook salmon adult immigration), green (O. mykiss adult immigration), and orange (O. mykiss adult emigration). Y-axes are scaled to match the dataset. OMY = O. mykiss.

3.2. RD1 AND BART WEIR FISH PASSAGE FACILITY BYPASS FLOW

3.2.1. Bypass Requirements

Bypass requirements for the RD1 and BART Weir fish passage facility are determined in two additive parts: contributions from natural Niles Canyon in-flows, measured at the Niles gage, and contributions from fisheries releases by SFPUC's live-stream operations further upstream in the Alameda Creek watershed.

[1] Development and use of a 7-Day Pulse Framework is a stipulation of the BiOp (NMFS 2017) and is intended to provide improved emigration for smolts and kelts during spring months of dry/critical dry years. As this condition was not triggered in 2024, a planned schedule for pulse releases was not required.

3.2.2. Niles Bypass Component

Niles in-flow bypasses are determined using a set of local criteria.

- The migration season, which is informed by time of year;
- *O. mykiss* immigration, 1 January 1 – 31 March 31
- *O. mykiss* emigration, 1 April 1 – 31 May 31
- Outside of peak migration, 1 June 1 – 31 Dec 31
- The water year type – 60% of water years should be classified as normal/wet:
- Normal/wet year if cumulative precipitation 1 Oct – 31 Mar exceeds the 40th percentile of cumulative rainfall
- Dry if the cumulative precipitation 1 Oct – 31 Mar is below the 40th percentile

Dependent on water year type and migration season, the bypass requirement is determined from the 24-hour average of the inflow at the Niles gage using discrete inflow tiers. A visual representation of this tier selection is presented in Figure 3.4. While this figure summarizes requirements under the BiOp, the BiOp contains descriptions of the bypass requirements in greater detail.

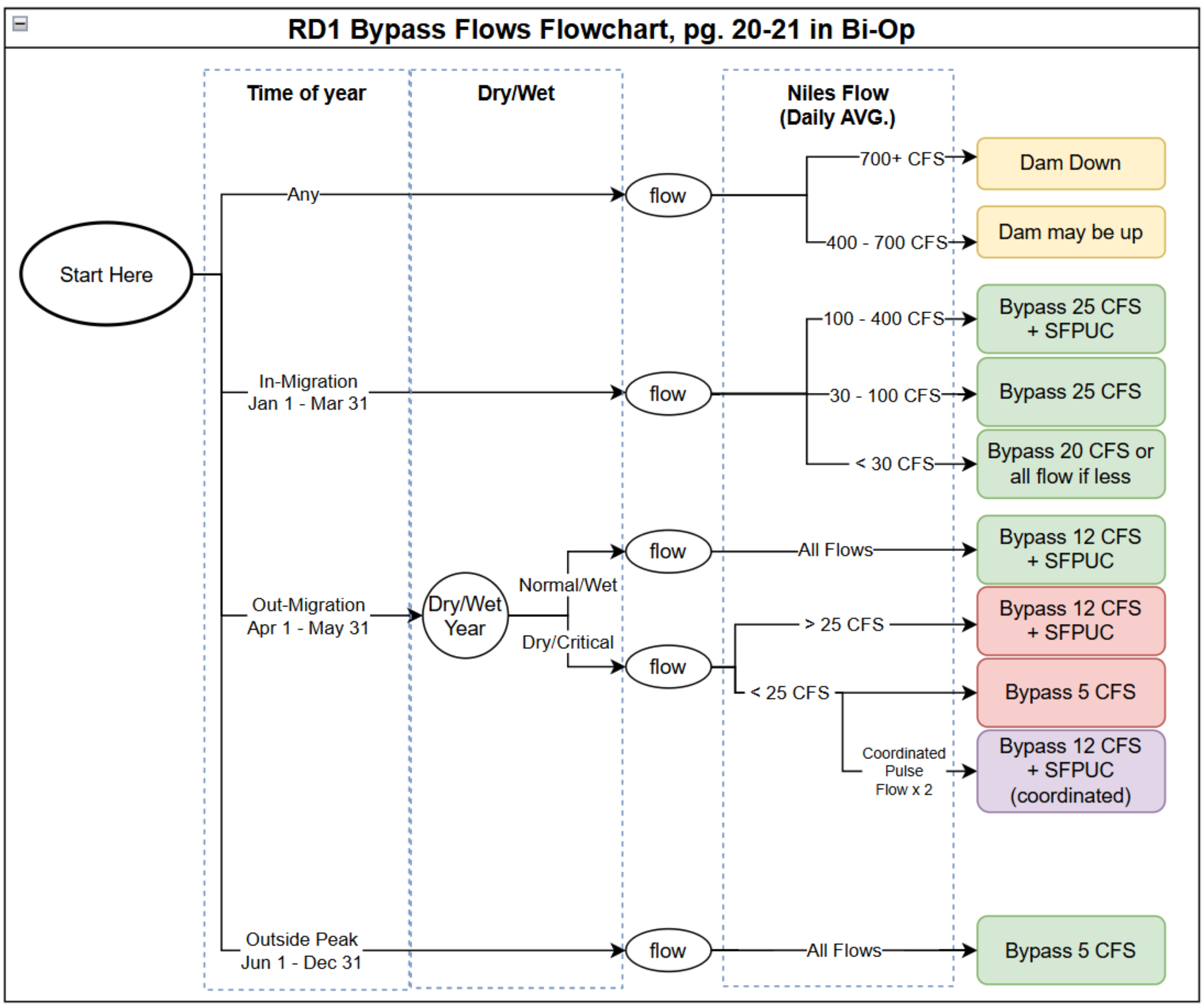

Figure 3.4: Flows chart of bypass requirements, depending on time-of-year, Niles inflows, and wet or dry/critical dry conditions.

3.2.3. SFPUC Fisheries Releases Bypass Component

SFPUC performs fisheries releases out of Calaveras Dam and bypass flows from Alameda Creek Diversion Dam, which at times may influence flows at the Niles gage. As described in the BiOp, depending on the migration season, flow rate, and year type, SFPUC bypass flows that arrive at the RD1 and BART Weir fish passage facility from these activities are included in the total bypass requirement for the RD1 and BART Weir fish passage facility.

3.2.4. Bypass Calculation Periods

The bypass tier for the current operating day is determined from the previous 24-hour period of Niles gage inflow. The RD1 and BART Weir fish passage facility is issued a bypass tier for the day, which ACWD Water Supply staff use to inform operations for the current 24-hour period. At the end of the period, the 24-hour average flow at the downstream Sequoia gage is used as the compliance point to determine if the bypass requirement was met or not.

3.2.5. 2023-2024 Reporting Period Bypass Compliance Results

ACWD provided bypass flows in compliance with the BiOp 100% of days in the 2023-2024 reporting period. Bypass target flows were met or exceeded for all but one day, 5 September 2023, when flow fell below target by ~1 cfs, due to lack of flow in the creek. In compliance with the BiOp requirements for such conditions, ACWD bypassed all available flow, and no inflowing water was diverted offstream nor used to increase storage in the RD1 impoundment. Refer to Figure 3.5. As noted in Section 2.1.2, the RD3 facility was not yet operational due to 2023 storm damage, so there was no water impounded above RD3 during this time. This day is within the "outside of peak migration" period of bypass requirements, when total flows are typically low in Alameda creek. Refer to Appendix A to view compliance criteria and bypass operations for the year.

An assessment of conditions on the day that fell below target indicates the low bypass flow was a result of two days of low flow at Niles gage and stream losses between Niles gage and the RD1 and BART Weir fish passage facility. The BiOp considered instances where there is insufficient flow arriving at the BART Weir (in the RD1 and BART Weir fish passage facility) to meet the daily bypass target and states, "If less than 5 cfs arrives at ACFCD Drop Structure, all of the flow at ACFCD Drop Structure shall be bypassed. No water will be released from storage to meet bypass flow requirements." (NMFS 2017, pg. 21) In the BiOp, the BART Weir is referred to as the ACFCD Drop Structure, which is located between RD1 and the transition pool of the RD1 and BART Weir fish passage facility.

On 5 September 2023, ACWD complied with BiOp requirements, specifically by not diverting water off-stream and bypassing all the flow reaching the BART Weir. However, with only about 11 cfs at the Niles gage, stream losses between the Niles gage and the RD1 and BART Weir fish passage facility ranging between approximately 5 to 6 cfs, and decreasing storage in the RD1 impoundment, the overnight flow through the RD1 and BART Weir fish passage facility gradually decreased, resulting in less than the target 5 cfs reaching the Sequoia gage bypass compliance point. On the morning of 5 September 2023, ACWD increased the valve opening of the low-flow weir to release additional water from storage to bolster downstream flows despite the BiOp specifically not requiring this to meet targets[2].

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[2] "If less than 5 cfs arrives at [ACFCD] Drop Structure, all of the flow at [ACFCD] Drop Structure shall be bypassed. **No water will be released from storage to meet bypass flow requirements** (emphasis added)." (NMFS, 2017, pg. 21)

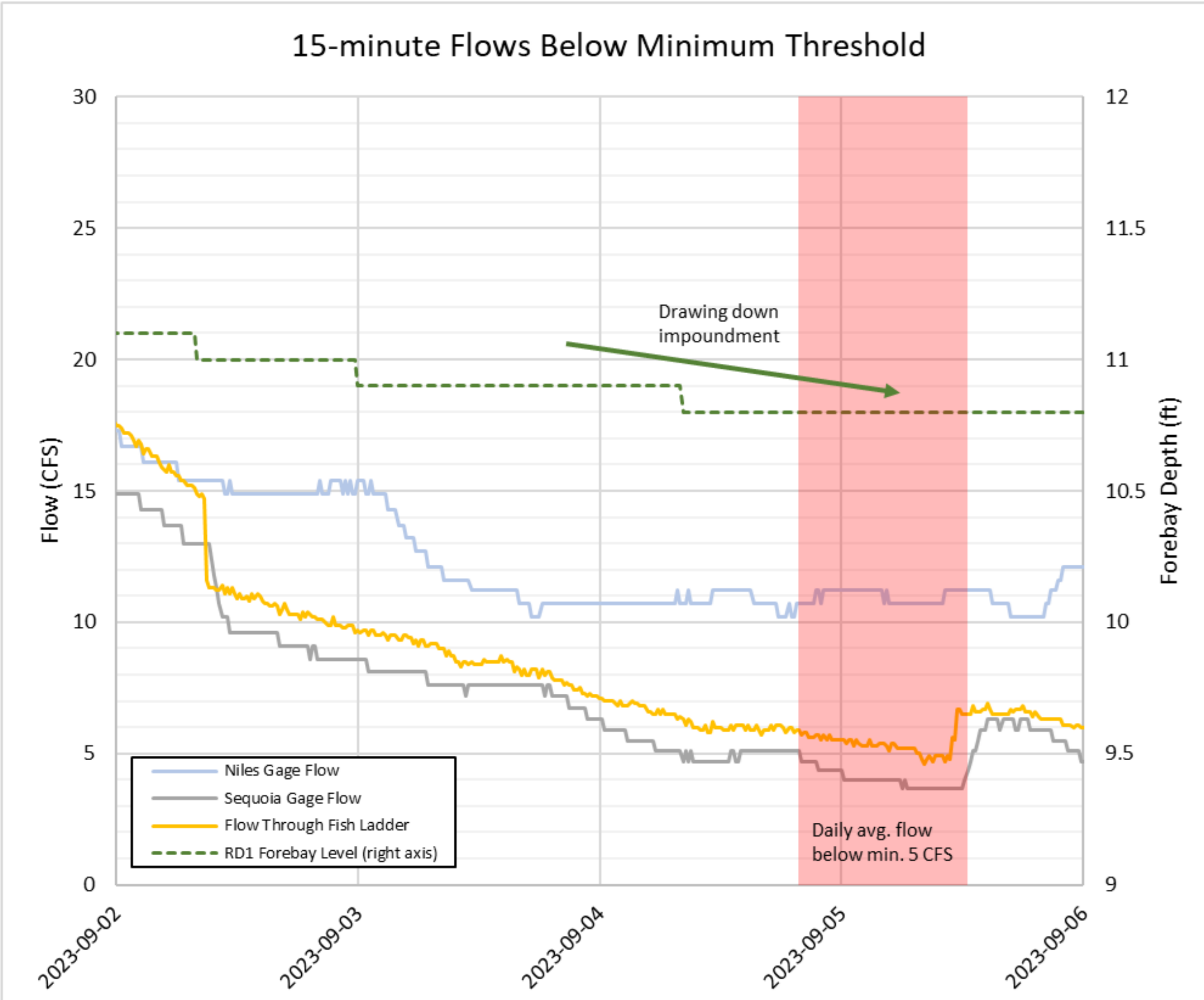

Figure 3.5: Granular Analysis. Highlighting the one day in which summer bypass flows were below the target flow of 5 cfs due to prevailing low flows at the USGS Alameda C NR Fremont CA - (11179000). Note that during this time the RD1 impoundment was dropping, and therefore no additions to storage were made at this time.

3.3. STREAM FLOWS AT NILES GAGE AND AT THE SEQUOIA GAGE

The upstream and downstream gages used for bypass flow compliance, Niles and Sequoia gages respectively, will differ in flows based on three main factors:

- ACWD's capture of water for off-stream diversions.
- Direct inflows between the gages from small tributaries and urban stormwater drains.
- Instream losses.

Direct inflows between the gages typically only happen during storm events and often overlap with periods of deflated dams and no off-stream diversions, with little consequence for ACWD in meeting bypass flow requirements. Instream losses between gages range from approximately 5 to 18 cfs and are more pronounced during depleted groundwater conditions or periods of drought and low stream flow. As observed during the late summer of 2023, instream losses can be significant enough to reduce Alameda Creek flows to below the minimum bypass target of 5 cfs.

3.3.1. Flow in RD3 and RD1 and BART Weir Fish Passage Facilities

When RD3 is inflated, flows through the RD3 fish passage facility generally range between 24 cfs and 45 cfs during the immigration season. If there is more than 45 cfs arriving at RD3 during the immigration season, excess flows will overtop RD3. In the emigration season, the RD3 fish passage facility juvenile spillway can be used to augment flows to provide up to approximately 150 cfs through the ladder. If there is more than 150 cfs arriving at RD3 in the emigration season, excess flows will overtop RD3. The RD3 foundation was modified to include a plunge pool downstream of RD3, and if RD1 is inflated, the plunge pool will be backwatered by the impoundment caused by RD1.

During the reporting period, RD3 fish passage facility operation was limited. RD3 ruptured in January 2023 and was partially repaired in fall of 2023. After repairs were completed, RD3 was operated more conservatively: the dam was operated at a lower bag pressure, was deflated during relatively smaller storm runoff events, and remained deflated for longer periods of time during the reporting period. During the immigration season, the impoundment level at RD1 was maximized whenever possible during periods when RD3 remained deflated, to provide increased depth of flow over the deflated RD3 bladder. When RD3 was deflated during the immigration season, ACWD Water Supply staff conducted additional daily monitoring in the vicinity of RD3, and staff observed no evidence of adverse impacts to immigration when RD3 was

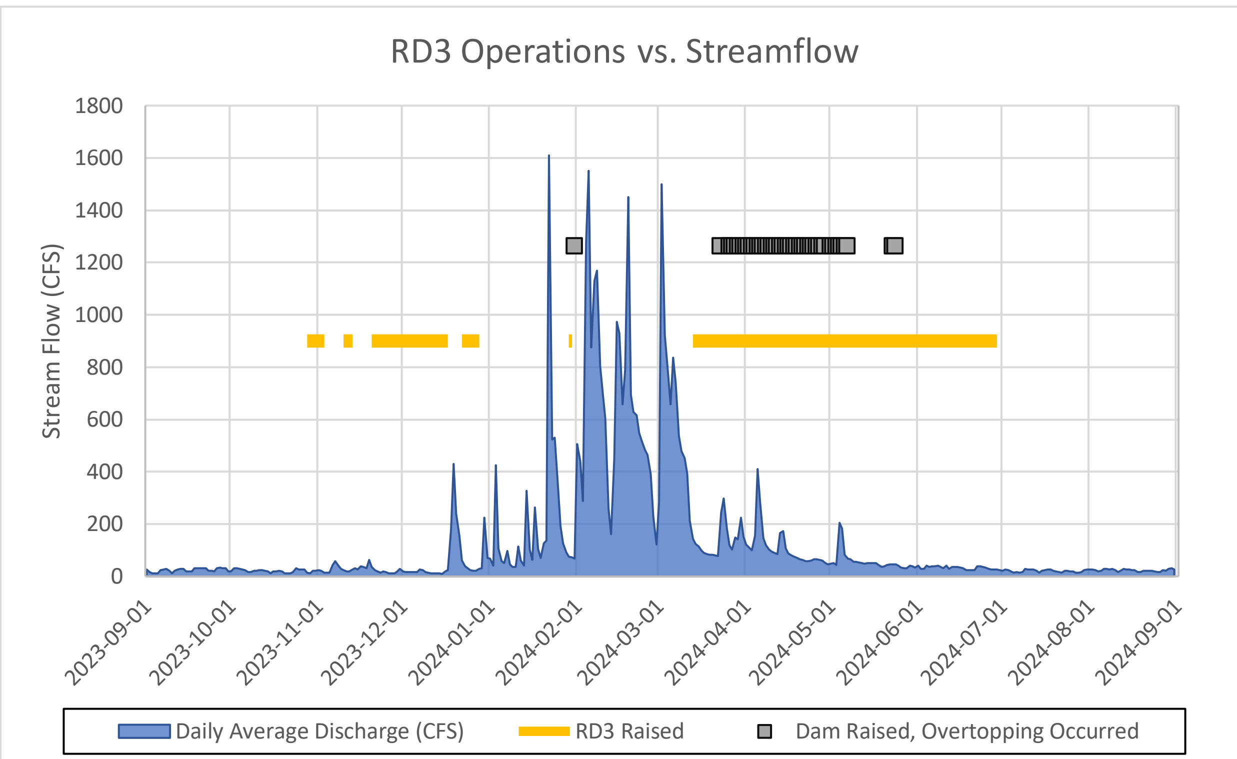

Figure 3.6: Stream flows measured at Niles gage. Graph shows periods where RD3 was inflated, and where RD3 overtopped while inflated.

deflated. There were four separate periods of relatively higher flows that required deflation of RD3 (see Figure 3.6). The RD3 fish passage facility was operated and passable on 30 January 2024, and again from 13 March through 30 June 2024. Flows were overtopping RD3 in late January for one day, and for a relatively extended period from late March to late May 2024 (see Figure 3.6).

When RD1 is inflated, flows through the RD1 and BART Weir fish passage facility generally range between 24 cfs and 45 cfs during the immigration season. Using the auxiliary bypass pipeline allows up to an additional 30 cfs to flow directly from the forebay to the entrance pool, thus providing for up to 75 cfs through the entrance gate of the vertical slot fish ladder. If there is more than 75 cfs arriving at RD1 during the immigration season, excess flows will overtop RD1. In the emigration season, the RD1 juvenile spillway will provide up to approximately 150 cfs through the ladder. If there is more than 150 cfs arriving at RD1 in the emigration season, excess flows will overtop RD1. Along with construction of the RD1 and BART Weir fish passage facility, the RD1 foundation was modified to include a plunge pool downstream of RD1.

During the reporting period, water overtopped RD1 when flows arriving at RD1 were greater than 45 cfs and less than about 1,200 cfs. At flow exceeding about 1,200 cfs, ACWD Water Supply staff deflate RD1. Refer to the Compliance Report in Appendix A for daily estimates of flows overtopping RD1. In general, flows overtopped RD1 for much of the time from mid-January to late March 2024. There were a few days of overtopping in May, after a small storm event, and again in July when the dam was partially inflated. The juvenile spillway was operational during two days in April 2024. Refer to Figure 3.7 for a graphical representation of stream flows and RD1 operations.

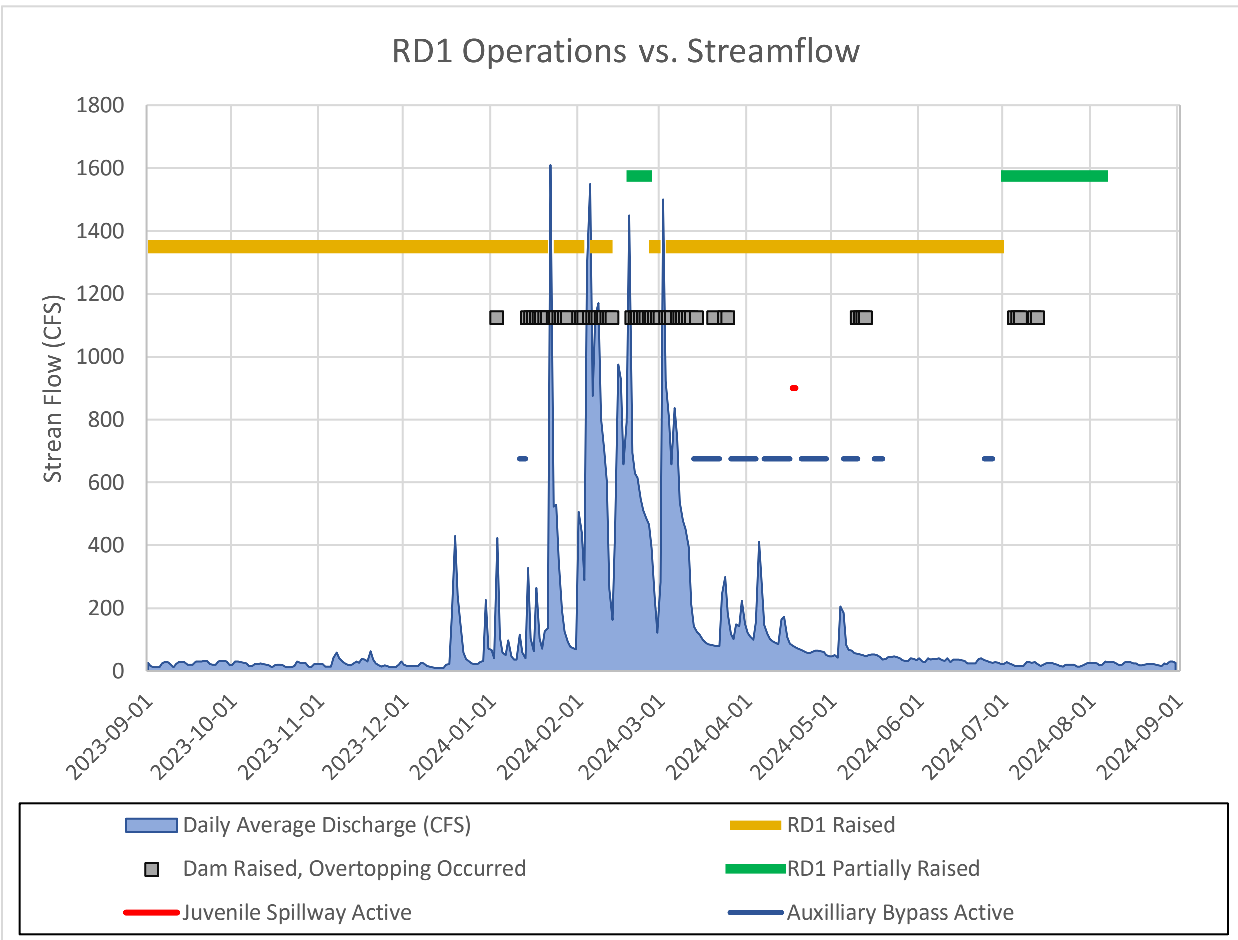

Figure 3.7: Stream flows measured at Niles gage. Graph shows periods where RD1 was fully inflated, partially inflated, where overtopping occurred while fully or partially inflated, and where the auxiliary and juvenile systems were active.

The percentage of creek flow that passed through the RD1 vertical slot fish ladder and associated biological monitoring equipment fluctuated substantially (refer to Figure 3.8). A larger portion of flow was exposed to the biological monitoring equipment during emigration rather than during immigration. In Figure 3.8, periods where the fish ladder flow as a percentage of channel total flow is higher than 100% are indicative of percolation losses in Alameda Creek between the RD1 and BART Weir fish passage facility and Sequoia gage, particularly later in the year.

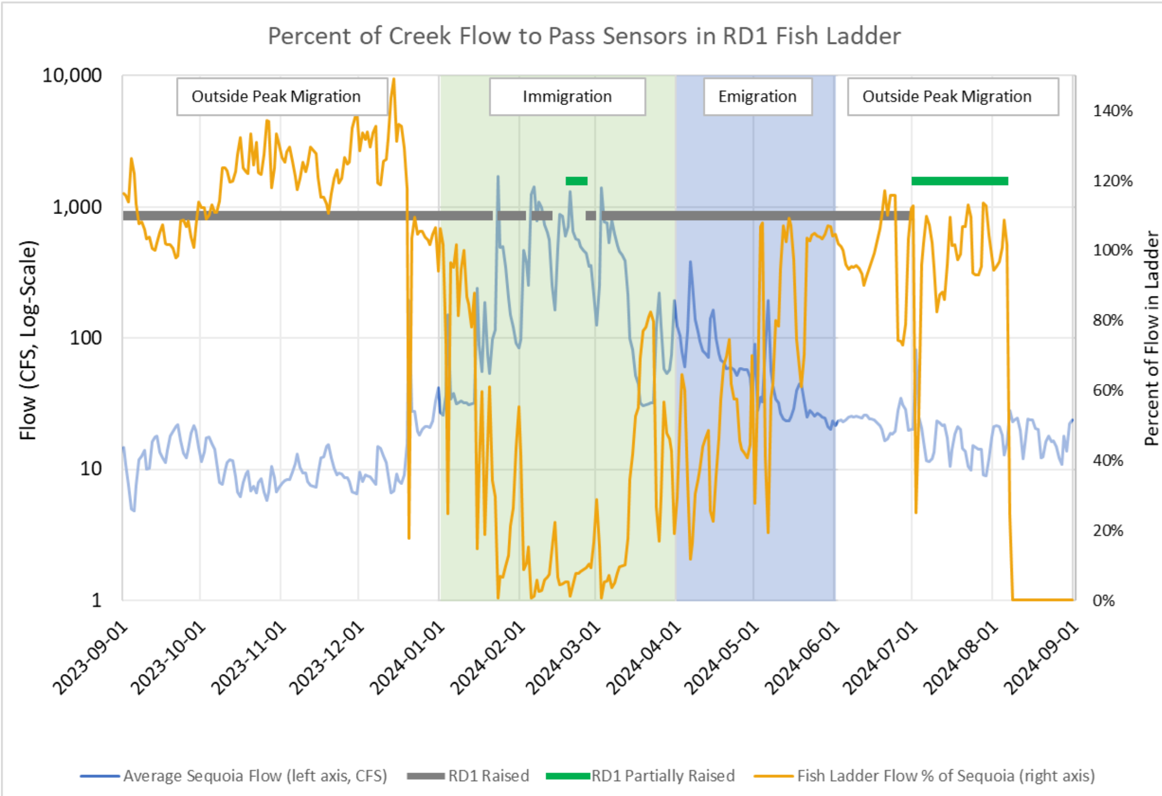

Figure 3.8: Fish ladder flow as a percentage of channel total as measured at Sequoia Gage, 1 September 2023 through 31 August 2024.

Low Flow Passage Conditions

While “low flow” has different meanings in other contexts, for RD1 and BART Weir fish passage facility operations, low flow passage conditions during the emigration season are understood to be flows through the fish passage facility of less than 15 cfs; at this threshold the juvenile spillway is not used, and the low flow gate is operated instead. In the reporting period, required daily bypass targets fell below 15 cfs on 13 May 2024. The low flow gate was used during two days in May 2024.

RD3 fish passage facility operations under low flow conditions are less sophisticated than the RD1 and BART Weir fish passage facility, as there is no low flow gate. Flows under 15 cfs simply pass through the appropriate exit gate, selected based on the RD3 impoundment elevation. During the reporting period, the RD3 fish passage facility was not operational during low flow passage conditions. During the emigration season, emigration passage was provided as all inflows either passed through the RD3 fish passage facility or overtopped RD3.

4. BIOLOGICAL MONITORING

4.1. PREDATOR/MILLING SURVEYS

4.1.1. Background

Fish passage facilities at migration barriers support access to and from vital upstream habitats for migratory species, such as *O. mykiss*. However, measuring and ensuring their effectiveness can be challenging. A lack of real-time monitoring and adaptive management limits flexibility in accommodating multiple species' needs in dynamic environments. Real-time data allows for timely adjustments to align operations with changing migratory patterns and environmental conditions. Additionally, factors including water temperature, flow, and predator presence all influence fish passage success, underscoring the need for ongoing monitoring and tailored facility management (Beeman and Adams 2015; NMFS 2017).

Anthropogenic changes to aquatic communities result both from introducing non-native species, especially predators, and from profound environmental changes that create areas of high mortality (Koed et al., 2002). Notably among the latter category are man-made reservoirs, which generally give rise to new ecosystems (Baxter 1977) with distinct biota, structures, and functions (Agostinho et al. 2008) that have a clear impact on predator-prey relationships (Petersen 1994; Agostinho et al. 2012). Therefore, surveys of migratory species and their potential predators at fish passage facilities provide valuable information on the efficiency and effectiveness of these structures and may identify possible design flaws or operational issues (Roscoe and Hinch 2010). By monitoring key indicators such as the presence and behavior of migratory species and predators, surveyors may document how these organisms interact with the infrastructure and document successes and areas of concern. For example, if large numbers of migratory fish species are observed resting in designated refuge areas, it may indicate that the habitat is suitable, and the passage design is functioning effectively. Conversely, behaviors such as disorientation, circling, passage failure or fallback, or milling in non-designated areas may signal potential design flaws. Predator behavior, including congregation near the facilities, is also a critical observation, as predators may target migratory species attempting to pass (Sabal et al. 2016). Adaptive management approaches may be implemented to address concerning behaviors, enabling timely adjustments to facility design or operation. Therefore, consistently monitoring migratory fish species behavior and those of their competitors and predators, is necessary to understand and optimize passage facility function (Kynard 1993).

Regular surveys reveal seasonal, species-specific patterns in migratory fish and predator behavior (Williams et al. 2003). Important seasonal behaviors include migration timing, orientation, swimming, schooling, and responses to water quality, competition, predation, and physical factors (e.g., illumination, sound, water depth, water velocity, and structure). Documenting these behaviors in real time can inform passage facility operations, allowing adjustments to better meet species' migratory needs. Additionally, monitoring for human disturbance is important for adapting operations and minimizing impacts on fish passage. Activities like construction, noise, and poaching can disrupt fish behavior, affecting their ability to navigate passage facilities (Braun 2015). Understanding these impacts can inform operation adjustments, such as limiting human activities during key migratory periods, to reduce conflicts and improve passage success.

Therefore, ACWD conducted surveys to document visual observations of predators, migratory species, human activities, and environmental conditions in and around the Project to assess how these potential migratory stressors might influence passage success of target species. This section summarizes the methods used to collect, process, and analyze data associated with these observations, and the results of those analyses.

4.1.2. Study Area

The study area for predator and milling surveys includes a total of ten sites, with seven sites located near the RD1 and BART Weir fish passage facility and three sites located near the RD3 fish passage facility (features 3 and 12 in Figure 1.2, respectively). From downstream to upstream, the seven sites associated with the RD1 and BART Weir fish passage facility include: "Sequoia Bridge to RD1", "Lower Fish Ladder", "BART Pool", "Transition Pool and Dragon's Teeth", "RD1 Fish Ladder and Plunge Pool", "RD1 Impoundment", and "Fish Screens". The three sites associated with the RD3 fish passage facility include: "RD3 Fish Ladder and Plunge Pool", "RD3 Impoundment", and "Bunting Fish Screens". Observations were categorized broadly into the RD1 and BART Weir and RD3 fish passage facilities for analysis.

4.1.3. Methods

CFS designed a protocol for ACWD Water Supply staff to conduct daily field surveys at each site and implement a combination of visual techniques to quantify and document observations of potential predators, migratory species, human activities, and environmental conditions within the study area. Visual surveys were conducted to observe and document presence, signs (e.g., tracks, nests, or other presence indicators), and behaviors exhibited by both potential predators and migratory species in the study area. Predator observations included any bird, fish, or mammal capable of preying on identified migratory species. Migratory species observations included *O. mykiss* (both live individuals and carcasses), Chinook Salmon, and Pacific Lamprey. To enhance species identification and documentation, survey teams were equipped with cameras, field guides, and binoculars. Supplementary surveys were also conducted every one to two weeks by a biologist from WRA Environmental Consultants to aid with species identification and training.

During each survey, additional visual data were collected. This included the monitoring of angling activities, as well as the observation of any concurrent construction and ladder operations. These supplementary observations support a comprehensive overview of human activities within the study area, potentially affecting the local wildlife focusing on migration success of target fish species.

Data were summarized, plotted, and qualitatively compared to mean daily flows, water temperature, and turbidity to determine whether there could be potential relationships between target species, predators, and environmental factors in the Alameda Creek Flood Control Channel.

ACWD launched a website in August 2024 for community members to upload photographs of fish and wildlife observed in and around Alameda Creek. New signage with “Quick Response” (QR) codes to access the website have been posted throughout the watershed. This new process will improve the standardization and quality assurance of data shared with ACWD and will strengthen qualitative surveys conducted during future monitoring years by ACWD staff, watershed interested parties and the local community. A summary of these photographs will be included in future reports.

4.1.4. Results

A total of 405 and 394 surveys were conducted at the RD1 and BART Weir and RD3 fish passage facilities between 1 September 2023 and 31 August 2024, respectively (Table 4.1). Surveys were carried out consistently throughout the monitoring period. Target species were observed in 10 (2%) and one (<1%) of the surveys conducted at the RD1 and BART Weir and RD3 fish passage facilities, respectively, while potential predators were observed in 242 (60%) and 186 (47%) of the surveys.

Table 4.1: Total number of surveys conducted at the RD1 and BART Weir and RD3 fish passage facilities and number of surveys with target species and potential predator observations from 1 September 2023 to 31 August 2024.

Facility	Number of Surveys	Surveys With Target Species Observations	Surveys With Potential Predator Observations
RD1	405	10	242
RD3	394	1	186

Target species observed included *O. mykiss* and Chinook Salmon (Figure 4.1). Most *O. mykiss* observations occurred in early July when the RD1 impoundment was lowered for routine maintenance scheduled for summer 2024. A total of three *O. mykiss* carcasses were observed and collected downstream of the RD1 fish ladder following stranding events throughout the migration period (see Section 4.2 for details). NMFS and CDFW were notified by ACWD immediately following all *O. mykiss* stranding events and carcass recoveries. Three *O. mykiss* estimated to be around 100 to 200 mm in length were observed by ACWD and WRA staff in the plunge pool downstream of RD1 on 22 March after it had become isolated, while two other live *O. mykiss* were observed by ACWD and WRA staff at the upstream exit of the RD1 fish ladder on 2 May. An observation of several adult Chinook Salmon was recorded near the RD1 fish ladder on 19 November; however, photos of these fish were not collected so their identification could not be confirmed. One additional Chinook Salmon observation was made in the RD1 fish ladder on 18 December when it was dewatered.

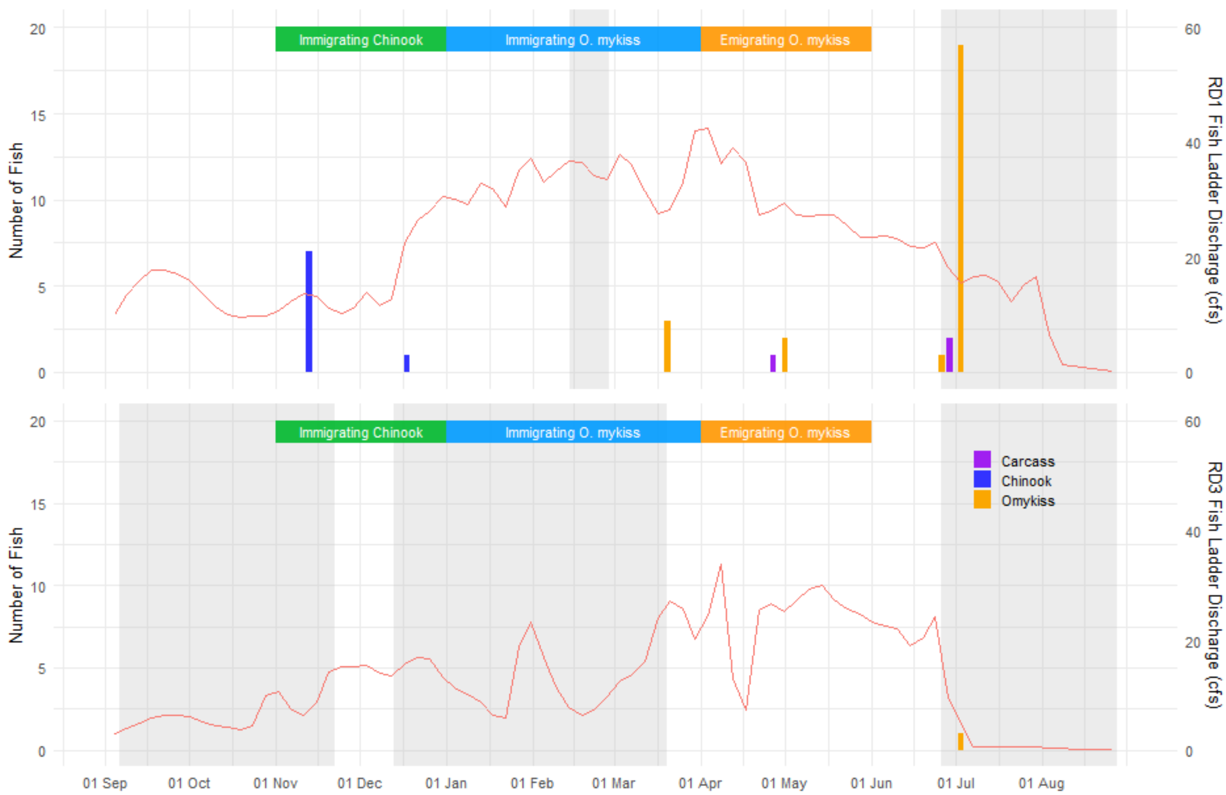

Figure 4.1: Number of target species visually observed at the RD1 and BART Weir (top) and RD3 (bottom) fish passage facilities. Gray areas indicate weeks where dams were deflated. Discharge in each fish ladder was calculated as the mean weekly value recorded by ACWD. Though not highlighted here, juvenile Chinook Salmon are expected to be emigrating through the Alameda Creek Flood Control Channel from February through May. Migration timing for immigrating and emigrating Chinook Salmon and O. mykiss are assumed from the Project's BiOp (NMFS 2017) and the literature (e.g., Moyle 2002).

Potential predators observed at the RD1 and BART Weir and RD3 fish passage facilities from 1 September 2023 to 31 August 2024 included avian, fish, and mammal species (Table 4.2; Figure 4.2). Potential avian predators were observed consistently throughout the monitoring period, with the majority occurring in October and November before the assumed *O. mykiss* migration period (1 January - 31 May). The most common potential avian species included merganser (*Mergus* spp), cormorants (*Nannopterum* spp), Great Egret (*Ardea alba*), Snowy Egret (*Egretta thula*), and Brown Pelican (*Pelecanus occidentalis*). Potential fish predators included black bass (*Micropterus* spp) and Sacramento Pikeminnow (*Ptychocheilus grandis*). Most of the predatory fish were observed in early July when the RD1 impoundment was lowered for routine maintenance scheduled for summer 2024. Potential mammalian predators included North American River Otter (*Lontra canadensi*) and Coyote (*Canis latrans*). Though not included in counts of potential predator observations, turtles, Turkey Vultures (*Cathartes aura*), and avians of unknown species were also observed at the facilities. There were also 23 and 5 signs of predators observed at the RD1 and BART Weir and RD3 fish passage facilities, respectively.

Table 4.2: Number of potential predators visually observed at the RD1 and RD3 fish passage facilities from 1 September 2023 to 31 August 2024. Migrating timing for immigrating and emigrating Chinook Salmon and O. mykiss are assumed from the Project's BiOp (NMFS 2017) and the literature (Moyle 2002).

Facility	Group	Species	Before Immigrating Chinook (Sep – Oct)	Immigrating Chinook Salmon (Nov – Dec)	Immigration *O. mykiss* (Jan – Mar)	Emigrating *O. mykiss* (Apr – May)	After Emigrating *O. mykiss* (Jun – Aug)
RD1	Avian	Black-crowned Night heron	2	0	0	0	0
		Brown Pelican	26	21	0	0	0
		Cormorant	247	36	10	6	15
		Bald Eagle	0	1	1	0	7
		Great Blue Heron	23	18	22	4	6
		Great Egret	44	64	38	3	53
		Green Heron	0	4	0	1	3
		Belted Kingfisher	1	1	1	0	0
		Merganser	154	75	39	37	59
		Osprey	1	0	0	0	0
		Snowy Egret	2	3	91	7	11
		Tern	20	1	2	0	0
		Unknown Ardeidae	62	93	42	0	0
	Fish	Black Bass	23	4	2	8	184
		Sacramento Pikeminnow	0	1	0	0	72
	Mammal	Coyote	0	0	0	0	1
		North American River Otter	1	0	2	0	0
RD3	Avian	Black-crowned Night heron	1	1	0	0	0
		Brown Pelican	45	0	0	1	0
		Cormorant	197	50	4	12	10
		Bald Eagle	0	1	0	0	2
		Great Blue Heron	3	2	1	0	1
		Great Egret	25	11	18	0	57
		Merganser	142	38	14	12	18
		Red-tailed Hawk	0	0	1	0	0
		Snowy Egret	3	15	45	7	12
		Tern	38	6	2	0	0
		Unknown Ardeidae	119	119	21	0	0
	Fish	Black Bass	0	0	0	0	3
		Sacramento Pikeminnow	0	0	0	0	2

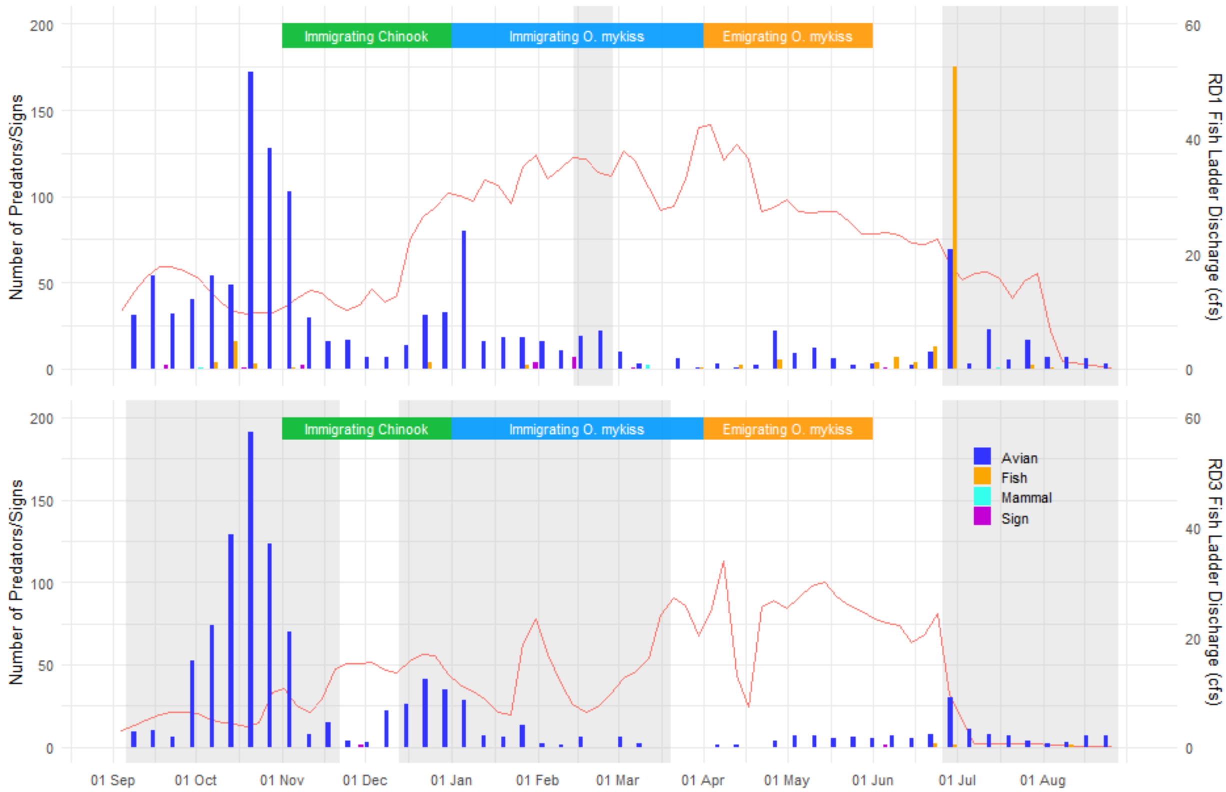

Figure 4.2: Number of potential predators visually observed at the RD1 and BART Weir (top) and RD3 (bottom) fish passage facilities. Gray areas indicate weeks where dams were deflated. Discharge in each fish ladder was calculated as the mean weekly value recorded by ACWD. Though not highlighted here, juvenile Chinook Salmon are expected to be emigrating through the Alameda Creek Flood Control Channel from February through May. Migration timing for immigrating and emigrating Chinook Salmon and O. mykiss are assumed from the Project's BiOp (NMFS 2017) and the literature (Moyle 2002).

Angling and construction activity were also observed during this time, but outside of the assumed *O. mykiss* migration period (1 January - 31 May). Fishing line was found on the bank near the RD1 and BART Weir fish passage facility in late December 2023, and an angler was observed near the RD3 fish passage facilities in late July 2024. Construction activity included debris removal at both facilities and maintenance of the RD3 dam in October through December 2023 and in August 2024. The Project's BiOp permits the Districts routine maintenance of the fish passage facilities which includes fish screens, diversions, fish ladders, drop structures, and associated equipment within Alameda Creek, so long as measures are employed to avoid and minimize the potential effects of maintenance activities on *O. mykiss* and water quality (NMFS 2017). These measures include actions to isolate work sites from the flowing waters of Alameda Creek, scheduling maintenance activities between 1 June and 31 October when *O. mykiss* are assumed to not be present at work sites, and regular notification and coordination with NMFS and CDFW staff.

4.2. STRANDING SURVEYS

4.2.1. Background

Unexpected fish behaviors (e.g., fish stranding) may result from certain "trigger" events associated with facility operations and/or flows in the Alameda Creek Flood Control Channel, particularly during the assumed *O. mykiss* migration period (1 January - 31 May). For example, any time the RD1 or RD3 fish ladders are taken offline for any reason, native and nonnative fish species may become temporarily stranded within the ladder. Additionally, the naturally flashy hydrograph of the Alameda Creek Watershed may cause situations that could lead to temporary fish stranding downstream of either dam.

To test whether specific triggers are more or less likely to cause fish stranding, ACWD conducted surveys during potential trigger events throughout the 2024 *O. mykiss migration period*. This section summarizes the methods used to collect, process, and analyze data associated with these potential trigger events and associated stranding surveys, and the results of those analyses.

4.2.2. Methods

Stranding surveys were conducted year-round starting in January 2024 anytime one of nine potential trigger events occurred (Table 4.3). Stranding surveys included a visual assessment of the associated area of concern for a given trigger event. Information recorded during the survey included the trigger code, date and time of the survey, ACWD staff conducting the survey, and whether stranded fish were observed. If stranded fish were observed during the survey, ACWD Water Supply staff would immediately notify CFS biologists. Photographs of stranded fish were recorded for documentation and to confirm species identification. Stranding results were then plotted and summarized by trigger code.

Table 4.3: Criteria and areas of concern associated with each potential trigger event

Code	Criteria	Areas of Concern
1	Transition pool WSE drops below level of concrete sill (37 ft)	Newly exposed infrastructure including dragon's teeth, rip rap, concrete sill, and adjacent structures
2	RD1 dam is inflated AND flows stop overtopping RD1 dam	Plunge pools below RD1 dam, newly exposed structures
3	Alameda Creek flows at Niles gage fall below 22 cfs	Potential isolated pools throughout Alameda Creek Flood Control Channel
4	Alameda Creek flows at Niles gage fall below 5 cfs	Potential isolated pools throughout Alameda Creek Flood Control Channel
5	RD1 fish ladder is dewatered	RD1 fish ladder
6	RD1 dam is inflated or deflated	Above and below RD1 dam, including plunge pools and sills
7	RD3 dam is inflated AND flows stop overtopping RD3 dam AND RD1 impoundment WSE is less than 53 ft	Plunge pools below RD3 dam, newly exposed structures
8	RD3 fish ladder is dewatered	RD3 fish ladder
9	RD3 dam is inflated or deflated	Above and below RD3 dam, including plunge pools and sills

4.2.3. Results

There were 21 stranding surveys completed at the RD1 and RD3 fish passage facilities between 4 January and 2 July 2024 (Table 4.4, Figure 4.3). At both sites, surveys were primarily triggered by operational changes (e.g., inflating/deflating dams, dewatering fish ladders) or reduced flows overtopping the dams. Three surveys were conducted at the RD3 fish passage facility, with all three triggers related to dewatering the fish ladder (trigger code 8) and/or inflating/deflating the dam (trigger code 9). No stranded fish were observed in any of the surveys conducted at the RD3 fish passage facility. The other 18 surveys were conducted at the RD1 and BART Weir fish passage facility, with eight surveys triggered by reduced flows overtopping the dam (trigger code 2), seven triggered by dewatering the fish ladder (trigger code 5), and three triggered by inflating/deflating the dam (trigger code 6). One stranded black bass was observed in late April during one of the eight surveys triggered by reduced flow overtopping the dam. No stranded fish were observed in the three surveys triggered by inflating/deflating the dam. Seven *O. mykiss*, one Pacific Lamprey, and two black bass were observed stranded in the RD1 fish ladder after it was dewatered (trigger code 5; Figure 4.4). Fish stranded in the RD1 fish ladder were "flushed" downstream, either by turning the ladder back on or by emptying buckets of water into the ladder from the grated walkway above. Three *O. mykiss* carcasses were observed and collected downstream of the RD1 fish ladder following stranding events. The three carcasses were scanned for but were not implanted with PIT tags. NMFS and CDFW were notified by ACWD immediately following all *O. mykiss* stranding events and carcass recoveries.

Though not recorded during a stranding survey and therefore not included in Table 4.4 or Figure 4.3, three additional *O. mykiss* were observed by ACWD and WRA staff during a predator/milling survey in the plunge pool downstream of RD1 on 22 March after it had become isolated (see Section 4.1.4 for details). These three *O. mykiss* and the seven observed during stranding surveys resulted in a total of 10 stranded *O. mykiss* observed between 4 January and 2 July 2024.

Table 4.4: Number and species of fish stranded by trigger code. Details regarding trigger codes and be found in Table 4.3.

Facility	Trigger Code	Number of Surveys	Number of Stranded Fish	Stranded Species
RD1	2	8	1	Black bass
	5	7	10	*O. mykiss*, Pacific Lamprey, black bass
	6	3	0	None
RD3	8/9	3	0	None

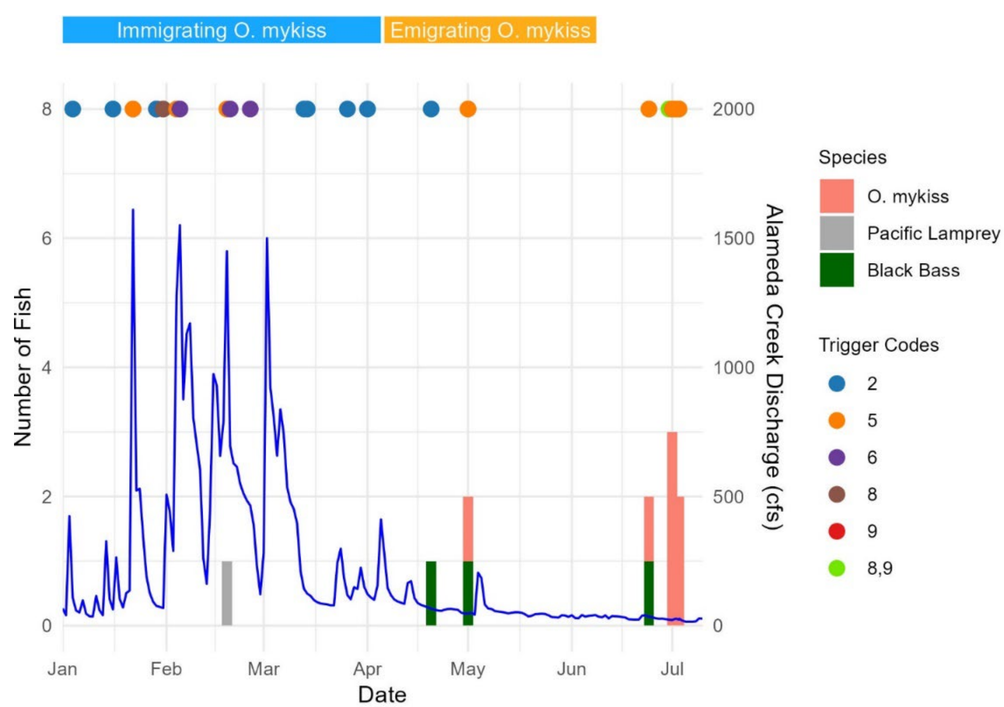

Figure 4.3: Stranding survey results from 1 January through 10 July 2024. Alameda Creek flows measured at the USGS Alameda C NR Fremont CA (11179100) stream gage. Daily counts of species are stacked.

Figure 4.4: O. mykiss temporarily stranded in the RD1 fish ladder on 1 July 2024.

4.3. ARIS SONAR

4.3.1. Background

Using imaging sonar has become an increasingly popular method for passively monitoring aquatic species given its ability to produce near-video-quality images of organisms without being limited by water clarity or light-related visibility constraints (Munnelly et al. 2024). Given these advantages, it was determined after consultation with and approval by NMFS and CDFW that an adaptive resolution imaging sonar (ARIS) Explorer 3000 (Sound Metrics Corp.) would be used to passively monitor *O. mykiss* and other fish species passing through the RD1 fish ladder (NMFS 2017). This section summarizes the methods used to collect, process, and analyze ARIS data collected during the 2024 *O. mykiss* migration period and the results of those analyses.

4.3.2. Methods

Data Collection, Processing, and Analysis

After the annual, regular maintenance was complete, the ARIS unit was re-installed on 27 November 2023 in preparation for the 2024 *O. mykiss* migration period and recorded data continuously from 28 December 2023 to 23 June 2024. The unit was set up to record 1-hour ARIS files to an external hard drive connected to a nearby desktop computer. External hard drives with recorded ARIS files were swapped with empty hard drives on a semi-regular basis (i.e., every one-to-two weeks), backed up to the cloud by ACWD Water Supply staff, and then sent to CFS in West Sacramento to be stored on a master hard drive and processed.

ARIS files were processed by CFS using two methods. Files were first processed using the hydroacoustic data processing computer program Echoview (Echoview Software Pty Ltd; Version 14.0.213). To do this, CFS developed and tested a set of processing steps (i.e., workflow) in Echoview that balanced processing accuracy (i.e., being able to identify, track, and measure individual fish) with processing speed. The final Echoview workflow, including what the operators used and their descriptions, can be found in Table 4.5.

Table 4.5: Echoview workflow describing operators used to semi-autonomously process ARIS files.

Operator	Description
Multibeam Background Removal	Calculates a statistic from a window of frames around an individual frame. The statistic captures the static background elements present in the data. With a minimum signal-to-noise ratio (SNR) value as a threshold, the algorithm then subtracts that background statistic from the individual frame, leaving the data without the static background. Parameters used were window size = 41 frames and minimum SNR = 8.5 dB.
XxYxZ Statistic	Calculates and applies an XxYxZ (row, column, frame) statistic filter to remove noisy data. This operator was used twice using a 5-row x 5-column x 1-frame window. The first operator calculated a 95th percentile within the window while the second operator calculated the mean.
Beam Opening	Applies a 3-row x 3-column x 1-frame window to fill in small spaces within data points (i.e., fish or other objects) that may have been removed during noise removal.
3x3 Convolution	Smooths data points to more accurately capture the shape of the object.
Multibeam Target Detection	Generates targets from groups of adjoining data points. Parameters used were seed threshold = 40 cm^2, link distance = 10 cm, and satellite cluster linking enabled.
Target Property Threshold	Targets with a width <2 cm were filtered out to remove reverberation and noise from the data.

Once processed in Echoview, dozens of metrics were exported for each identified target, including length, width, perimeter, area, orientation, echo intensity, etc. However, because Echoview cannot easily distinguish between fish and other moving objects (e.g., bubbles, debris), additional post-processing was needed to classify targets identified in Echoview as actual fish versus other objects. Given that the most commonly observed non-fish object identified in the ARIS files were groups of bubbles in the downstream corner of the fish ladder, an additional post-processing step was needed to filter these targets from the dataset. To do this, a subset of exported Echoview outputs were manually compared against raw ARIS files and classified as either fish or bubbles. The resulting dataset of 376 targets manually classified as fish and 253 classified as bubbles and their associated metrics exported from Echoview were then used to develop a Random Forest (RF) model using the "randomForest" package in R (Liaw and Wiener 2002; R Core Team 2024) to determine the probability that each target was either a fish or group of bubbles. The resulting RF model incorporated the mean, max, and variance of 11 Echoview metrics. The most significant variables used in the model were "Target range" (distance from the sonar unit to the centroid of a target), "Target orientation" (angle between the target's central axis and line perpendicular to sonar), and "Target intensity variation", (standard deviation of the intensity of samples within the target divided by their mean). Overall, the RF model had an accuracy greater than 90% with relatively symmetric misclassifications.

The entire process was then semi-automated using a set of Python and R computer programming scripts that looped through all ARIS files stored in a given Windows folder and then determined the probability that each target identified in Echoview was a fish or group of bubbles. Targets with a ≥50% probability of being bubbles were removed from the dataset, while all other targets were classified as fish.

The five metrics summarized for each target identified in Echoview and classified as a fish by the RF model were date and time of observation, movement direction, length, and potential taxon and life stage. Echoview uses the cardinal direction (i.e., 0-360°) that the ARIS unit is pointed towards and the location of the first and last detection of a target to determine its movement direction (i.e., the overall direction it swam). Because the ARIS unit was pointed approximately 180° (i.e., due south) throughout the migration period and the upstream to downstream direction of this section of the fish ladder is approximately 200° (i.e., slightly southwest), movement directions from 110 to 290° were classified as downstream moving fish and movement directions from 0 to 110° and 290 to 360° as upstream moving fish.

Although Echoview estimates an average length for each target, it also provides an estimate of the target's length at every frame along its tracked route through the unit's field of view. Given that the estimated length of a target identified in Echoview can fluctuate along its track depending on image quality, it was determined that using a near-maximum estimated length for each fish identified in Echoview would be more accurate than the average estimated length. To decide which length measurement to use, the 90th, 95th, 99th, and maximum length of each fish were compared against manually reviewed lengths of the same fish. Identified fish recorded within the assumed *O. mykiss* migration period (1 January through 31 May) were then binned into possible *O. mykiss* life stages based on the time of year they were observed, size frequencies identified in the literature (Table 4.6; Moyle 2002; Williams 2006), and, for immigrating and emigrating adults, movement direction. We also provide a brief summary of fish observed in June, outside of the assumed *O. mykiss* migration period.

Table 4.6: Criteria used to determine possible O. mykiss life stage of fish images identified by Echoview. Adult-sized fish migrating downstream during the immigration period or upstream during the emigration period were assumed to be other species using the fish ladder.

Life Stage	Time	Size Range (cm)	Direction
Juvenile	Year round	3 - 10	Not applicable*
Smolt	Year round	10 - 41	Not applicable*
Adult (immigrating)	1 January - 31 March	≥ 41	Upstream
Adult (emigrating kelt)	1 April - 31 May	≥ 41	Downstream
NA	1 January - 31 March	≥ 41	Downstream
	1 April - 31 May	≥ 41	Upstream

** Though the direction of juvenile and smolt-sized fish observed by the ARIS was evaluated, it was not used to determine possible O. mykiss life stage given the possibility of movement in either direction by these life stages (Hayes et al. 2011).*

The second method used to process ARIS files was to review a subset of files manually. Stratified random sampling was used to select three ARIS files from each daily set of those processed by Echoview on odd dates during the assumed *O. mykiss* migration period (e.g., 1 January, 3 January, 5 January, etc.). To do this, daily sets of ARIS files were classified into three equal quantiles by total estimated fish counts (e.g., 8 files of "high" counts, 8 files of "medium" counts, and 8 files of "low" counts" for a given set of 24 1-hour files). A random file was then selected from each of the three percentile groups each day and manually reviewed by CFS staff.

Selected ARIS files were manually reviewed by first creating an echogram of the file using the computer program ARISFish (Sound Metrics Corp.). ARISFish echograms are a visual representation of an ARIS file where the unit's field of view is condensed into a single vertical line at each frame within the ARIS file (Figure 4.5). The y-axis of the echogram is the distance from the sonar unit, the x-axis represents time (i.e., frame number), and the grayscaled color represents intensity of the sound waves returning to the unit. Objects moving through the unit's field of view appear as "tracks" on the echogram (Figure 4.5). During the manual review process, tracks within the echogram were marked by reviewers and then clips of those tracks were reviewed in the video-like sonar imagery to determine whether the object was a fish and, if so, its length. Reviewers also provided quality score of 1-5 for each marked object depending on their confidence in the length measurement (Table 4.7).

In addition to the three random daily ARIS files, all ARIS files recorded in December and January were manually reviewed. These files were manually reviewed before it was confirmed that Echoview would be used to automate the review process for the 2024 migration period, and because of the possibility of observing immigrating adult Chinook Salmon during this time, which are easier to identify compared to other fish species observed in the fish ladder given their relatively large size.

Manually identified fish with quality scores of 2 or higher were then binned into possible *O. mykiss* life stages based on the time of year they were observed and size frequencies identified in the literature (Table 4.6); however, direction was not included in the classification of immigrating or emigrating adults. Total counts of fish images for the same set of ARIS files were then compared by size class (i.e., juvenile, smolt, and adult) between the Echoview and manual review datasets.

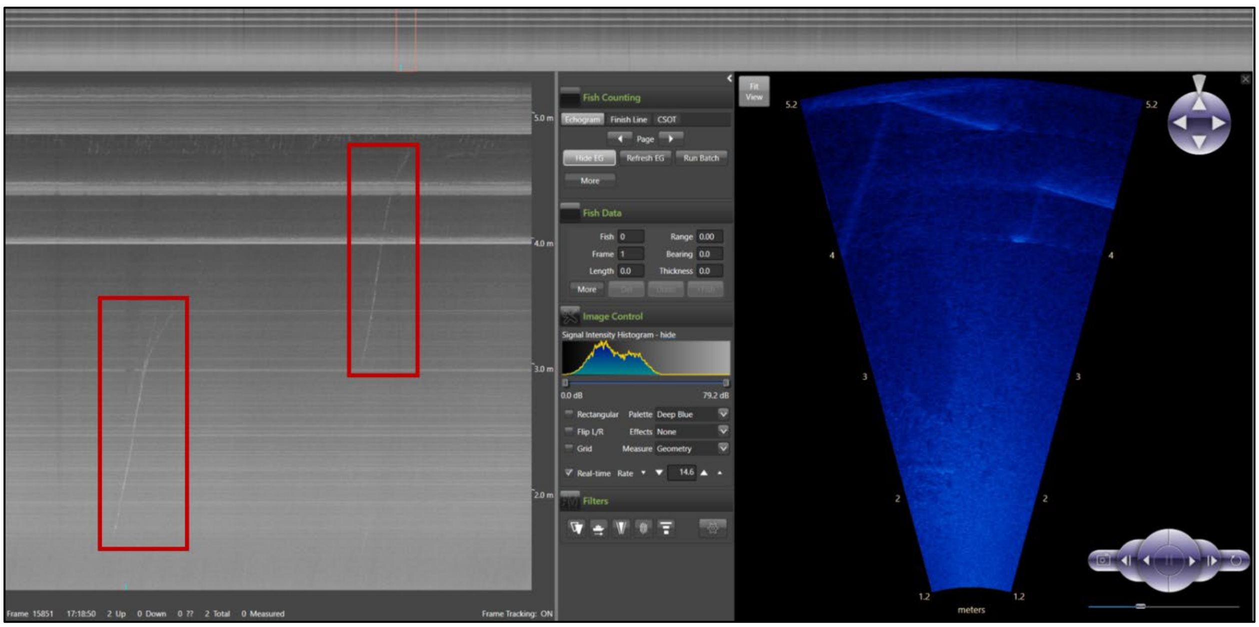

Figure 4.5: Screenshot of ARISFish computer program used for manually processing sonar imagery. A section of the ARIS file's echogram is shown on the left with fish "tracks" (red boxes), while the video-like sonar imagery of the same ARIS file is shown on the right.

Table 4.7: Descriptions of quality scores assigned to each object manually marked and measured in ARISFish by manual reviewers.

Quality Score	Description
1	100% confident object is a fish; 0% confident in length measurement (e.g., tail not visible, fish only partially enters field of view, school of small unmeasurable fish).
2	100% confident object is a fish; 1-49% confident in length measurement.
3	100% confident object is a fish; 50-74% confident in length measurement.
4	100% confident object is a fish; 75-99% confident in length measurement.
5	100% confident object is a fish; 100% confident in length measurement.

Equipment Performance

Several new methods were used in 2024 to monitor and evaluate ARIS unit performance and its image quality throughout the *O. mykiss* migration period. First, the computer program TeamViewer was installed on the RD1 desktop in early 2024, which allowed ACWD and CFS to regularly (i.e., every few days) log in to the desktop computer and ensure that the ARIS unit was operating, and that data were being recorded and saved to an external hard drive. Secondly, each ARIS file that was manually reviewed by CFS staff was assigned a quality score of 0 - 3 by the reviewer depending on the relative level of detail that could be seen in the imagery. Descriptions of these scores are detailed in Table 4.8 with an example of a high-quality score of 3 shown in Figure 4.6.

Table 4.8: Descriptions of image quality scores assigned to each manually reviewed ARIS file.

Quality Score	Description
0	All four fish ladder walls within the ARIS field of view are visible and sharply defined.
1	All four fish ladder walls within the ARIS field of view are visible but not all are sharply defined. The most downstream wall fades in and out of view.
2	Some but not all the fish ladder walls are visible or sharply defined.
3	None of the fish ladder walls are visible.

A second method was tested to quantitatively evaluate ARIS unit performance throughout the *O. mykiss* migration period. For a stationary ARIS unit with a static range and field of view, the maximum energy measurement of a fixed target within the field of view can be an indicator of variability of transmission loss due to acoustic scattering through the water between the unit and the target (Bill Hanot, Sound Metrics Corp., personal communication). Changes in the maximum energy level from the same target over time may therefore be an indicator of sonar image quality. To test this, the maximum energy level at the upstream point of the fish ladder wall was measured during the first few seconds of the first ARIS file recorded each day (Figure 4.6). These daily measurements were then compared to daily averages of the image quality scores assigned by manual reviewers discussed above to determine whether the two were related. Maximum energy levels were also compared to the mean daily flow and turbidity to determine whether there was a relationship between image quality and environmental factors.

Although sonar image quality was generally much better throughout the 2024 migration period compared to the previous year, the ARIS unit was briefly turned off and manually cleaned by ACWD on 17 April to prevent potential image quality issues due to biofouling and sediment accumulation within the unit. The unit, its rotator, and mount were all visually inspected and manually cleaned with water using an electric pressure washer. The ARIS unit was removed from the RD1 fish ladder on 23 June following the end of the assumed *O. mykiss* emigration period (May 31) and sent to Sound Metrics Corp. for annual routine maintenance.

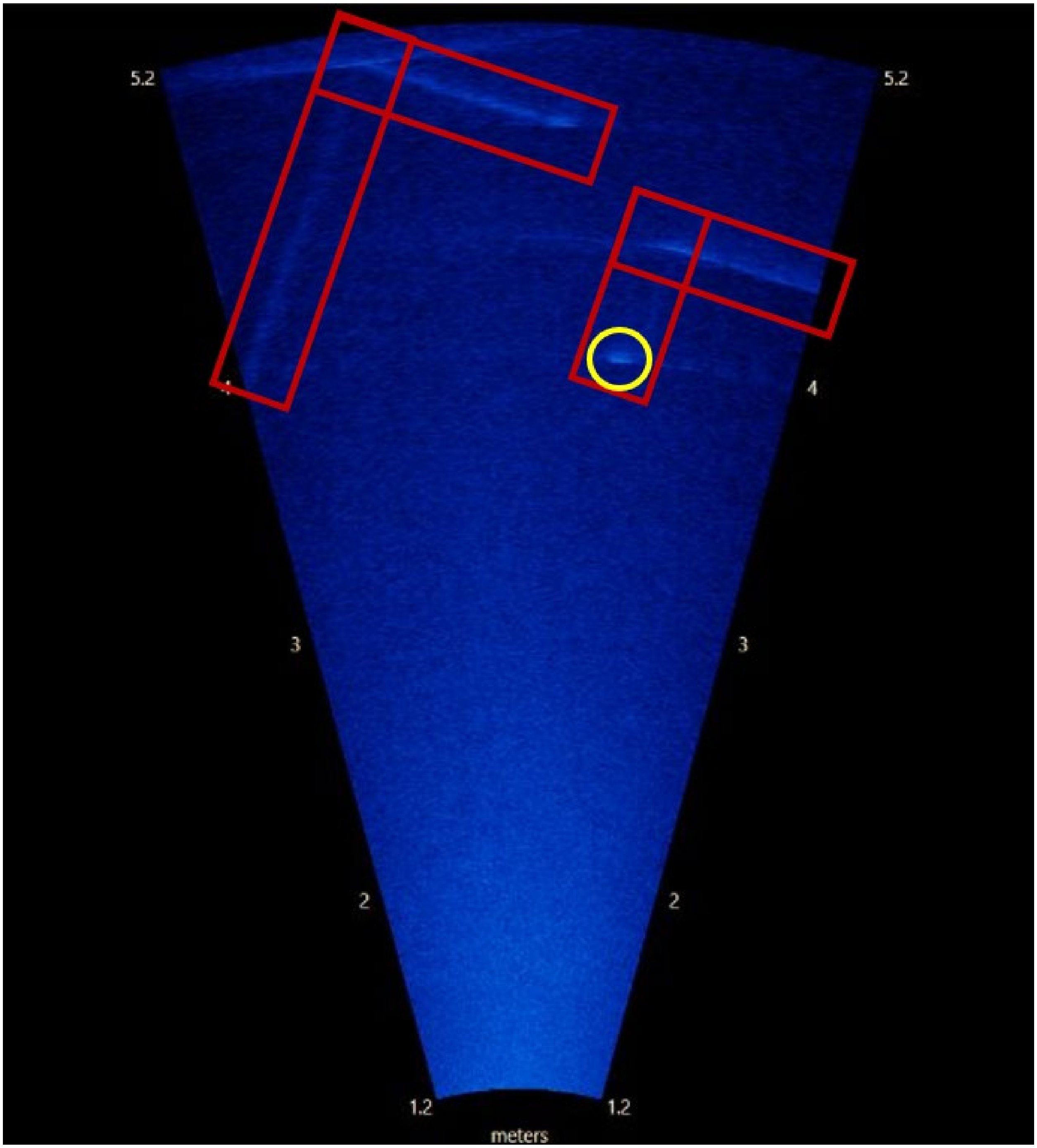

Figure 4.6: Sonar image showing the four walls used to assign qualitative image quality scores (red boxes) and the fixed target used to measure daily maximum energy levels (yellow circle).

4.3.3. Results

***O. mykiss* Detections**

ARIS files were recorded on 143 of the 152 days (94% of the time) during the migration period from 1 January through 31 May 2024; however, only 104 (68%) of those days were fully recorded (i.e., recorded for all 24 hours). These incomplete recordings were largely due to a software version issue early in the season, which was resolved by 8 February 2024. After this date, 83 out of the 133 (81%) remaining days within the migration period were fully recorded. Reasons for incomplete recordings after 8 February included other seemingly random software errors throughout the monitoring period and an emergency dewatering of the RD1 impoundment and fish ladder after a drowning event on 30 April.

It is worth noting that the term "fish image" is used throughout this section of the report when referring to the targets classified as fish that were observed in the ARIS data. As with any other count data gathered from imagery, it is possible (and in the case of the RD1 fish ladder, likely) that the same fish was recorded multiple times as it swam in and out of the sonar unit's field of view on its way upstream or downstream through the fish ladder. Side-to-side and back-and-forth movements associated with milling, resting, and/or predatory behaviors could also cause the same fish to be recorded multiple times. Because of this, the counts, lengths, and movement directions of fish images reported in this section should not be thought of as unique fish. Instead, these results should be used as indicators of general patterns in the timing and relative frequency of possible *O. mykiss* life stages using the fish ladder. Although all fish images are summarized by possible *O. mykiss* life stages (Table 4.6), many of these images were likely of other native and nonnative fish species commonly observed using the fish ladder, including Sacramento Pikeminnow, Sacramento Sucker (*Catostomus occidentalis*), Common Carp (*Cyprinus carpio*), and Largemouth Bass (*Micropterus nigricans*).

There were 333,473 targets identified by Echoview in ARIS data recorded on from 1 January through 31 May 2024 at the RD1 fish ladder. The RF model used to differentiate fish from bubbles targets classified nearly a quarter (23%) of these targets as bubbles, resulting in a total of 256,828 fish images. The 99th percentile of lengths measured for each fish image from Echoview data was the most highly correlated length estimate (R = 0.51) when compared against manually reviewed lengths. It is worth noting, however, that although it was the most highly correlated length measurement, the 99th percentile of lengths measured from Echoview data generally underestimated fish size compared to manually reviewed lengths by a mean percentage of 15% and mean difference of 10 cm (SD = 16 cm). Despite this difference, it was the most accurate measurement of fish length and was therefore used to classify the fish images produced by Echoview into one of four possible *O. mykiss* life stages.

Of the 256,828 fish images produced by Echoview, 11,987 were within the size class of possible adult *O. mykiss* but were migrating in the opposite direction of what would be expected at the time (i.e., downstream during the immigration period, upstream during the emigration period), and were therefore removed from the dataset. From the resulting dataset of 244,841 fish images, 14,118 (6%) were classified as possible immigrating adult *O. mykiss*, 7,539 (3%) as possible juveniles, 221,314 (90%) as possible smolts, and 1,870 (<1%) as possible emigrating kelts. Besides a several-day peak in immigrating adults in late January, most fish images of possible *O. mykiss* were observed in late February through mid-April for all four life stages, with a significant reduction in activity through most of May (Figure 4.7). Peak observations of possible immigrating adult *O. mykiss* was on 16 March, while peaks in juvenile and smolt-sized fish images occurred on 17 March. Though outside the assumed migration period, there were 13,102 additional targets classified as possible *O. mykiss* in June 2024. Of these, 79 (<1%) fish images were classified as possible emigrating kelts, 12,868 (98%) as possible smolts, and 155 (1%) as possible juveniles. Given the timing and water quality conditions within the Flood Control Channel in June, it is likely that most of these fish images were of Sacramento Pikeminnow, Sacramento Sucker, Common Carp, and Largemouth Bass. Refer to Section 2.4 for additional details on water quality conditions.

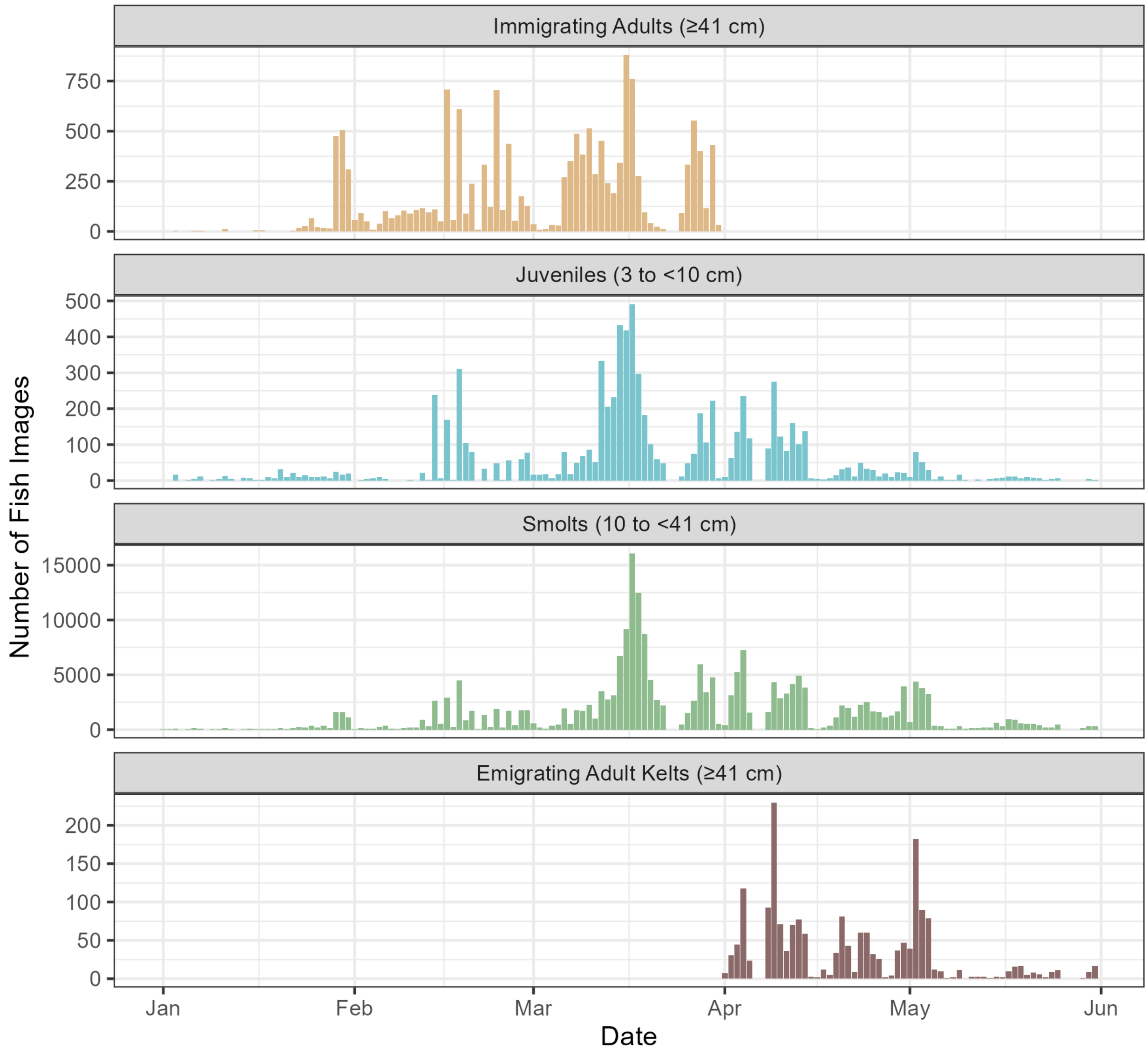

Figure 4.7: Number of fish images produced by Echoview by date and possible O. mykiss life stage. Criteria used to determine possible O. mykiss life stage are detailed in Table 4.6.

Overall, there were over twice as many upstream movements compared to downstream movements for all three size classes combined, with the majority of that difference made up of smolt-sized fish (Table 4.9). It is worth noting that although a binary upstream-downstream classification was used here, many of the fish images made movements that were closer to being side-to-side rather than upstream or downstream. For example, 42% of all possible *O. mykiss* fish images made movements within 30° of the left-right lateral axis of the fish ladder, suggesting that a large proportion of the fish observed in the fish ladder were not making clear upstream or downstream movements. These swimming patterns were also observed anecdotally by manual reviewers, suggesting possible milling and/or resting behavior in this section of the RD1 fish ladder.

Table 4.9: Number of fish images by migration direction and possible O. mykiss life stage.

Life Stage	Downstream	Upstream
Juvenile	2,893	4,646
Smolt	63,674	157,640
Adult	1,870	14,118
Total	68,437	176,404

Manual reviewers observed and measured fish images throughout the migration period to help inform and compare against Echoview counts. Although many fish images were observed that matched the size and timing of possible migrating adult and smolt *O. mykiss*, assumed Chinook Salmon and Pacific Lamprey were also observed using the RD1 fish ladder during the 2024 migration period (Figure 4.8). A distribution of lengths manually measured in the December 2023 and January 2024 data with confidence scores ≥50% showed two distinct size classes of possible *O. mykiss* and Chinook Salmon using the ladder (Figure 4.9). During this time, 1,242 smolt-sized fish images were observed, ranging from 10 to 40.9 cm, while 837 adult-sized fish images (≥ 41 cm) were observed, ranging from 41 to 96.4 cm. Although there currently is not enough information to clearly distinguish between immigrating *O. mykiss* and Chinook Salmon in Alameda Creek using sonar imagery alone, other researchers have classified fish images from sonar data with lengths >80 cm as Chinook Salmon (Mueller et al. 2010; Kupilik and Petersen 2014). Using this threshold, there were 43 possible Chinook Salmon fish images observed on 21, 28, and 29 December 2023, and 25 and 27 January 2024. It is worth noting, however, that the studies using this threshold were based out of Alaska, where Chinook Salmon size may be different than California populations.

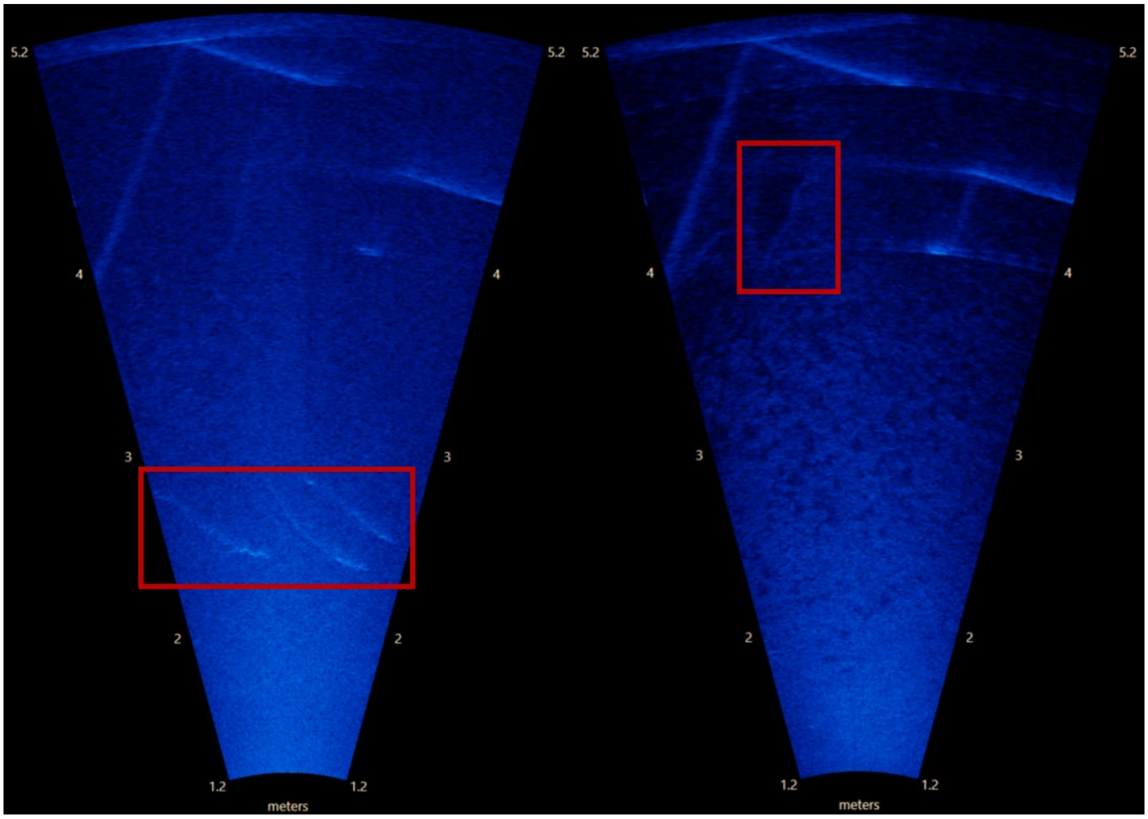

Figure 4.8: Sonar imagery showing three possible 70-85 cm Chinook Salmon from 18 December 2023 (left) and possible 68 cm Pacific Lamprey from 19 February 2024 on right.

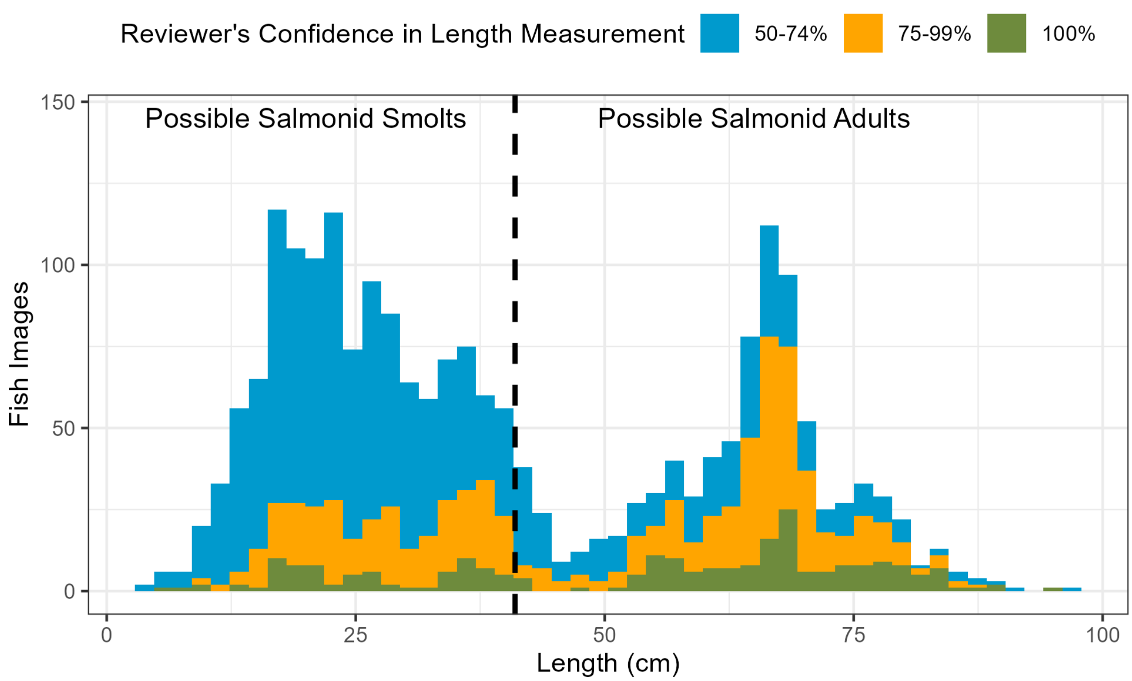

Figure 4.9: Number of fish images produced by manual reviewers by length from all ARIS files recorded in December 2023 and January 2024.

Counts of Echoview fish images were higher than those observed and measured by manual reviewers for the same set of ARIS files (Table 4.10). Echoview counts were 4.7, 4.5, and 1.8 times higher than manual counts for images that fell into juvenile, smolt, and adult-sized *O. mykiss* classes, respectively. This decreasing trend in overestimation of fish images with increasing size is likely at least partially because larger-sized fish images from December and January ARIS files were used to develop the Echoview workflow of operators outlined in Table 4.5 and to develop the RF model used to classify Echoview targets as fish or groups of bubbles. Despite this explanation, these results are not surprising, however, as automated methods used to process sonar imagery (e.g., Echoview) tend to overestimate counts of fish in low-density settings and can vastly overestimate counts when milling behavior activity is common (Munnelly et al. 2024), as is the case in the RD1 fish ladder. Furthermore, debris and objects that appeared to be fish to manual reviewers but had a quality score of 1 (i.e., reviewer had 0% confidence in length measurement) could also account for some of the discrepancies between Echoview and manual reviewer counts. Given that the primary purpose of the ARIS unit is to passively monitor migrating adult *O. mykiss*, future efforts will continue to focus on refining counts and lengths of adult-sized fish images rather than shifting focus towards improved counts of juvenile and smolt sized-fish. PIT tag antennas installed within the RD1 fish ladder just downstream of the ARIS unit are likely a more effective method for passively monitoring these smaller-sized *O. mykiss* life stages (see Section 4.4 below).

Table 4.10: Number of fish images by possible O. mykiss life stage observed by Echoview and manual reviewers from ARIS data recorded between 1 January and May 31 2024 at the RD1 fish ladder. Results only include counts from ARIS files that were processed by both Echoview and by manual reviewers.

Life Stage	Echoview Count	Manual Count
Juvenile	734	157
Smolt	19,339	4,281
Adult	3,290	1,791
Total	23,363	6,229

Equipment Performance

The ability to remotely access the ARIS unit throughout the monitoring period proved to be a valuable tool for monitoring sonar image quality, as well as ensuring that the ARIS unit was operating properly, and that data were being recorded and saved to an external hard drive. As previously mentioned, the ARIS unit was briefly turned off and manually cleaned by ACWD on 17 April 2024 to prevent potential image quality issues due to biofouling and sediment accumulation within the unit. According to average daily image quality scores assigned to each ARIS file that was manually reviewed, image quality had dropped for several weeks before the unit was cleaned but immediately improved shortly thereafter and for the rest of the monitoring period (Figure 4.10). Maximum energy measurements recorded throughout the monitoring period were only weakly correlated with average daily image quality scores (R = 0.16), mean daily Alameda Creek flows (R = -0.09), mean daily RD1 fish ladder flows (R = 0.19), and turbidity (R = -0.15). Regardless, average daily quality scores do appear to be a useful metric for monitoring the ARIS unit's performance.

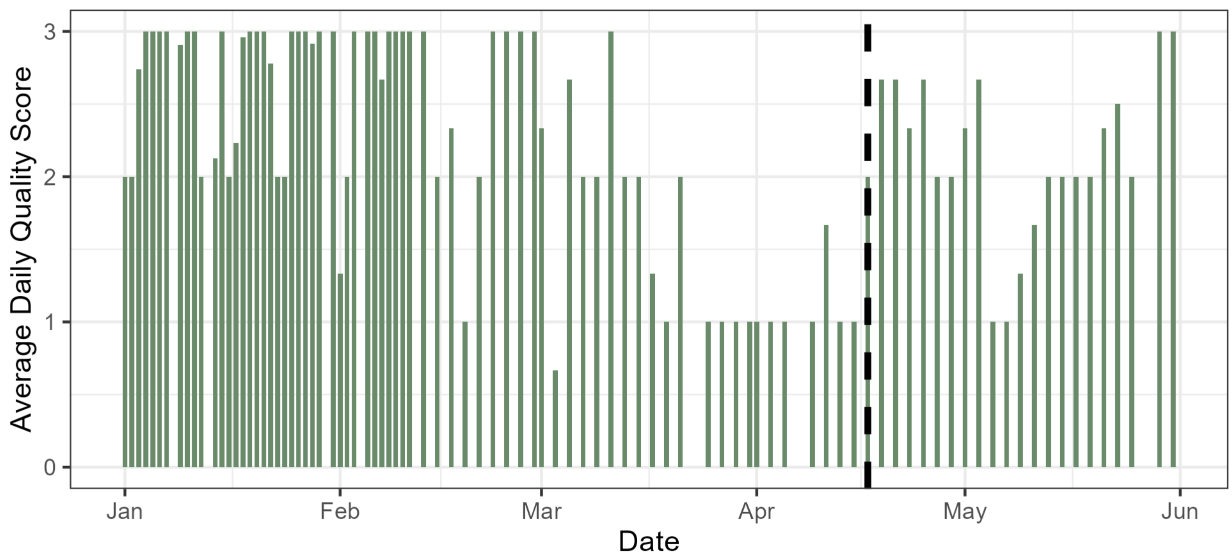

Figure 4.10: Average daily image quality score assigned to each ARIS file that was manually reviewed throughout the 2024 migration period. The dashed vertical line indicates 17 April 2024 when the ARIS unit was manually cleaned by ACWD.

4.4. PIT TAG ANTENNAS

4.4.1. Background

Like imaging sonar, Passive Integrated Transponder (PIT) technology has become an increasingly popular method for monitoring movement patterns of fish species (Gibbons and Andrews 2004). Although *O. mykiss* are not PIT tagged as part of this Project, they are tagged in the upper Alameda Creek Watershed by SFPUC during their fall electrofishing surveys and winter and spring rotary screw trap and fyke net monitoring (SFPUC 2024). It was therefore determined after consultation with and approval by NMFS and CDFW that four PIT tag antennas (by Biomark, Inc.) would be installed in the RD1 fish ladder and used to passively monitor PIT-tagged *O. mykiss* and other fish species passing through the ladder (NMFS 2017). Two of the PIT tag antennas are vertical slot, pass-through antennas that operate at all flows, but are referred to as the "low flow" antennas. Those two antennas also have an overflow pass-through antenna above that operates at higher flows (i.e., typically >75 cfs). The two pairs of low and high flow antennas are located at two separate vertical slots within the ladder (i.e., one pair downstream of the other) and are 31.6 ft apart so that when a PIT-tagged fish swims through the ladder, the direction and speed of the fish can be determined. This section summarizes the methods used to collect, process, and analyze PIT detection data collected during the 2024 *O. mykiss* migration period and the results of those analyses.

4.4.2. Methods

Equipment Performance

PIT detection data from 1 September 2023 to 31 August 2024 were downloaded directly from Biomark's online web portal and included information on the date and time of every PIT detection, which antenna the detection occurred, and the PIT tag code that was detected. While a subset of these data was used to confirm and characterize *O. mykiss* navigating the RD1 fish ladder, most detections were from test tags used to evaluate antenna performance throughout the monitoring period using three different methods.

Each of the four antennas has an associated test tag attached directly to the antenna that is programmed to ping once every hour. To better understand the continuous performance of the four antennas, the proportion of expected daily test tag detections was calculated and plotted for each day during the *O. mykiss* migration period. Dips or downward trends in the proportion of expected daily test tag detections could indicate temporary or long-term reductions in antenna performance.

The second method used to evaluate PIT tag antenna performance consisted of swinging a test tag in front of a randomly selected antenna on 25 randomly selected days. The proportion of detections to known tests was calculated for each antenna.

The last method used to evaluate PIT tag antenna performance were two efficiency tests conducted on 30 December 2023 and 6 May 2024. During the first test, three groups of thirty PIT-tagged radishes, a semi-neutrally buoyant object, were released in the upstream most portion of the RD1 fish ladder (Merz et al. 2021). Discharge in the ladder during testing was estimated by ACWD to be approximately 150 cfs. These flows were high enough that the water level exceeded the tops of the low flow antennas and partially covered the high flow antennas, allowing the 90 PIT-tagged radishes to pass through either the high or low flow antenna at the upstream and downstream ends of the PIT tag antenna array. High flows were maintained for approximately 30 minutes after the third group of radishes was released to ensure that all test tags had passed through the antennas before flows returned to normal operations.

The second efficiency test was a repeat of the test conducted on 30 November 2022 to determine whether efficiency had changed over time. Like the 2022 test, ten groups of five floating apparatuses from West Fork Environmental were released in the upstream-most portion of the RD1 fish ladder (Figure 4.11). These float apparatuses are designed to hold and orient PIT tags parallel to flow and perpendicular to the PIT tag antennas for use in efficiency tests. Like the 2022 test, discharge in the ladder was set to 30 cfs at the time of 2024 testing. Although SFPUC only implants Full Duplex (FDX) PIT tags in *O. mykiss* within the upper watershed, four Half Duplex (HDX) tags were also tested during the 6 May 2024 efficiency testing to determine whether potential fish implanted with HDX PIT tags from other studies could be detected by the Project's antennas.

Figure 4.11: Customized float apparatus from West Fork Environmental to hold and orient PIT tags parallel to flow and perpendicular to PIT tag antennas for use in efficiency testing. The bottom photo shows the apparatus floating through one of the vertical slots of the RD1 fish ladder parallel with flow.

Given that the PIT tags could only pass through either the low or (in the case of the December 2023 test) high flow antenna, detections from the upstream pair and downstream pair of antennas were grouped before calculating detection efficiencies. Because the number of test tags passing through the fish ladder was known, detection efficiency was calculated as the number of PIT tags detected divided by the number released. Detection efficiencies from 2024 were then qualitatively compared to efficiency test results from 2022 and 2023.

Data Collection, Processing, and Analysis

All unknown PIT tag codes (i.e., codes not used for the antenna testing detailed above) detected from 1 September 2023 to 31 August 2024 were sent to SFPUC to determine if they were *O. mykiss*, when and where they were tagged, and general characteristics of the fish when they were tagged (e.g., fork length, weight, life stage). Although these data were not analyzed in detail, it is worth noting that they were preliminary at the time SFPUC provided them to ACWD and therefore may change after being reviewed and finalized for SFPUC's 2023-2024 annual report.

PIT detection data were then used to summarize the timing, direction, and speed of *O. mykiss* movements in the RD1 fish ladder during the 2024 migration period. Detection data were also qualitatively compared to mean daily flow, water temperature, and turbidity to determine whether there could be potential relationships between *O. mykiss* emigration and environmental factors in the Alameda Creek Flood Control Channel.

In addition to the number of emigrating PIT-tagged *O. mykiss* detected by the antennas, there may have also been additional PIT-tagged *O. mykiss* emigrating through the fish ladder that were not detected or that swam over RD1 where there are no PIT tag antennas during high flows. To account for potentially missed tags in the ladder, mean daily ladder flows and flow-detection efficiency relationships from the four PIT tag antenna efficiency tests conducted in 2022-2024 were used to estimate the potential number of additional PIT-tagged *O. mykiss* emigrating through the ladder that may have been missed by the antennas. The estimated number of emigrating PIT-tagged *O. mykiss* swimming over RD1 (N_D) was calculated for each day that emigrating PIT-tagged *O. mykiss* were detected in the ladder as:

$$N_D = \frac{N_L * Q_D}{Q_L}$$

where N_L is the total number of emigrating PIT-tagged *O. mykiss* passing through the ladder (i.e., detected and potentially missed), Q_L is the mean daily flow going through the ladder, and Q_D is the estimated mean daily flow going over the dam. Daily estimates of detected and potentially missed PIT-tagged *O. mykiss* were then summed over the entire monitoring period.

Finally, PIT detection data were used to determine if and how well the ARIS unit was able to detect *O. mykiss* that were known to pass through the fish ladder. To do this, all 1-hour ARIS files that were recorded at the same time as a detected *O. mykiss* were manually reviewed using methods similar to those detailed in Section 4.3.2 above. Although the lengths of PIT-tagged *O. mykiss* were recorded by SFPUC at the time of tagging, their lengths at the time of detection (and potential ARIS recording) were unknown. To account for this, a range of potential daily winter-spring growth rates (0.08 to 0.26 mm/day) observed for recaptured age-1+ *O. mykiss* in nearby coastal California streams (i.e., near Santa Cruz, California; Sogard et al. 2012) were applied to each detected *O. mykiss* based on their length at the time of tagging and number of days between tagging and detection. Fish lengths from the manually reviewed ARIS files were then compared against estimated ranges from the PIT detection data to determine if there were potential matches.

4.4.3. Results

Equipment Performance

Test tags attached to each of the four PIT tag antennas programmed to ping once every hour were detected throughout the *O. mykiss* migration period, confirming that there were no significant periods (i.e., more than a few hours) when any of the antennas were not functioning (Figure 4.12). The upstream low and high flow antennas detected all 24 expected test tag pings 142 (93%) and 136 (89%) of the 152 days from 1 January through 31 May 2024, while the downstream low and high flow antennas detected all 24 pings 59 (39%) and 97 (64%) of the 152 days, respectively. The majority of the expected test tag pings were detected by each antenna all 152 days, with relatively small but noticeable reductions in the proportion detected during the first few days of April. These reductions in the proportion of expected test tag detections correspond to increases in noise recorded at the antennas. Although the noise source could not be definitively confirmed, nighttime construction on the BART bridge was noted during this period. Regardless, all four antennas appeared to be functioning consistently well throughout the *O. mykiss* migration period.

Swing tests were conducted on 25 randomly selected days, with each antenna tested at least seven times during the *O. mykiss* migration period. All four antennas successfully detected the test tag during each swing test.

The four PIT tag antenna efficiency tests conducted to date have shown mixed results (Table 4.11). The cumulative detection efficiency of all four antennas together appears to be nearly 100% when the fish ladder is passing 30 cfs, suggesting that at this flow, all PIT-tagged fish will be detected by at least one of the antennas in the ladder and that efficiency has remained consistently high over the last two migration periods. Tests conducted at higher flows suggest that detection efficiency may decrease with increased flow through the ladder. However, this is likely at least partially due to how the PIT tags were oriented using various floating objects during the tests. For example, the floating apparatuses used for efficiency testing at 30 cfs are designed to hold and orient PIT tags parallel with flow and perpendicular to the antennas, which is typically the tag orientation that provides the best detection range and resulting detection efficiency for PIT tag antennas. Although radishes are a useful substitute for testing PIT tag antennas given their relatively low cost and semi-neutrally buoyant properties, it is likely that they passed through the antennas at random orientations during the efficiency testing conducted at 60 and 150 cfs, reducing the chance of their implanted PIT tag being detected. Additional testing should be conducted at these flows using the same floating apparatuses that were used during the efficiency testing conducted at 30 cfs.

None of the four Half Duplex (HDX) tags tested during the 6 May 2024 efficiency testing were detected, suggesting that potential fish implanted with HDX PIT tags from other studies will not be detected by the Project's antennas.

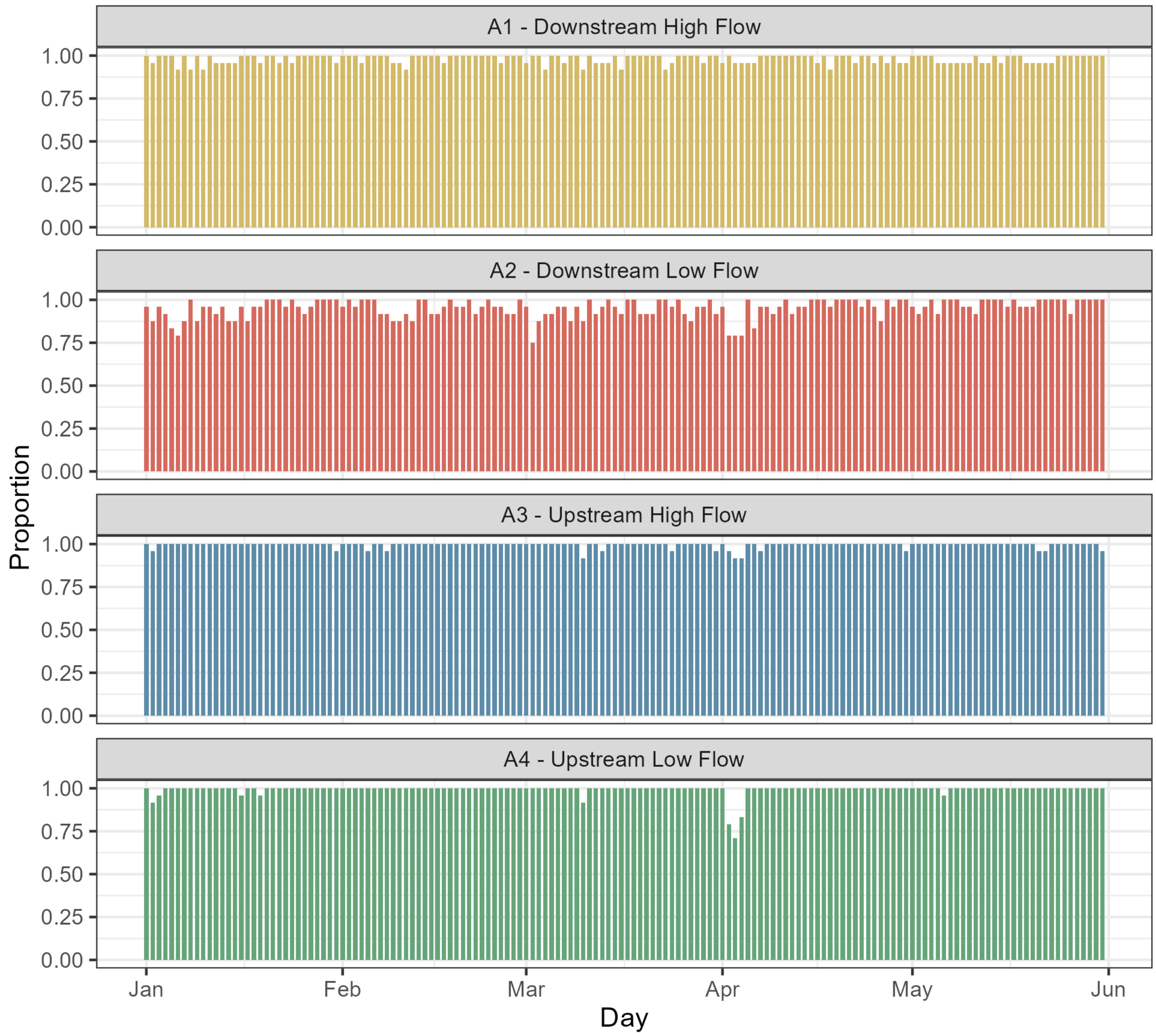

Figure 4.12: Proportion of expected hourly test tags detected by PIT tag antennas during the 2024 O. mykiss migration period. Relatively high proportions of detected test tags throughout the entire migration period confirmed that there were no significant periods (i.e., more than a few hours) when any of the antennas were not functioning.

Table 4.11: Number of unique test tags and proportion of test tags detected at each pair of antennas for all four PIT tag antenna efficiency tests conducted to date.

	30 November 2022 Average 30 cfs n = 50		**20 April 2023 60 cfs n = 90**		**30 December 2023 ~150 cfs n = 90**		**6 May 2024 30 cfs n = 50**	
Antennas	**Detected**	**Efficiency**	**Detected**	**Efficiency**	**Detected**	**Efficiency**	**Detected**	**Efficiency**
Downstream	46	0.92	47	0.52	28	0.31	50	1.0
Upstream	43	0.86	55	0.61	29	0.32	48	0.96
Cumulative	50	1.0	67	0.74	47	0.52	50	1.0

***O. mykiss* Detections**

There were 50 individual PIT-tagged *O. mykiss* detected by the Project's PIT tag antennas during the 2024 migration period (1 January through 31 May), with one additional PIT-tagged *O. mykiss* detected in early July during an experimental pulse flow (see Section 4.5 for more details). All 51 *O. mykiss* were tagged within the southern Alameda Creek Watershed by SFPUC in 2023 and 2024. One of the PIT-tagged *O. mykiss* was tagged in the spring of 2023, while the remaining fish were tagged during electrofishing surveys in the fall of 2023 and rotary screw trap and fyke net monitoring in the spring of 2024. None of the 51 PIT-tagged *O. mykiss* were detected by the high flow antennas, which is not surprising given that flows never reached the high flow antennas during the 2024 migration period.

PIT-tagged *O. mykiss* migrating through the RD1 fish ladder were detected as early as 12 March, with peak migration occurring in late March (Figure 4.13). Of the 51 PIT-tagged *O. mykiss* detected, 37 (73%) were detected by the upstream and then downstream antennas, confirming downstream migration. Four PIT-tagged *O. mykiss* were only detected moving upstream, with all four occurring in early May. Two PIT-tagged *O. mykiss* had more complicated detection patterns, including one fish detected moving downstream and then back upstream less than five minutes later on 19 April 2024. The other fish made several upstream and downstream movements between 1 and 3 July during an experimental pulse flow (see Section 4.5 for more details). Eight PIT-tagged *O. mykiss* were only detected on one antenna and therefore their direction could not be confirmed. All but one of these fish were only detected at the downstream antenna, suggesting that they either migrated through the fish ladder but were missed by the upstream antenna, or that they had migrated over RD1 instead of through the ladder, migrated back upstream through the ladder to the downstream antenna, and then turned around before passing through the upstream antenna.

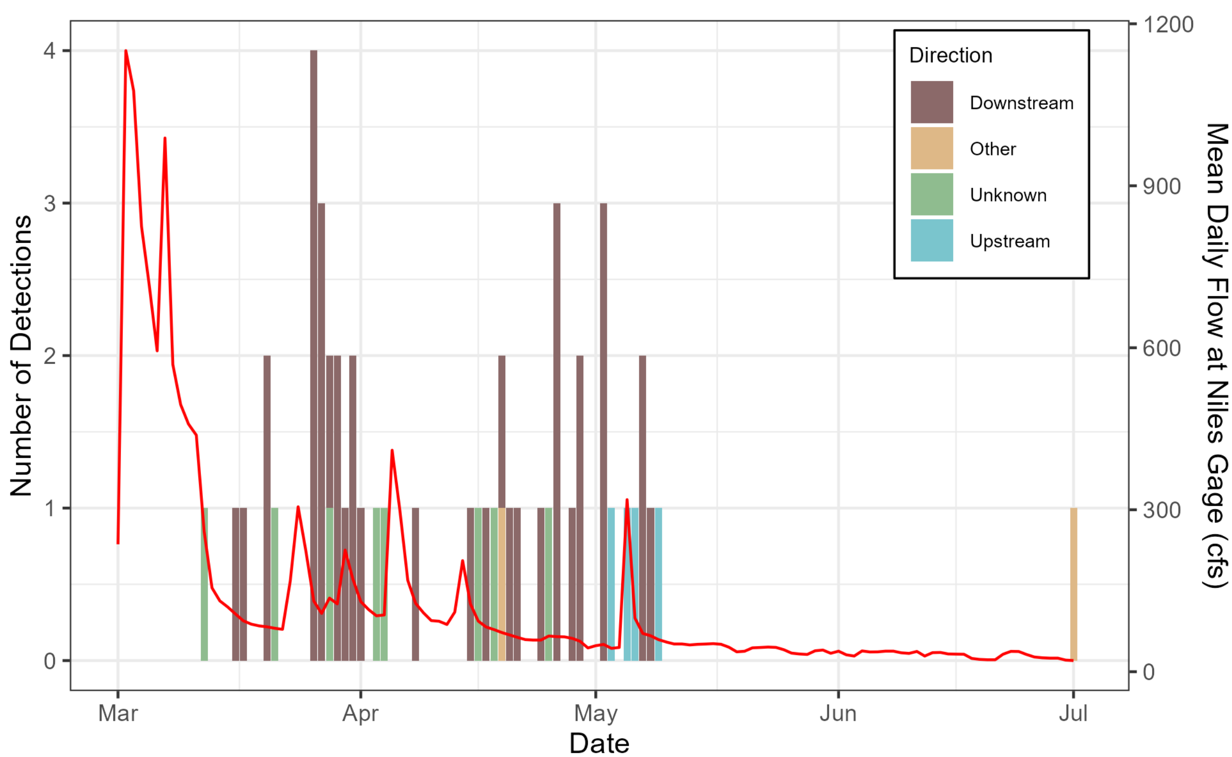

Figure 4.13: Number of PIT-tagged O. mykiss detected by the Project's PIT tag antennas by direction in 2024. "Unknown" directions are of fish only detected by one antenna, while "Other" directions are of fish detected moving in more than one direction.

The 37 fish that migrated downstream and four fish that migrated upstream were used to calculate the directional travel time and speed of fish navigating this portion of the RD1 fish ladder (Table 4.12). Mean travel times and speed were nearly three times faster for PIT-tagged *O. mykiss* moving downstream compared to upstream, while median downstream movements were approximately twice as fast as upstream movements. The fastest downstream movement was made in 8 seconds on 20 March when flows in the fish ladder were 27 cfs, while the fastest upstream movement was made in 20 seconds on 5 May when flows in the ladder were 35 cfs.

Table 4.12: Summary statistics of travel times and speed of PIT-tagged O. mykiss detection by the Project's PIT tag antennas in 2024.

Direction	Time (s)		Speed (ft/s)	
	Mean ± SD	Median (Range)	Mean ± SD	Median (Range)
Downstream	73.9 ± 112.8	33 (8 - 569)	1.1 ± 0.8	0.96 (0.06 - 4.0)
Upstream	204.5 ± 317.7	59 (20 - 680)	0.7 ± 0.7	0.56 (0.05 - 1.6)

Given the dataset, statistical tests could not be used to determine whether there were significant relationships between emigrating PIT-tagged *O. mykiss* and environmental factors. However, distributions of mean daily Alameda Creek and RD1 fish ladder flows, water temperature, and turbidity levels when downstream migrating fish were detected were compared to distributions of mean daily values during the months PIT-tagged *O. mykiss* were detected migrating downstream (i.e., March through May; Figure 4.14). PIT-tagged *O. mykiss* appeared to emigrate at higher Alameda Creek flows (measured at the USGS Alameda C NR Niles CA stream gage) compared to the range of flows available in March through May. Interestingly, this did not appear to be true for flows in the RD1 fish ladder or for water temperature, as the distributions of fish ladder flows and temperature when fish were detected were relatively similar to the distributions available in March through May. Emigrating *O. mykiss* appeared to migrate at slightly higher turbidity levels compared to the ranges available; however, there was a strong correlation between Alameda Creek flows and turbidity during this time (R = 0.78), suggesting that one of these conditions may be confounding.

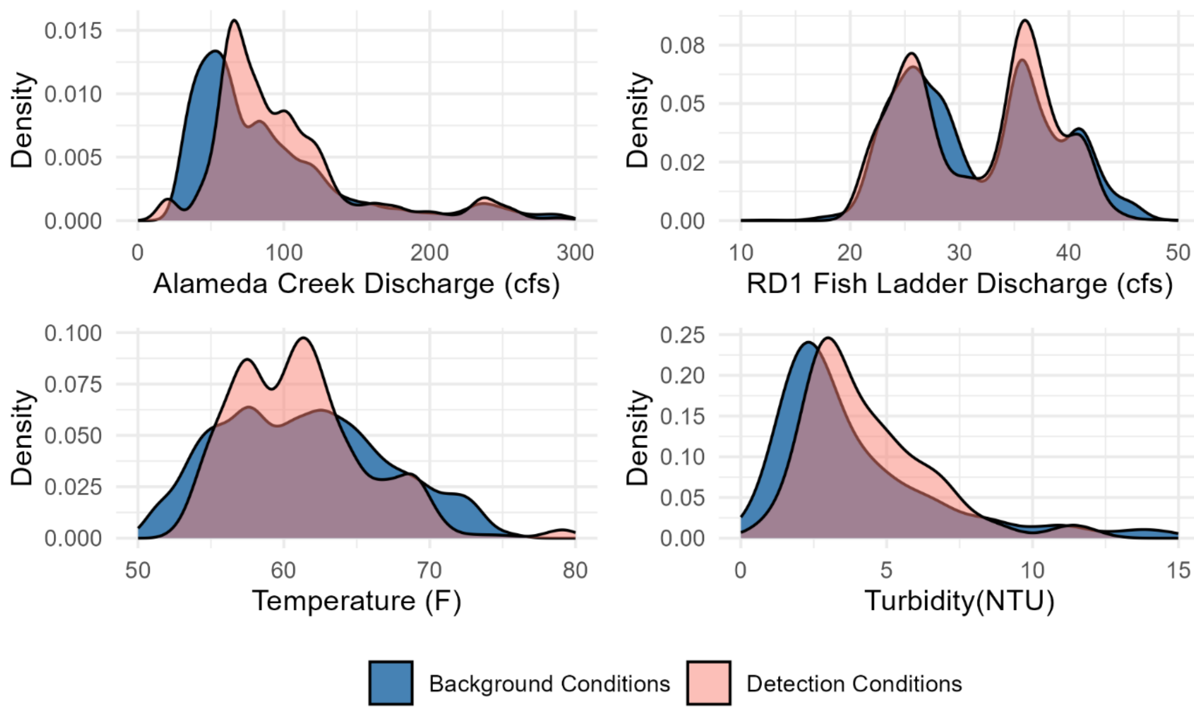

Figure 4.14: Relative density of mean daily environmental conditions on days PIT-tagged O. mykiss were detected migrating downstream (pink) and density of mean daily background conditions (blue) during the months PIT-tagged O. mykiss were detected migrating downstream (i.e., March through May).

Interestingly, 23 out of the 37 (62%) PIT-tagged *O. mykiss* migrating downstream were detected during the day, and only 3 (8%) were detected during twilight (i.e., the period between sunrise/sunset and beginning/end of astronomical twilight). The need for visual cues because of challenging hydraulic conditions and/or predator avoidance near and within the fish ladders may explain this potential preference for diurnal movement behavior (Reebs et al. 1995; Keefer et al. 2013), though previous studies have shown that *O. mykiss* smolts emigrating through parts of the Sacramento-San Joaquin Delta prefer daytime travel (Chapman et al. 2013).

Using the relationship between RD1 fish ladder flows and PIT tag antenna efficiencies discussed above, and estimates of flow spilling over the RD1 dam, the total number of emigrating PIT-tagged *O. mykiss* was estimated to be 62. This includes the 37 detected *O. mykiss* migrating downstream, an estimated six additional PIT-tagged *O. mykiss* migrating through the ladder undetected by the antennas, and an estimated 19 swimming over the dam. In future monitoring years, capture efficiencies from SFPUC's rotary screw trap and fyke net and the proportion of captured fish that are tagged could be used to estimate the total (i.e., tagged and untagged) number of *O. mykiss* smolts emigrating from the Alameda Creek Watershed to San Francisco Bay.

Using potential winter-spring growth rates of 0.08 to 0.26 mm/day (Sogard et al. 2012), *O. mykiss* detected by the PIT tag antenna array were estimated to range between 117 and 246 mm. Four of the 50 (8%) PIT-tagged *O. mykiss* detected by the antennas while the ARIS unit was operating matched the potential timing and length of fish targets observed in the ARIS data. While 8% is a relatively low percentage, the analysis was based on *O. mykiss* growth rates from nearby streams and not from the Alameda Creek Watershed. When growth rates for Alameda Creek *O. mykiss* become available through SFPUC's tagging program, length estimates of *O. mykiss* using the RD1 fish ladder may become more accurate, potentially improving the ability to match ARIS data with PIT tag detection data.

4.5. EXPERIMENTAL PULSE FLOWS

4.5.1. Background

The Project's BiOp permits the Districts to conduct routine maintenance of fish screens, diversions, fish ladders, drop structures, and associated equipment within Alameda Creek, so long as measures are employed to avoid and minimize the potential effects of maintenance activities on *O. mykiss* and water quality (NMFS 2017). These measures include actions to isolate work sites from the flowing waters of Alameda Creek, scheduling maintenance activities between 1 June and 31 October when *O. mykiss* are assumed to not be present at work sites, and regular notification and coordination with NMFS and CDFW. The Districts' Operations and Maintenance Plan is meant to assist with ensuring maintenance activities avoid impacts to the extent practicable.

On 31 June through 2 July 2024, ACWD dewatered their RD1 and RD3 impoundments and fish ladders for routine maintenance scheduled for summer 2024. Given that the Project is relatively new with many uncertainties, ACWD used the required dewatering as an opportunity to better understand how future pulse flows, which are required by the Project's BiOp during April and May of dry and critically dry water years, may affect *O. mykiss* migration and water quality conditions within and downstream of the impoundments.

This section summarizes the methods used to collect, process, and analyze observational, water quality, and PIT detection data collected during the experimental pulse flow and the results of those analyses.

4.5.2. Methods

Alameda Creek flow data were downloaded from the USGS Alameda C NR Fremont CA (11179100) stream gage, located approximately 0.8 river miles downstream of the RD1 and BART Weir fish passage facility (Figure 4.15). These data were then used to estimate the magnitude and duration of the experimental pulse flow.

Two water quality arrays were used to characterize conditions within and downstream of the RD1 impoundment before, during, and after the experimental pulse flow. One array of water temperature loggers was deployed at and downstream of the RD1 fish ladder to better understand how distance downstream of the ladder may have affected potential changes in water quality during the experimental pulse. Loggers were deployed at the downstream entrance of the RD1 fish ladder and approximately every river mile downstream of the ladder to San Francisco Bay (Figure 4.15). To monitor how salt water from San Francisco Bay might influence temperature stratification in Alameda Creek, two temperature loggers were deployed at the most downstream site near Coyote Hills Regional Park, with one near the surface (~6 in from the surface) and the other near the bottom of the water column (~6 in from the channel bed). Water quality and flow data at and downstream of the RD1 fish ladder were summarized, plotted, and qualitatively compared amongst logger sites before, during, and after the experimental pulse flow.

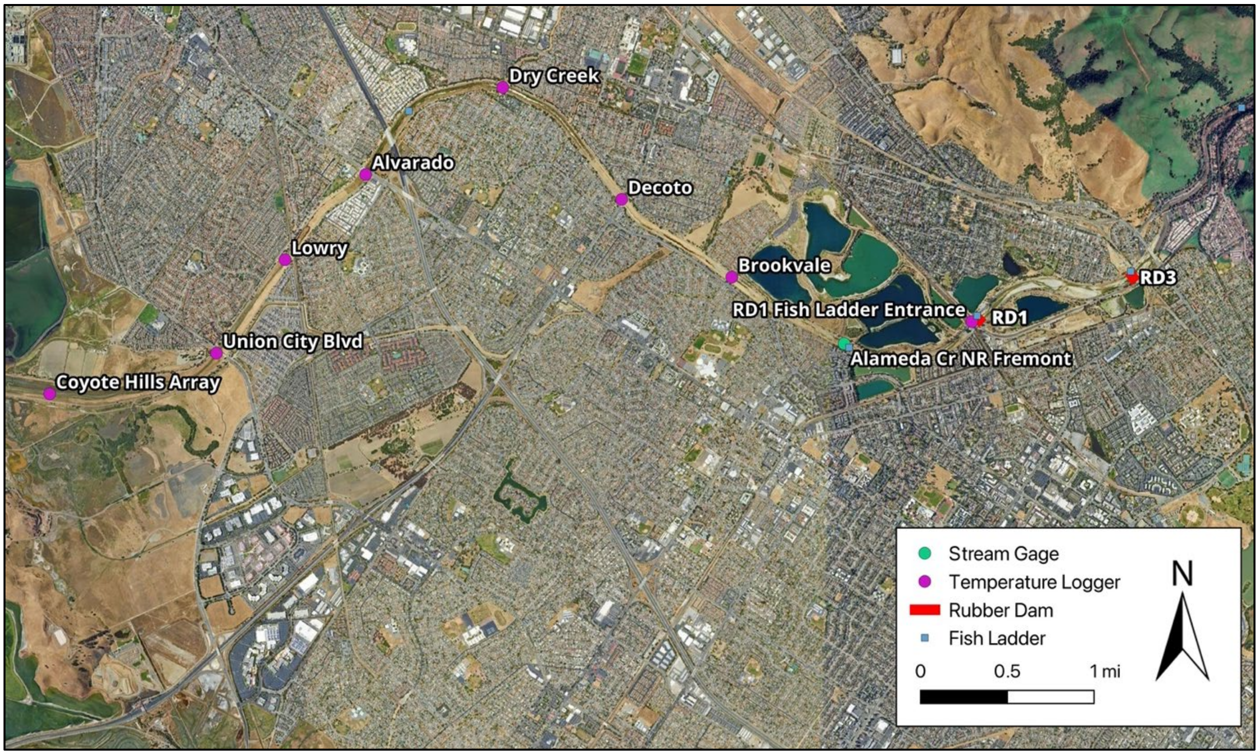

Figure 4.15: Map showing locations of temperature loggers and USGS stream gage (11179100) downstream of RD1 and RD3 impoundment footprints.

A second water quality array was deployed in the RD1 impoundment to monitor potential vertical stratification of DO and water temperature before and during the experimental pulse flow. The array consists of three pairs of DO and temperature loggers attached to a rope, with one pair near the surface, one near the bottom of the water column, and one at the midpoint between the other two. The array was secured using a weight at the bottom and a buoy at the top.

O. mykiss movement during and after the experimental pulse flow was monitored using the PIT tag antennas described in Section 4.4 above.

4.5.3. Results

The experimental pulse flow (as measured by USGS stream gage 11179100 – 0.8 miles downstream of the RD1 and BART Weir fish passage facility) occurred on 1 July from 10:15 to 18:45 (~8.5 hours), peaking at 496 cfs at 12:30 (Figure 4.16). Maximum water temperatures at the four stations closest to the RD1 fish ladder dropped during the experimental pulse flow but quickly returned to normal fluctuations the following day. The temperature at the downstream entrance of the fish ladder was relatively stable before the pulse flow. However, after the pulse, the temperatures in the ladder resembled the fluctuations observed at the loggers downstream of the impoundment, suggesting a potential buffering of water temperature within the fish ladder while the RD1 impoundment is full. As expected, the effect of the pulse flow was strongest at the temperature loggers closest to the RD1 and BART Weir fish passage facility (Table 4.13). The largest difference between peak daily temperatures from before and during the pulse flow was a 4.1°F drop at the Decoto logger, which then increased by 6.5°F the following day. The Dry Creek, Brookvale, and Alvarado loggers also showed drops in peak daily temperature during the initial pulse flow, followed by an increase the following day. The logger at the RD1 fish ladder entrance showed an increase in maximum daily temperature of 8.1°F after the pulse flow.

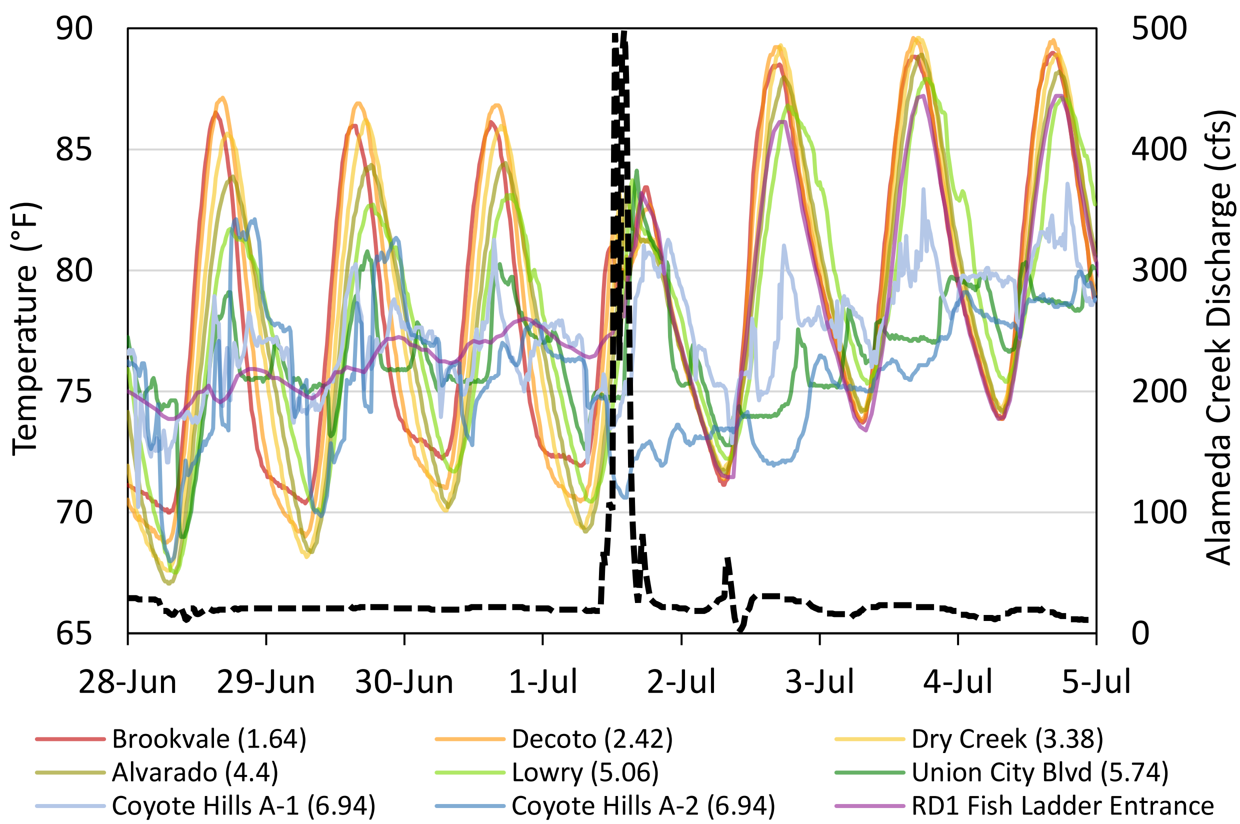

Figure 4.16: Water temperature (color lines) and flows (dashed black line) downstream of the RD1 fish ladder before and after the experimental pulse flow (1 July). Numbers in parentheses refer to the number of river miles each logger was located downstream of the RD1 fish ladder. The Coyote Hills A-1 logger was deployed near the water surface, while the A-2 logger was deployed near the bottom of the water column.

Table 4.13: Peak daily water temperatures (°F) downstream of the RD1 fish ladder before and after the experimental pulse flow (1 July). Numbers in parentheses refer to the number of river miles each logger was located at downstream of the RD1 fish ladder. The Coyote Hills 1 logger was deployed near the water surface, while the Coyote Hills 2 logger was deployed near the bottom of the water column.

Date	RD1 Fish Ladder (0)	Brookvale (1.6)	Decoto (2.4)	Dry Creek (3.4)	Alvarado (4.4)	Lowry (5.1)	Union City Blvd (5.7)	Coyote Hills 1 (6.9)	Coyote Hills 2 (6.9)
28 Jun	75.9	86.5	87.1	85.7	83.9	81.7	79.1	79.0	82.1
29 Jun	77.3	85.97	86.9	86.2	84.4	82.7	80.8	80.3	81.3
30 Jun	78.0	86.1	86.8	86.0	84.4	83.1	80.3	81.3	78.9
1 Jul	83.2	83.4	82.7	83.2	83.4	83.7	84.1	81.3	77.2
2 Jul	86.1	88.5	89.2	89.3	88.0	86.8	77.6	81.0	76.3
3 Jul	87.2	88.8	89.6	89.6	88.9	87.9	79.7	83.4	78.6
4 Jul	87.2	89.0	89.5	88.9	88.2	87.1	80.3	83.6	80.0

Interestingly, the two loggers at the most downstream site (Coyote Hills) showed slightly different trends in water temperature before, during, and after the pulse (Figure 4.16; Table 4.13). Temperatures near the surface (A-1) generally increased throughout the period, while bottom temperatures (A-2) decreased until the day after the experimental pulse flow, then increased again. Given that no obvious temperature change was observed near the surface of Alameda Creek during the pulse flow, it is likely that the decrease in temperature observed at the bottom of the water column was influenced by denser salt water from San Francisco Bay, and that the shift in temperature the day after the pulse may be related to tidal changes.

Water quality (temperature and DO) from the RD1 impoundment array are shown in Figure 4.17. Surface, midchannel, and bottom water temperature and DO levels remained relatively consistent in the impoundment on 28 and 29 June, ranging from 73.8-77.6°F and 10.0-12.9 mg/L, respectively. Daily patterns of stratification were also apparent during this time, with water temperature at the bottom of the impoundment lower than the rest of the water column from approximately noon until midnight, but relatively uniform from midnight until noon the following day. Inversely, dissolved oxygen levels at the bottom of the impoundment were lower than the rest of the water column from approximately midnight until noon but were more uniform from noon until midnight. These results highlight that although the RD1 impoundment has relatively simple physical habitat conditions (e.g., channelized unvegetated banks, low and uniform velocities, no instream cover), more complex microhabitat conditions related to water quality can occur in the impoundment that should be considered when planning for future pulse flow events.

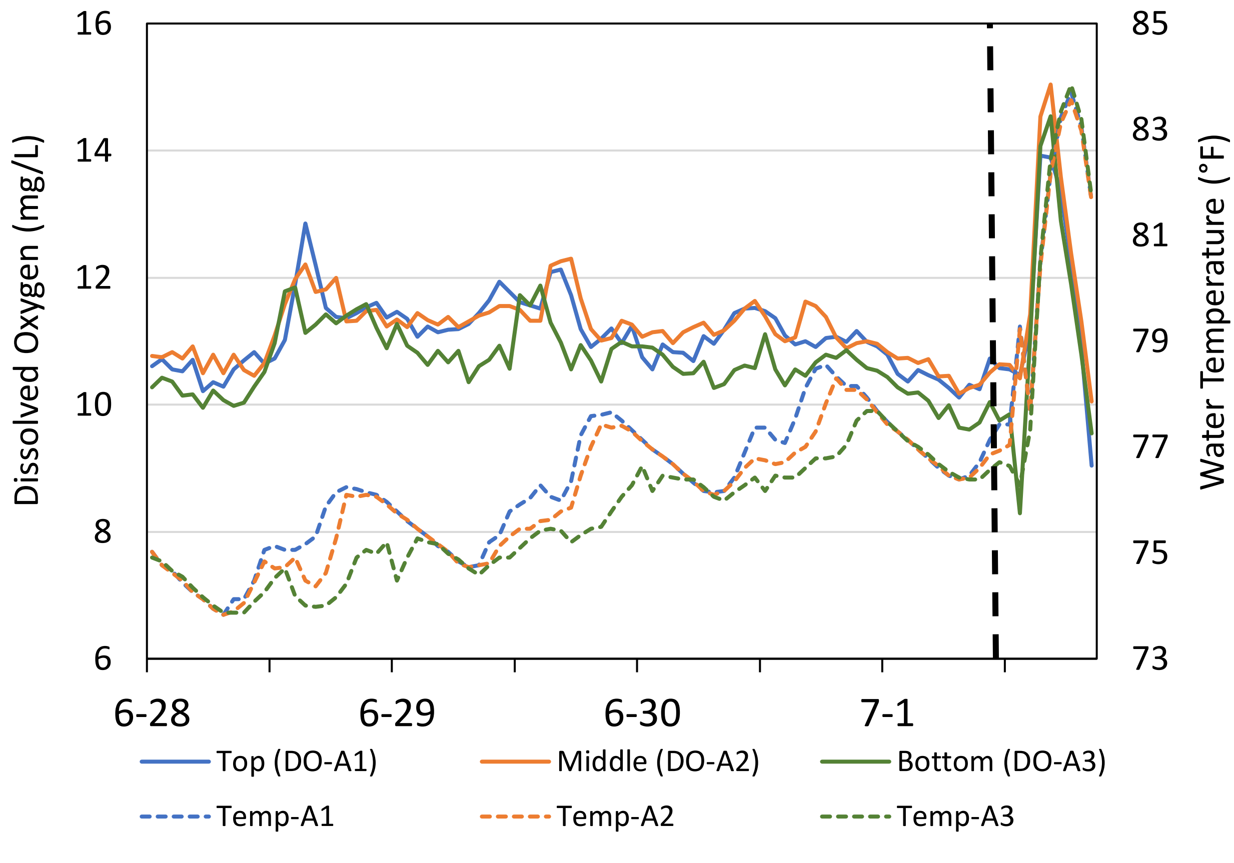

Figure 4.17: Water temperature and dissolved oxygen concentrations within the RD1 fish ladder before and during the experimental pulse flow (1 July). The dashed vertical line indicates 1 July 2024 at approximately 10:15 when the experimental pulse flow began.

One PIT-tagged *O. mykiss* was detected within the fish ladder initially migrating upstream during the experimental pulse flow. It was first detected on 1 July at 14:57 at the downstream antenna and then intermittently on the same downstream antenna until 21:02. It was then detected at the upstream antenna intermittently from 21:16 to 23:21. From 1 July 23:21 until 2 July at 00:13, the tag was detected at both the upstream and downstream antennas, suggesting that the fish was travelling both up and down the ladder.

It was last detected at the downstream antenna on 3 July at 02:39. A possible explanation as to why this fish was first detected moving upstream during the pulse flow is that it may have been missed by the upstream antenna during its first downstream movement within the fish ladder, or that it may have moved downstream over the RD1 dam at some point, and then tried to return back upstream through the ladder. It may have been returning upstream to avoid warmer water temperatures in the lower reaches of the Flood Control Channel.

4.6. FISH PASSAGE

4.6.1. Background

During system surveys in the early summer of 2023, it was determined that the above normal runoff in Alameda Creek during the winter of 2023 deposited a relatively high volume of sediment (e.g., gravel, sand, silt) within the lower vortex pool and chute fish ladder at the RD1 and BART Weir fish passage facility (ACWD and ACFCD 2023). Depth and velocity surveys conducted in August 2023 suggested that the sediment within the ladder could be causing some impediment for adult and juvenile salmonid passage, particularly because of the blocked orifices between subsequent pools of the ladder that are assumed to be preferred by migrating salmonids (NMFS 2022).

Given that the sediment was not removed from the ladder since it had first been observed in 2023, a second depth and velocity survey was conducted in September 2024 to determine whether minimum passage conditions were still being met and whether conditions at the submerged orifices improved, remained the same, or worsened. This section summarizes the methods used to collect, process, and analyze data collected during the survey and provides an overview of the results of those analyses.

4.6.2. Methods

Three survey methods were conducted by CFS on 26 September 2024 to evaluate fish passage conditions at the lower vortex pool and chute fish ladder at the RD1 and BART Weir fish passage facility. Surveys were conducted between 09:00 and 11:00 when flows at the USGS Alameda C NR Niles CA - (11179000) stream gage measured 35 cfs.

The full length of the lower ladder was visually surveyed to determine where the shallowest cross sections were located and where flow transect surveys could be conducted to determine whether water depths or velocities could be impediments to fish passage. Depths and velocities were recorded every 0.5 m (~1.6 ft) along the identified cross sectional transects using a Hach FH950 handheld flow meter attached to a USGS top setting wading rod, with velocities recorded at 60% of the depth (Figure 4.18). The proportion of each transect with depths and velocities that met passage criteria for adult *O. mykiss* were then calculated. For depths, this threshold was 0.6 ft, as specified in the Project's BiOP (NMFS 2017). For velocity, the threshold was 3.4 ft/s, which approaches the upper sustained swimming ability of adult *O. mykiss* and Chinook Salmon (Bell 1991).

Depths and spill height were also surveyed within the lower ladder to determine if pool depths and jump heights were potential impediments to adult passage. For practical applications, pools need to be at least 1.5 times deeper than the height of the jump to be passable by immigrating adult *O. mykiss* and Chinook Salmon (Robison et al. 1999). The most upstream weir of the fish ladder had the highest jump and was surveyed, while all other weirs had smaller spill heights and were too deep to survey.

Finally, orifices between subsequent pools were surveyed to confirm if and how many remained blocked, potentially impairing both adult and juvenile salmonid passage.

Figure 4.18: Flow transect conducted above the lower fish ladder on 26 September 2024 when flows at the USGS Alameda C NR Niles CA - (11179000) stream gage measured 35 cfs.

4.6.3. Results

The shallowest cross-sections of the lower RD1 fish ladder were across the downstream entrance and upstream exit of the ladder, similar to what was observed during the summer 2023 surveys. The two transects were 22.0 and 25.9 feet wide, with depths ranging from 0 to 1.9 ft deep and velocities ranging from 0 to 3.9 ft/s (Table 4.14). Depth and velocity criteria were met along 85 and 93% of the downstream entrance transect, and 56 and 100% of the upstream exit transect, respectively. These results suggest that the increased sediment within the ladder was not directly impeding adult or juvenile salmonid passage at 35 cfs.

Table 4.14: Results of flow transects recorded at the shallowest cross-sections of the lower RD1 fish ladder.

Transect	Width (ft)	Depth Range (ft)	Velocity Range (ft/s)	Percentage of transect ≥0.6 ft	Percentage of transect ≤3.4 ft/s
Downstream entrance	22.0	0 - 1.0	0 - 3.9	85%	93%
Upstream exit	25.9	0.2 - 1.9	0 - 2.3	56%	100%

The most upstream weir had a pool depth of 4.1 ft, which was 13.7 times greater than its jump height of 0.3 ft. These results suggest that sediment within the pools is not impeding the ability of adult salmonids to jump over the weirs at 35 cfs. However, only one submerged orifice within the fish ladder was open and free of sediment, while the remaining orifices were filled with and blocked by sediment. These results are similar to the August 2023 survey results and suggest that sediment within the ladder may still be impeding passage for adult and juvenile salmonids, as well as other native species known to use fish ladder orifices for passage, including lamprey, suckers, and minnows (Bell 1991; Clay 1995; Matica 2020; NMFS 2022). As flows decrease, passage conditions may become even worse if blocked orifices force fish to swim over the weirs, exposing them to shallower depths and potentially greater risks of predation (e.g., birds, mammals). In addition to blocking the orifices, sediment may also be altering the general flow characteristics within the ladder that support fish energy efficiency during passage. Recommendations for sediment removal is discussed in Section 5.1.1.

4.7. FISH SCREENS

4.7.1. Background

ACWD operates four diversion points within the Alameda Creek Flood Control Channel (NMFS 2017) Refer to Figure 1.2 and Section 1.2.2 for descriptions of the four diversion points. A 150 cfs-capacity diversion is operated with four fish screens immediately upstream of the RD3 fish passage facility on the north levee to serve the Alameda Creek Pipeline. A 28 cfs-capacity diversion with one fish screen is operated immediately upstream of the RD3 fish passage facility on the south levee to fill the Bunting Pond. A 50 cfs-capacity diversion with a fish screen is operated on the south levee in between the RD1 and BART Weir and RD3 fish passage facilities to fill the Kaiser Pond. Prior to the Project, the Shinn Pond recharge facility was filled by two unscreened diversion points with a combined capacity of 425 cfs. As part of the Project, the two Shinn Pond diversion points were consolidated into a single location with fish screens. ACWD uses all four diversion points year-round to exercise their water rights from Alameda Creek and to take delivery of water from the SWP.

The new Shinn Pond fish screen facility is designed to meet NMFS standards for the protection of anadromous salmonids. When operated as designed (e.g., free of sediment, trash, woody debris), the screens prevent entrainment and impingement of *O. mykiss* and other fish species as water from Alameda Creek is diverted. The fish screens are designed to provide a maximum approach velocity (i.e., velocities perpendicular to screen surface) of 0.33 ft/s, which allows the smallest life stages of *O. mykiss* to freely swim away from the face of the screen and avoid impingement (NMFS 2017). The screens are also designed to operate effectively in an environment with minimal- to-no sweeping flow (i.e., velocities parallel to screen surface) and in an environment that is affected by intermittent periods of high flow events with heavy debris loads. The cylindrical style screens include self-cleaning brush systems and can easily be removed from the channel for inspection or repair without special equipment. For these reasons, when operated as designed, no adverse effects are expected by the Project's fish screens, as all life stages of *O. mykiss* are protected from entrainment and impingement (NMFS 2017).

Given that the approach velocities at the diversions are largely assumed and have not been tested in the field, a fish screen approach velocity survey was conducted at one of ACWD's fish screens during the 2024 migration period to determine whether direct measurement of approach velocity was possible and if so, whether those velocities met the 0.33 ft/s criteria detailed above. This section summarizes the methods used to collect and evaluate those approach velocity data.

4.7.2. Methods

The approach velocity survey was conducted on 6 May 2024 at the Bunting Pond diversion fish screen upstream of the RD3 dam. At the time of testing, flows at the USGS Alameda C NR Niles CA - (11179000) stream gage measured 88 cfs, while approximately 22 cfs were being withdrawn by the diversion facility (79% of 28-cfs capacity). Vertical approach velocities were measured using a Hach FH950 handheld flow meter attached to a telescoping fiberglass pole so that the velocity probe pointed straight upwards (Figure

4.19). CFS staff positioned themselves directly above the fish screens using an inflatable kayak, lowered the velocity probe to sit directly on top of the fish screen, and recorded the vertical approach velocity for at least 10 seconds at three locations along the screen.

4.7.3. Results

Relatively high turbidity (11.4 NTU) and wind speeds made it difficult to find and hold position with an inflatable kayak over the Bunting Pond diversion fish screen for long periods of time; however, it was determined that using this technique to measure approach velocities at the fish screens is possible. Approach velocities at the time of the survey ranged from 0.03 to 0.07 ft/s, well below the 0.33 ft/s criteria specified in the Project's BiOp (NMFS 2017). It is worth noting, however, that the wooden structure holding the velocity probe in place (Figure 4.19) may have reduced the approach velocity during the survey and that improvements to the design of the equipment should be made before additional approach velocities surveys are conducted.

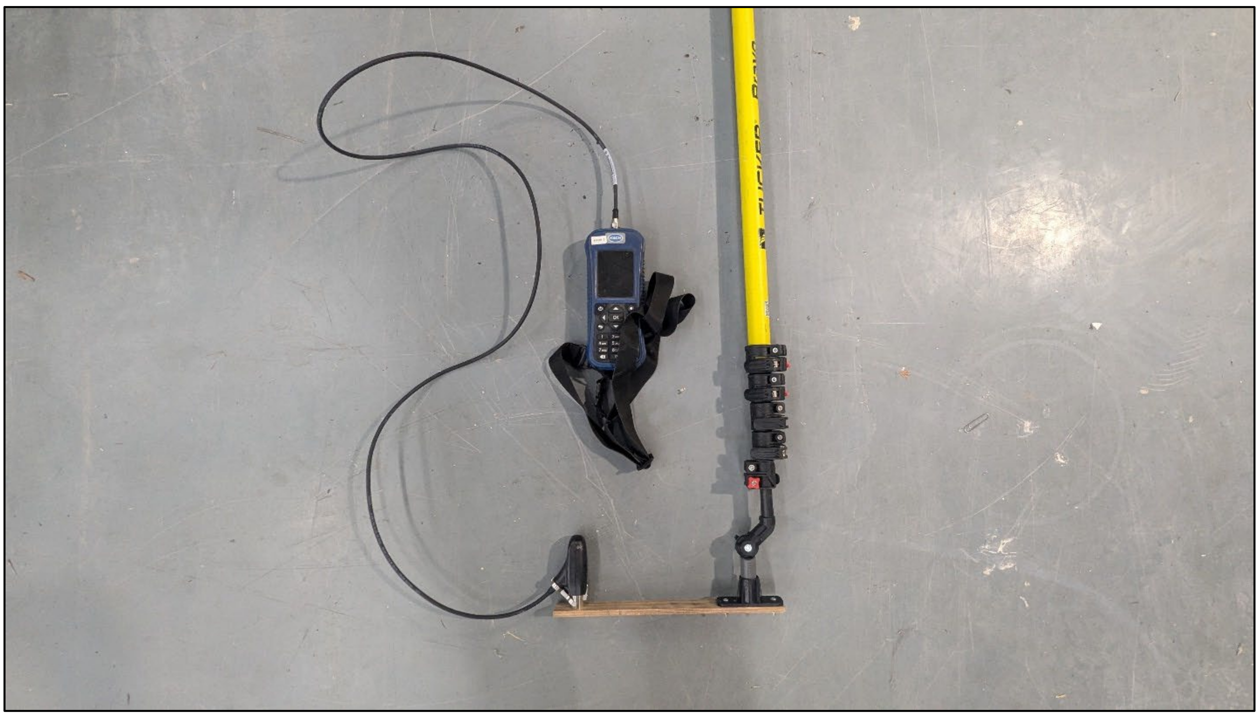

Figure 4.19: Hach FH950 handheld flow meter vertically attached to a telescoping fiberglass pole used for measuring approach velocity at ACWD's Bunting Pond diversion fish screen.

5. ADAPTIVE MANAGEMENT

Adaptive management is the process of adjusting management actions and/or directions based on new information (NMFS 2007; ACWD, in pres.). Ongoing monitoring and learning will be used to recognize differences in the consequences of various actions, subsequently offering the opportunity to evaluate management strategies. By comparing different actions, the Districts will be able to refine operations and maintenance and choose the best actions to meet water supply and Alameda Creek Flood Control Channel goals while supporting anadromous fish passage. Below lists adaptive management activities recommended in the 2022-2023 Annual Report that were implemented prior to or during the 2023-2024 reporting period, followed by a discussion and summary of recommended adaptive management actions for future monitoring years.

1. ACWD completed and implemented safety protocols necessary to access and clean the ARIS unit within the RD1 fish ladder. The ARIS unit was briefly turned off and manually cleaned by ACWD on 17 April 2024 to improve image quality impacted by biofouling and sediment accumulation within the unit. According to average daily image quality scores assigned to each ARIS file that was manually reviewed, image quality had dropped for several weeks before the unit was cleaned but immediately improved shortly thereafter and for the rest of the monitoring period, articulating the benefit of regular servicing triggered by image quality scores.
2. ACWD established a protocol for confirming that the ARIS unit was recording and that the image quality met minimum standards by improving communications capabilities to remotely monitor the ARIS operations at the RD1 and BART Weir fish passage facility. ACWD Water Supply staff was able to more frequently monitor the operations to ensure that the ARIS unit was operating, and that data were being recorded and saved to an external hard drive.
3. ACWD developed an improved process for storing ARIS files.
4. ACWD improved ARIS file processing using the hydroacoustic data processing computer program Echoview. Continued improvements in Echoview workflows will decrease the turnaround time needed for draft results from the ARIS data.
5. ACWD launched a website in August 2024 for community members to upload fish and wildlife photographs captured in and around Alameda Creek. New signage with QR codes to access the website have been posted throughout the watershed. This new process will improve the standardization and quality assurance of data shared with ACWD and will strengthen qualitative surveys conducted during future monitoring years by ACWD staff, watershed interested parties and the local community.
6. ACWD developed and implemented a stranding monitoring protocol. The protocol will continue to enhance the protection of target fish species within the Project footprint and further the success of restoring *O. mykiss*, Chinook Salmon and Pacific Lamprey in the watershed.
7. ACWD replaced all temperature loggers that were lost during the 2022-2023 reporting period and developed a protocol to help reduce the future loss of equipment and the valuable data they provide.
8. Alameda Creek stream conditions can change rapidly. To improve modeling for more accurate groundwater level estimates under varying stream conditions and recharge operations, ACWD conducted operational tests from 15 February to 26 February. During the testing, RD1 was partially deflated to minimize impoundment depth while still providing optimal fish ladder flows for immigration passage. The tests aimed to provide data to support the optimization of operations for both the fish passage and groundwater recharge facilities. Fish passage was not affected during the testing period.

5.1. OPERATIONS AND MAINTENANCE

Overall, ACWD met its goals of fish passage enhancement on Alameda Creek while maintaining its water supply goals throughout the 2023-2024 reporting period. ACWD was able to operate, monitor, and adaptively manage its fish passage facilities in accordance with the Project's BiOp (NMFS 2017). Summarized below are recommendations for future monitoring years related to the Project's operations and maintenance based on results from the 2023-2024 reporting period.

5.1.1. Fish Passage

- Sediment should be flushed or removed from the entrance, exit, and within the lower vortex pool and chute fish ladder to improve fish passage conditions. The work appears to be possible with hand tools and/or high-pressure hoses, as recommended in the Project's BiOp (NMFS 2017).
- Fish passage surveys within the lower vortex pool and chute fish ladder should be repeated annually until the sediment is removed. Surveys should be conducted at the minimum expected flows during the adult immigration period (20 cfs) and smolt emigration period (5 or 12 cfs, depending on water year type) to determine whether fish passage criteria will be met at those flows.
- RD3 fish passage facility automatic operations should be closely monitored, and ACWD should continue investigations to determine the cause of the exit gate oscillation, resultant elevated head drop, and unexpected ladder shutdown observed during the 2024 reporting period.
- A long-term strategy should be developed for maintaining fish ladder functionality as a part of the Project's Operations and Maintenance Plan.

5.1.2. Rubber Dam Operations

- While direction from the RD3 bladder manufacturer recommends normal operation of RD3 with reduced operating pressures, when RD3 is inflated, ACWD Water Supply staff should perform daily inspection for signs of leaks or failures near the bladder repair areas.

5.1.3. Fish Screens

- Approach velocities should be measured at the new Shinn Pond fish screen facility when diversions are at maximum capacity. Surveys should be conducted when water clarity is high, and wind speeds are low to make finding and holding position over the fish screens as easy as possible. Improvements should be made to the survey equipment to minimize any potential influence of the equipment on velocity measurements.

5.2. BIOLOGICAL MONITORING

During the 2023-2024 reporting period, ACWD was able to document successful immigration of Chinook Salmon and Pacific Lamprey with the ARIS unit and emigrating *O. mykiss* with the PIT tag antenna array. Predator/milling and stranding surveys continued to provide valuable information about how fish passage facilities might influence the behavior and passage success of target species. The experimental pulse flow conducted in early July 2024 also provided valuable information about how passage conditions were influenced by a short duration, high magnitude increase in flow downstream of the RD1 fish ladder. Summarized below are recommendations for future monitoring years based on the results of this monitoring.

5.2.1. Predator/Milling Surveys

- Although target species and predator observation data were consistently gathered throughout the 2023-2024 reporting period, there remains room for improvement in detailing observations, particularly regarding species identification. Enhancing the use of available tools, such as cameras and field guides, would provide more comprehensive insights into the interactions between target species and potential predators at the fish passage facilities. Furthermore, the frequency of surveys should be reduced from approximately daily during the entire calendar year to approximately weekly during the assumed *O. mykiss* migration period (1 January - 31 May). Additional surveys should be completed during the Chinook Salmon immigration period (1 November – 31 December) when feasible.

- Flow regulation has been shown to be a useful method for disrupting the reproductive success of nonnative predatory black bass and enhancing the recovery of native fishes (Bestgen and Hill 2016; Bestgen 2018). A similar outcome could be possible in the Alameda Creek Flood Control Channel, where nonnative black bass are abundant and have the potential to prey upon migrating *O. mykiss* and other native fishes. Strategically timing pulse flows (and subsequent dewatering of the RD1 and RD3 impoundments) towards the end of the *O. mykiss* emigration period (31 May) may help in the disruption of the reproductive success of these black bass by desiccating nests or causing their abandonment. Dewatering the RD1 and RD3 impoundments throughout the summer may also expose black bass to other predators (e.g., birds, mammals) and reduce their food availability, which may also help reduce their abundance, potentially enhancing the recovery of *O. mykiss* and other native fish species in the watershed.
- Predation on concentrated prey near anthropogenic barriers in rivers is a commonly observed behavior of birds (Agostinho et al. 2012), aquatic mammals (Fryer 1998; van der Leeuw and Tidwell 2021), and piscivorous fish (Sabal et al. 2016; Boulêtreau et al. 2018; Rillahan et al. 2021; Alcott et al. 2021). This potentially learned behavior may explain the relatively high number of adult black bass observed near the fish ladders. It may be beneficial to migrating *O. mykiss,* Chinook Salmon, and Pacific Lamprey to directly remove these predators in future years, particularly if flow regulation (e.g., nest desiccation, predator exposure, food availability) does not reduce their abundance.
- Given the points above, the potential impact that black bass could have on migrating *O. mykiss* and other native fishes in the Alameda Creek Flood Control Channel should be evaluated further. Additionally, the presence of black bass and their nests should be monitored within the RD1 and RD3 fish ladders and impoundments to determine whether management actions could or have had an effect on their abundance and reproductive success.

5.2.2. Stranding Surveys

- Continue to conduct thorough stranding surveys of both fish ladders each time they are dewatered. When stranded fish are observed in either fish ladder, more efficient methods for encouraging downstream movement (i.e., without fish handling) could be used rather than fully re-watering the ladder. For example, hoses can be used to introduce a smaller volume of water from the impoundments while the fish ladder is being dewatered to flush stranded fish downstream.
- Continue to discuss strategies with NMFS and CDFW if capture and transport of stranded fish is expected. *O. mykiss* should be transported upstream or downstream of the fish ladders depending on life stage, time of the year, and water quality conditions (Hayes et al. 2011). Release locations with suitable habitat conditions and minimal transport times should be identified prior to the initiation of potential stranding events (e.g., dewatering fish ladders, inflating/deflating dams).
- Although trigger events associated with the fish ladders appear to result in a relatively high likelihood of stranded fish, other triggers may not. For example, no stranded fish were observed from inflating/deflating either dam and only one stranded black bass was observed from reduced flows overtopping the RD1 dam. There were, however, three stranded *O. mykiss* observed in the isolated plunge pool downstream of the RD1 dam during a predator/milling survey on 22 March, though a stranding survey was not conducted. Additional stranding data are required during future

monitoring years (i.e., year-round) to determine which trigger events are more or less likely to lead to stranding of *O. mykiss* and other native species.

- *O. mykiss* were observed stranded in the RD1 fish ladder as late as July, over a month later than when the Project's BiOp assumed *O. mykiss* would no longer be present in the Alameda Creek Flood Control Channel (NMFS 2017). Additional research is needed to determine why *O. mykiss* that visually appeared to be in good health were observed in the RD1 fish ladder later than what would typically be expected when maximum daily water temperatures were above assumed lethal levels (i.e., 77°F or 25°C, NMFS 2017).

5.2.3. ARIS Sonar

- Although sonar imagery has become an increasingly popular method for passively monitoring aquatic species given its ability to produce near-video-quality images of organisms without being limited by water clarity or light-related visibility constraints, there are still substantial limits in its ability to identify fish images to species (Munnelly et al. 2024). Species-specific tailbeat frequencies (TBF) are a metric that can be calculated from and used to identify fish species in sonar imagery data; however, this method still requires a certain number of fish images of a known or assumed species before the TBF for that species can be calculated and used for classification. For example, TBFs have been calculated from sonar imagery collected in Alaska to classify immigrating salmon by species; however, those authors first had to assume that fish over a certain length were Chinook Salmon and that the remainder were Sockeye Salmon (*O. nerka*; Mueller et al. 2010; Kupilik and Petersen 2014). Other studies have used swimming patterns to identify fish images to species before calculating their TBF (e.g., anguilliform or S-shaped swimming motions of eels and lamprey; Mueller et al. 2008; Kirk et al. 2015) or calculated TBF of known species released into an isolated experimental pond (Helminen et al. 2021). Given that juvenile, smolt, and adult-sized *O. mykiss* in Alameda Creek share the same ranges of body lengths and general C-shaped swimming patterns as other native and nonnative fish species commonly observed in and around the RD1 fish ladder, species identification using TBF may not be applicable with the sonar imagery data alone. For example, pairing the ARIS unit with an underwater video camera to opportunistically identify migrating *O. mykiss* and other species captured by the ARIS unit would allow species-specific metrics (including TBF) to be calculated to more accurately differentiate *O. mykiss* from other species observed by the ARIS unit.
- Continue to improve the accuracy of fish counts and lengths identified in Echoview, primarily focusing on fish that fall within the adult *O. mykiss* size range (≥41 cm).
- Evaluate the feasibility of moving the ARIS unit upstream slightly to avoid recording bubbles and fish milling/resting in the downstream corners of the ladder. Removing bubbles from the unit's field of view would increase the accuracy of Echoview counts and improve Echoview's processing time. Furthermore, having fewer side-to-side movements of fish potentially milling and/or using the corners of the ladder for resting would increase the accuracy of estimated upstream and downstream movements.
- Develop a protocol to ensure that the ARIS unit is consistently recording and pointed in the same direction throughout the monitoring season.
- In 2024, ACWD staff improved communications capabilities to remotely monitor the ARIS operations at the RD1 and BART Weir fish passage facility, which allowed ACWD and CFS to regularly (i.e., every few days) evaluate ARIS unit operations and confirm that data were being recorded and saved to an external hard drive. However, these improved capabilities were limited and sometimes unreliable. In future years, ACWD will implement a more reliable connection method for performing these routine checks of the ARIS unit.

- Continue to monitor sonar image quality in real time and as ARIS files are reviewed. Plan to manually clean the ARIS unit at least once per migration period and to send the unit in for regular annual maintenance each summer. Additional maintenance may be required after wetter than average winters or if the ARIS unit starts recording earlier than the *O. mykiss* migration period (e.g., to monitor potential immigrating Chinook Salmon to confirm suitable camera operations prior to 1 January).

5.2.4. PIT Tag Antennas

- Given the ability to continuously monitor antenna performance using the test tags attached to each of the four PIT tag antennas, random swing tests are no longer required. However, if known power outages occur at the RD1 fish ladder, test tags should be used to evaluate whether all four antennas are functioning properly once power is restored.
- Additional efficiency testing should be conducted at 60 and 150 cfs using the same floating apparatuses that were used during the efficiency testing conducted at 30 cfs. Although radishes are a useful substitute for testing PIT tag antennas given their relatively low cost and semi-neutrally buoyant properties, it is likely that they passed through the antennas at random orientations during the efficiency testing conducted at 60 and 150 cfs, reducing the chance of their implanted PIT tag being detected.
- Read range tests of each PIT tag antenna should be repeated using methods similar to the testing performed by Biomark after the antennas were initially deployed but before the fish ladder was fully operational.
- Use capture efficiencies from SFPUC's rotary screw trap and fyke net and the proportion of captured fish that are tagged to estimate the total (i.e., tagged and untagged) number of *O. mykiss* smolts emigrating from the Alameda Creek Watershed to San Francisco Bay when that data becomes available.
- Use length at capture and recapture from SFPUC's monitoring to estimate growth and size of *O. mykiss* smolts emigrating from the Alameda Creek Watershed to San Francisco Bay when that data becomes available.
- Deployment of additional PIT tag antennas within Alameda Creek between SFPUC's traps and the RD1 and BART Weir fish passage facility and between the RD1 and BART Weir fish passage facility and San Francisco Bay would refine estimates of emigrating *O. mykiss*, help in estimating emigration survival, and allow for more robust statistical models to determine potential relationships between migration rates and environmental factors.

5.2.5. Experimental Pulse Flows

- Water quality conditions (e.g., water temperature, DO) should be monitored upstream, within, and downstream of the Project throughout the year, especially immediately before, during, and after dewatering and pulse flow events.
- Pulse flows should occur before potential water quality barriers (e.g., lethal or sublethal water temperatures and/or DO) develop upstream or downstream of the Project.
- The proportion of pulse flows released through the RD1 fish ladder should be maximized during dewatering and pulse flow events to detect as many emigrating PIT-tagged *O. mykiss* as possible.

5.3. SUMMARY OF ADAPTIVE MANAGEMENT RECOMMENDATIONS

Below is a summary of the adaptive management activities to be implemented and/or proposed to be implemented in future monitoring years.

1. The Project's BiOp addresses improving understanding of watershed hydrology through the installation of new stream gages as well as studies on stream losses through Sunol Valley (NMFS 2017). The SFPUC and USGS have completed the installation of a new stream gage on Alameda Creek in Sunol, upstream of the confluence with Arroyo de la Laguna Creek. Data from this new gage should be evaluated to support further efforts to characterize Sunol Valley losses and improve the determination of net SFPUC releases reaching Niles Gage for inclusion into ACWD's bypass flow calculation.
2. Sediment should be flushed or removed from within the transition pool and vortex pools of the RD1 and BART Weir fish passage facility to improve fish passage conditions.
3. ACWD will monitor the RD3 fish passage facility automatic operations and continue the investigation to determine the cause of the exit gate oscillation, resultant elevated head drop, and unexpected ladder shutdown observed during the 2024 reporting period.
4. Approach velocities should be measured at the new Shinn Pond fish screen facility when diversions are at maximum capacity.
5. The potential impact that black bass could have on migrating *O. mykiss* and other native fishes in Alameda Creek and whether management actions could influence their abundance, and reproductive success should be evaluated. ACWD will continue to use predator/milling surveys and underwater video cameras to document their presence in and around Creek Facilities.
6. ACWD will continue to conduct thorough stranding surveys of both fish ladders each time they are dewatered. When stranded fish are observed in either fish ladder, more efficient methods for encouraging downstream movement will be used rather than re-watering the ladder.
7. Use underwater video cameras in the RD1 fish ladder to opportunistically identify migrating *O. mykiss* and other species captured by the ARIS unit to more accurately differentiate *O. mykiss* from other species observed by the ARIS unit.
8. ACWD will evaluate the feasibility of moving the ARIS unit within the RD1 fish ladder to avoid recording bubbles and fish milling/resting in the downstream corners of the ladder.
9. Develop a protocol to ensure that the ARIS unit is consistently recording and pointed in the same direction throughout the monitoring season.
10. Set up a more reliable communications connection for routine checks of the ARIS unit.
11. Additional PIT tag antenna efficiency testing should be conducted at 60 cfs using the same floating apparatuses that were used during the efficiency testing conducted at 30 cfs.
12. ACWD will use information from SFPUC's monitoring (e.g., *O. mykiss* growth rates, trap capture efficiencies) when it becomes available to improve estimates of fish size and number of *O. mykiss* smolts emigrating from the Alameda Creek Watershed to San Francisco Bay.
13. Water quality conditions (e.g., water temperature, DO) should be monitored upstream, within, and downstream of the Project throughout the year, especially immediately before, during, and after dewatering and pulse flow events.

6. ACKNOWLEDGMENTS

This Project and the FLOWS Program continue to be rewarding and a great success. However, the program is a labor-intensive undertaking, requiring ongoing collaboration, planning, and coordination. This second monitoring year was successful not only because of the dedicated efforts of staff from ACWD and ACFCD and their consultants, Cramer Fish Sciences and Chuck Hanson, respectively, but also because of the contributions of the individuals and organizations acknowledged here.

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APPENDIX A
Bypass Compliance Report

RD1 Bypass Compliance Report

Input Measuring Period (noon to noon)	Bypass Compliance Period (noon to noon)	Input Measuring Period End (at noon)	Bypass Compliance Period End (at noon)	Compliance Met (True/False)	Migration Season	Wet/Dry Season	Niles In-flow, CFS	SFPUC Required Bypass at RD1, CFS	Required Bypass Flow, CFS	Total Bypass Flow (fishway flow, auxiliary flow, overspill), CFS	Fishway Flow, CFS	Auxiliary Flow, CFS	Dam Up/Down	RD1 Dam Overspill, CFS	Excess Bypass, CFS
08/31/2023 - 09/01/2023	09/01/2023 - 09/02/2023	9/1/2023	9/2/2023	TRUE	Off Season	Wet	27.9	0.00	5.0	14.0	16.5	-	UP	-	9.0
09/01/2023 - 09/02/2023	09/02/2023 - 09/03/2023	9/2/2023	9/3/2023	TRUE	Off Season	Wet	23.2	0.00	5.0	9.0	9.8	-	UP	-	4.0
09/02/2023 - 09/03/2023	09/03/2023 - 09/04/2023	9/3/2023	9/4/2023	TRUE	Off Season	Wet	16.2	0.00	5.0	6.0	7.3	-	UP	-	1.0
09/03/2023 - 09/04/2023	09/04/2023 - 09/05/2023	9/4/2023	9/5/2023	FALSE	Off Season	Wet	12.6	0.00	5.0	4.0	5.6	-	UP	-	-
09/04/2023 - 09/05/2023	09/05/2023 - 09/06/2023	9/5/2023	9/6/2023	TRUE	Off Season	Wet	12.7	0.00	5.0	5.0	6.5	-	UP	-	-
09/05/2023 - 09/06/2023	09/06/2023 - 09/07/2023	9/6/2023	9/7/2023	TRUE	Off Season	Wet	19.2	0.00	5.0	10.0	11.2	-	UP	-	5.0
09/06/2023 - 09/07/2023	09/07/2023 - 09/08/2023	9/7/2023	9/8/2023	TRUE	Off Season	Wet	28.2	0.00	5.0	13.0	13.8	-	UP	-	8.0
09/07/2023 - 09/08/2023	09/08/2023 - 09/09/2023	9/8/2023	9/9/2023	TRUE	Off Season	Wet	29.1	0.00	5.0	13.0	14.4	-	UP	-	8.0
09/08/2023 - 09/09/2023	09/09/2023 - 09/10/2023	9/9/2023	9/10/2023	TRUE	Off Season	Wet	27.6	0.00	5.0	12.0	12.7	-	UP	-	7.0
09/09/2023 - 09/10/2023	09/10/2023 - 09/11/2023	9/10/2023	9/11/2023	TRUE	Off Season	Wet	16.4	0.00	5.0	8.0	8.5	-	UP	-	3.0
09/10/2023 - 09/11/2023	09/11/2023 - 09/12/2023	9/11/2023	9/12/2023	TRUE	Off Season	Wet	16.6	0.00	5.0	13.0	14.0	-	UP	-	8.0
09/11/2023 - 09/12/2023	09/12/2023 - 09/13/2023	9/12/2023	9/13/2023	TRUE	Off Season	Wet	27.8	0.00	5.0	17.0	17.0	-	UP	-	12.0
09/12/2023 - 09/13/2023	09/13/2023 - 09/14/2023	9/13/2023	9/14/2023	TRUE	Off Season	Wet	28.6	0.00	5.0	18.0	18.1	-	UP	-	13.0
09/13/2023 - 09/14/2023	09/14/2023 - 09/15/2023	9/14/2023	9/15/2023	TRUE	Off Season	Wet	29.8	0.00	5.0	18.0	17.6	-	UP	0.4	13.0
09/14/2023 - 09/15/2023	09/15/2023 - 09/16/2023	9/15/2023	9/16/2023	TRUE	Off Season	Wet	22.9	0.00	5.0	13.0	13.5	-	UP	-	8.0
09/15/2023 - 09/16/2023	09/16/2023 - 09/17/2023	9/16/2023	9/17/2023	TRUE	Off Season	Wet	23.2	0.00	5.0	11.0	11.6	-	UP	-	6.0
09/16/2023 - 09/17/2023	09/17/2023 - 09/18/2023	9/17/2023	9/18/2023	TRUE	Off Season	Wet	21.4	0.00	5.0	12.0	11.8	-	UP	0.2	7.0
09/17/2023 - 09/18/2023	09/18/2023 - 09/19/2023	9/18/2023	9/19/2023	TRUE	Off Season	Wet	26.4	0.00	5.0	16.0	16.6	-	UP	-	11.0
09/18/2023 - 09/19/2023	09/19/2023 - 09/20/2023	9/19/2023	9/20/2023	TRUE	Off Season	Wet	31.6	0.00	5.0	19.0	19.0	-	UP	-	14.0
09/19/2023 - 09/20/2023	09/20/2023 - 09/21/2023	9/20/2023	9/21/2023	TRUE	Off Season	Wet	30.6	0.00	5.0	20.0	20.0	-	UP	-	15.0
09/20/2023 - 09/21/2023	09/21/2023 - 09/22/2023	9/21/2023	9/22/2023	TRUE	Off Season	Wet	31.8	0.00	5.0	22.0	21.5	-	UP	0.5	17.0
09/21/2023 - 09/22/2023	09/22/2023 - 09/23/2023	9/22/2023	9/23/2023	TRUE	Off Season	Wet	32.7	0.00	5.0	21.0	20.7	-	UP	0.3	16.0
09/22/2023 - 09/23/2023	09/23/2023 - 09/24/2023	9/23/2023	9/24/2023	TRUE	Off Season	Wet	26.8	0.00	5.0	14.0	15.6	-	UP	-	9.0
09/23/2023 - 09/24/2023	09/24/2023 - 09/25/2023	9/24/2023	9/25/2023	TRUE	Off Season	Wet	22.6	0.00	5.0	13.0	13.6	-	UP	-	8.0
09/24/2023 - 09/25/2023	09/25/2023 - 09/26/2023	9/25/2023	9/26/2023	TRUE	Off Season	Wet	22.3	0.00	5.0	12.0	13.3	-	UP	-	7.0
09/25/2023 - 09/26/2023	09/26/2023 - 09/27/2023	9/26/2023	9/27/2023	TRUE	Off Season	Wet	26.8	0.00	5.0	16.0	17.7	-	UP	-	11.0
09/26/2023 - 09/27/2023	09/27/2023 - 09/28/2023	9/27/2023	9/28/2023	TRUE	Off Season	Wet	31.9	0.00	5.0	21.0	21.1	-	UP	-	16.0
09/27/2023 - 09/28/2023	09/28/2023 - 09/29/2023	9/28/2023	9/29/2023	TRUE	Off Season	Wet	33.3	0.00	5.0	21.0	21.5	-	UP	-	16.0
09/28/2023 - 09/29/2023	09/29/2023 - 09/30/2023	9/29/2023	9/30/2023	TRUE	Off Season	Wet	30.6	0.00	5.0	19.0	20.1	-	UP	-	14.0
09/29/2023 - 09/30/2023	09/30/2023 - 10/01/2023	9/30/2023	10/1/2023	TRUE	Off Season	Wet	24.7	0.00	5.0	12.0	14.1	-	UP	-	7.0
09/30/2023 - 10/01/2023	10/01/2023 - 10/02/2023	10/1/2023	10/2/2023	TRUE	Off Season	Wet	20.1	0.00	5.0	12.0	12.8	0.0	UP	-	7.0
10/01/2023 - 10/02/2023	10/02/2023 - 10/03/2023	10/2/2023	10/3/2023	TRUE	Off Season	Wet	26.2	0.00	5.0	15.0	17.3	0.1	UP	-	10.0
10/02/2023 - 10/03/2023	10/03/2023 - 10/04/2023	10/3/2023	10/4/2023	TRUE	Off Season	Wet	31.6	0.00	5.0	18.0	19.5	0.0	UP	-	13.0
10/03/2023 - 10/04/2023	10/04/2023 - 10/05/2023	10/4/2023	10/5/2023	TRUE	Off Season	Wet	29.2	0.00	5.0	17.0	18.5	-	UP	-	12.0
10/04/2023 - 10/05/2023	10/05/2023 - 10/06/2023	10/5/2023	10/6/2023	TRUE	Off Season	Wet	26.8	0.00	5.0	15.0	17.0	0.2	UP	-	10.0
10/05/2023 - 10/06/2023	10/06/2023 - 10/07/2023	10/6/2023	10/7/2023	TRUE	Off Season	Wet	24.9	0.00	5.0	13.0	14.7	0.8	UP	-	8.0
10/06/2023 - 10/07/2023	10/07/2023 - 10/08/2023	10/7/2023	10/8/2023	TRUE	Off Season	Wet	19.5	0.00	5.0	9.0	10.4	0.2	UP	-	4.0
10/07/2023 - 10/08/2023	10/08/2023 - 10/09/2023	10/8/2023	10/9/2023	TRUE	Off Season	Wet	20.2	0.00	5.0	7.0	8.4	0.1	UP	-	2.0
10/08/2023 - 10/09/2023	10/09/2023 - 10/10/2023	10/9/2023	10/10/2023	TRUE	Off Season	Wet	18.2	0.00	5.0	9.0	11.1	0.0	UP	-	4.0
10/09/2023 - 10/10/2023	10/10/2023 - 10/11/2023	10/10/2023	10/11/2023	TRUE	Off Season	Wet	23.1	0.00	5.0	11.0	13.2	-	UP	-	6.0
10/10/2023 - 10/11/2023	10/11/2023 - 10/12/2023	10/11/2023	10/12/2023	TRUE	Off Season	Wet	24.2	0.00	5.0	12.0	14.1	0.2	UP	-	7.0
10/11/2023 - 10/12/2023	10/12/2023 - 10/13/2023	10/12/2023	10/13/2023	TRUE	Off Season	Wet	23.0	0.00	5.0	12.0	14.3	0.2	UP	-	7.0
10/12/2023 - 10/13/2023	10/13/2023 - 10/14/2023	10/13/2023	10/14/2023	TRUE	Off Season	Wet	23.4	0.00	5.0	11.0	13.2	0.2	UP	-	6.0
10/13/2023 - 10/14/2023	10/14/2023 - 10/15/2023	10/14/2023	10/15/2023	TRUE	Off Season	Wet	20.1	0.00	5.0	7.0	9.2	0.0	UP	-	2.0
10/14/2023 - 10/15/2023	10/15/2023 - 10/16/2023	10/15/2023	10/16/2023	TRUE	Off Season	Wet	16.7	0.00	5.0	6.0	7.8	-	UP	-	1.0
10/15/2023 - 10/16/2023	10/16/2023 - 10/17/2023	10/16/2023	10/17/2023	TRUE	Off Season	Wet	15.5	0.00	5.0	7.0	9.1	-	UP	-	2.0
10/16/2023 - 10/17/2023	10/17/2023 - 10/18/2023	10/17/2023	10/18/2023	TRUE	Off Season	Wet	20.3	0.00	5.0	9.0	10.7	-	UP	-	4.0
10/17/2023 - 10/18/2023	10/18/2023 - 10/19/2023	10/18/2023	10/19/2023	TRUE	Off Season	Wet	21.6	0.00	5.0	10.0	11.8	-	UP	-	5.0
10/18/2023 - 10/19/2023	10/19/2023 - 10/20/2023	10/19/2023	10/20/2023	TRUE	Off Season	Wet	21.7	0.00	5.0	9.0	11.3	-	UP	-	4.0
10/19/2023 - 10/20/2023	10/20/2023 - 10/21/2023	10/20/2023	10/21/2023	TRUE	Off Season	Wet	15.2	0.00	5.0	5.0	7.5	0.1	UP	-	-
10/20/2023 - 10/21/2023	10/21/2023 - 10/22/2023	10/21/2023	10/22/2023	TRUE	Off Season	Wet	12.8	0.00	5.0	8.0	10.8	0.0	UP	-	3.0
10/21/2023 - 10/22/2023	10/22/2023 - 10/23/2023	10/22/2023	10/23/2023	TRUE	Off Season	Wet	12.4	0.00	5.0	6.0	8.6	-	UP	-	1.0
10/22/2023 - 10/23/2023	10/23/2023 - 10/24/2023	10/23/2023	10/24/2023	TRUE	Off Season	Wet	13.7	0.00	5.0	8.0	10.3	-	UP	-	3.0
10/23/2023 - 10/24/2023	10/24/2023 - 10/25/2023	10/24/2023	10/25/2023	TRUE	Off Season	Wet	26.3	0.00	5.0	7.0	8.8	-	UP	-	2.0
10/24/2023 - 10/25/2023	10/25/2023 - 10/26/2023	10/25/2023	10/26/2023	TRUE	Off Season	Wet	27.9	0.00	5.0	6.0	8.3	-	UP	-	1.0
10/25/2023 - 10/26/2023	10/26/2023 - 10/27/2023	10/26/2023	10/27/2023	TRUE	Off Season	Wet	25.7	0.00	5.0	6.0	8.2	-	UP	-	1.0
10/26/2023 - 10/27/2023	10/27/2023 - 10/28/2023	10/27/2023	10/28/2023	TRUE	Off Season	Wet	25.8	0.00	5.0	8.0	10.8	-	UP	-	3.0
10/27/2023 - 10/28/2023	10/28/2023 - 10/29/2023	10/28/2023	10/29/2023	TRUE	Off Season	Wet	21.0	0.00	5.0	10.0	12.9	-	UP	-	5.0
10/28/2023 - 10/29/2023	10/29/2023 - 10/30/2023	10/29/2023	10/30/2023	TRUE	Off Season	Wet	13.9	0.00	5.0	7.0	9.1	-	UP	-	2.0
10/29/2023 - 10/30/2023	10/30/2023 - 10/31/2023	10/30/2023	10/31/2023	TRUE	Off Season	Wet	17.3	0.00	5.0	7.0	9.3	-	UP	-	2.0
10/30/2023 - 10/31/2023	10/31/2023 - 11/01/2023	10/31/2023	11/1/2023	TRUE	Off Season	Wet	23.3	0.00	5.0	7.0	9.7	-	UP	-	2.0
10/31/2023 - 11/01/2023	11/01/2023 - 11/02/2023	11/1/2023	11/2/2023	TRUE	Off Season	Wet	23.6	0.00	5.0	8.0	10.1	-	UP	-	3.0
11/01/2023 - 11/02/2023	11/02/2023 - 11/03/2023	11/2/2023	11/3/2023	TRUE	Off Season	Wet	23.0	0.00	5.0	8.0	10.5	-	UP	-	3.0
11/02/2023 - 11/03/2023	11/03/2023 - 11/04/2023	11/3/2023	11/4/2023	TRUE	Off Season	Wet	18.8	0.00	5.0	8.0	10.7	-	UP	-	3.0
11/03/2023 - 11/04/2023	11/04/2023 - 11/05/2023	11/4/2023	11/5/2023	TRUE	Off Season	Wet	14.4	0.00	5.0	8.0	10.9	-	UP	-	3.0
11/04/2023 - 11/05/2023	11/05/2023 - 11/06/2023	11/5/2023	11/6/2023	TRUE	Off Season	Wet	15.2	0.00	5.0	10.0	12.5	-	UP	-	5.0
11/05/2023 - 11/06/2023	11/06/2023 - 11/07/2023	11/6/2023	11/7/2023	TRUE	Off Season	Wet	16.0	0.00	5.0	12.0	15.9	-	UP	-	7.0

RD1 Bypass Compliance Report

Input Measuring Period (noon to noon)	Bypass Compliance Period (noon to noon)	Input Measuring Period End (at noon)	Bypass Compliance Period End (at noon)	Compliance Met (True/False)	Migration Season	Wet/Dry Season	Niles In-flow, CFS	SFPUC Required Bypass at RD1, CFS	Required Bypass Flow, CFS	Total Bypass Flow (fishway flow, auxiliary flow, overspill), CFS	Fishway Flow, CFS	Auxiliary Flow, CFS	Dam Up/Down	RD1 Dam Overspill, CFS	Excess Bypass, CFS
11/06/2023 - 11/07/2023	11/07/2023 - 11/08/2023	11/7/2023	11/8/2023	TRUE	Off Season	Wet	61.8	0.00	5.0	10.0	13.2	-	UP	-	5.0
11/07/2023 - 11/08/2023	11/08/2023 - 11/09/2023	11/8/2023	11/9/2023	TRUE	Off Season	Wet	47.4	0.00	5.0	9.0	12.0	-	UP	-	4.0
11/08/2023 - 11/09/2023	11/09/2023 - 11/10/2023	11/9/2023	11/10/2023	TRUE	Off Season	Wet	33.5	0.00	5.0	9.0	11.6	-	UP	-	4.0
11/09/2023 - 11/10/2023	11/10/2023 - 11/11/2023	11/10/2023	11/11/2023	TRUE	Off Season	Wet	28.0	0.00	5.0	8.0	10.7	-	UP	-	3.0
11/10/2023 - 11/11/2023	11/11/2023 - 11/12/2023	11/11/2023	11/12/2023	TRUE	Off Season	Wet	23.2	0.00	5.0	7.0	9.9	-	UP	-	2.0
11/11/2023 - 11/12/2023	11/12/2023 - 11/13/2023	11/12/2023	11/13/2023	TRUE	Off Season	Wet	20.2	0.00	5.0	7.0	9.4	-	UP	-	2.0
11/12/2023 - 11/13/2023	11/13/2023 - 11/14/2023	11/13/2023	11/14/2023	TRUE	Off Season	Wet	19.9	0.00	5.0	8.0	10.6	-	UP	-	3.0
11/13/2023 - 11/14/2023	11/14/2023 - 11/15/2023	11/14/2023	11/15/2023	TRUE	Off Season	Wet	30.7	0.00	5.0	9.0	11.4	-	UP	-	4.0
11/14/2023 - 11/15/2023	11/15/2023 - 11/16/2023	11/15/2023	11/16/2023	TRUE	Off Season	Wet	27.4	0.00	5.0	12.0	15.2	-	UP	-	7.0
11/15/2023 - 11/16/2023	11/16/2023 - 11/17/2023	11/16/2023	11/17/2023	TRUE	Off Season	Wet	30.0	0.00	5.0	12.0	15.7	-	UP	-	7.0
11/16/2023 - 11/17/2023	11/17/2023 - 11/18/2023	11/17/2023	11/18/2023	TRUE	Off Season	Wet	39.7	0.00	5.0	13.0	17.4	0.1	UP	-	8.0
11/17/2023 - 11/18/2023	11/18/2023 - 11/19/2023	11/18/2023	11/19/2023	TRUE	Off Season	Wet	31.4	0.00	5.0	13.0	16.5	0.0	UP	-	8.0
11/18/2023 - 11/19/2023	11/19/2023 - 11/20/2023	11/19/2023	11/20/2023	TRUE	Off Season	Wet	54.9	0.00	5.0	10.0	12.9	-	UP	-	5.0
11/19/2023 - 11/20/2023	11/20/2023 - 11/21/2023	11/20/2023	11/21/2023	TRUE	Off Season	Wet	42.7	0.00	5.0	9.0	11.3	0.1	UP	-	4.0
11/20/2023 - 11/21/2023	11/21/2023 - 11/22/2023	11/21/2023	11/22/2023	TRUE	Off Season	Wet	29.2	0.00	5.0	9.0	11.2	0.0	UP	-	4.0
11/21/2023 - 11/22/2023	11/22/2023 - 11/23/2023	11/22/2023	11/23/2023	TRUE	Off Season	Wet	20.9	0.00	5.0	9.0	11.3	-	UP	-	4.0
11/22/2023 - 11/23/2023	11/23/2023 - 11/24/2023	11/23/2023	11/24/2023	TRUE	Off Season	Wet	16.2	0.00	5.0	8.0	10.9	-	UP	-	3.0
11/23/2023 - 11/24/2023	11/24/2023 - 11/25/2023	11/24/2023	11/25/2023	TRUE	Off Season	Wet	16.7	0.00	5.0	8.0	10.7	-	UP	-	3.0
11/24/2023 - 11/25/2023	11/25/2023 - 11/26/2023	11/25/2023	11/26/2023	TRUE	Off Season	Wet	18.5	0.00	5.0	8.0	10.4	-	UP	-	3.0
11/25/2023 - 11/26/2023	11/26/2023 - 11/27/2023	11/26/2023	11/27/2023	TRUE	Off Season	Wet	13.6	0.00	5.0	7.0	8.6	-	UP	-	2.0
11/26/2023 - 11/27/2023	11/27/2023 - 11/28/2023	11/27/2023	11/28/2023	TRUE	Off Season	Wet	12.0	0.00	5.0	7.0	10.0	0.2	UP	-	2.0
11/27/2023 - 11/28/2023	11/28/2023 - 11/29/2023	11/28/2023	11/29/2023	TRUE	Off Season	Wet	11.9	0.00	5.0	7.0	8.9	-	UP	-	2.0
11/28/2023 - 11/29/2023	11/29/2023 - 11/30/2023	11/29/2023	11/30/2023	TRUE	Off Season	Wet	14.0	0.00	5.0	8.0	10.5	-	UP	-	3.0
11/29/2023 - 11/30/2023	11/30/2023 - 12/01/2023	11/30/2023	12/1/2023	TRUE	Off Season	Wet	28.0	0.00	5.0	10.0	11.6	-	UP	-	5.0
11/30/2023 - 12/01/2023	12/01/2023 - 12/02/2023	12/1/2023	12/2/2023	TRUE	Off Season	Wet	22.6	0.00	5.0	10.0	11.4	-	UP	-	5.0
12/01/2023 - 12/02/2023	12/02/2023 - 12/03/2023	12/2/2023	12/3/2023	TRUE	Off Season	Wet	17.9	0.00	5.0	10.0	11.7	-	UP	-	5.0
12/02/2023 - 12/03/2023	12/03/2023 - 12/04/2023	12/3/2023	12/4/2023	TRUE	Off Season	Wet	16.1	0.00	5.0	10.0	11.6	-	UP	-	5.0
12/03/2023 - 12/04/2023	12/04/2023 - 12/05/2023	12/4/2023	12/5/2023	TRUE	Off Season	Wet	16.1	0.00	5.0	9.0	11.1	-	UP	-	4.0
12/04/2023 - 12/05/2023	12/05/2023 - 12/06/2023	12/5/2023	12/6/2023	TRUE	Off Season	Wet	16.1	0.00	5.0	9.0	10.7	-	UP	-	4.0
12/05/2023 - 12/06/2023	12/06/2023 - 12/07/2023	12/6/2023	12/7/2023	TRUE	Off Season	Wet	15.5	0.00	5.0	10.0	12.6	-	UP	-	5.0
12/06/2023 - 12/07/2023	12/07/2023 - 12/08/2023	12/7/2023	12/8/2023	TRUE	Off Season	Wet	17.9	0.00	5.0	20.0	19.8	0.0	UP	0.2	15.0
12/07/2023 - 12/08/2023	12/08/2023 - 12/09/2023	12/8/2023	12/9/2023	TRUE	Off Season	Wet	25.7	0.00	5.0	15.0	16.1	0.0	UP	-	10.0
12/08/2023 - 12/09/2023	12/09/2023 - 12/10/2023	12/9/2023	12/10/2023	TRUE	Off Season	Wet	19.4	0.00	5.0	14.0	15.2	-	UP	-	9.0
12/09/2023 - 12/10/2023	12/10/2023 - 12/11/2023	12/10/2023	12/11/2023	TRUE	Off Season	Wet	14.5	0.00	5.0	11.0	13.0	-	UP	-	6.0
12/10/2023 - 12/11/2023	12/11/2023 - 12/12/2023	12/11/2023	12/12/2023	TRUE	Off Season	Wet	11.8	0.00	5.0	8.0	10.6	-	UP	-	3.0
12/11/2023 - 12/12/2023	12/12/2023 - 12/13/2023	12/12/2023	12/13/2023	TRUE	Off Season	Wet	10.4	0.00	5.0	6.0	8.6	-	UP	-	1.0
12/12/2023 - 12/13/2023	12/13/2023 - 12/14/2023	12/13/2023	12/14/2023	TRUE	Off Season	Wet	10.0	0.00	5.0	10.0	12.2	-	UP	-	5.0
12/13/2023 - 12/14/2023	12/14/2023 - 12/15/2023	12/14/2023	12/15/2023	TRUE	Off Season	Wet	10.3	0.00	5.0	10.0	11.6	-	UP	-	5.0
12/14/2023 - 12/15/2023	12/15/2023 - 12/16/2023	12/15/2023	12/16/2023	TRUE	Off Season	Wet	10.1	0.00	5.0	8.0	10.7	-	UP	-	3.0
12/15/2023 - 12/16/2023	12/16/2023 - 12/17/2023	12/16/2023	12/17/2023	TRUE	Off Season	Wet	13.8	0.00	5.0	9.0	11.1	-	UP	-	4.0
12/16/2023 - 12/17/2023	12/17/2023 - 12/18/2023	12/17/2023	12/18/2023	TRUE	Off Season	Wet	22.4	0.00	5.0	12.0	12.4	-	UP	-	7.0
12/17/2023 - 12/18/2023	12/18/2023 - 12/19/2023	12/18/2023	12/19/2023	TRUE	Off Season	Wet	25.6	0.00	5.0	34.0	26.8	-	UP	7.2	29.0
12/18/2023 - 12/19/2023	12/19/2023 - 12/20/2023	12/19/2023	12/20/2023	TRUE	Off Season	Wet	330.2	0.00	5.0	182.0	33.6	-	UP	148.4	177.0
12/19/2023 - 12/20/2023	12/20/2023 - 12/21/2023	12/20/2023	12/21/2023	TRUE	Off Season	Wet	309.1	0.00	5.0	28.0	31.0	-	UP	-	23.0
12/20/2023 - 12/21/2023	12/21/2023 - 12/22/2023	12/21/2023	12/22/2023	TRUE	Off Season	Wet	248.1	0.00	5.0	24.0	26.2	-	UP	-	19.0
12/21/2023 - 12/22/2023	12/22/2023 - 12/23/2023	12/22/2023	12/23/2023	TRUE	Off Season	Wet	79.7	0.00	5.0	15.0	17.4	-	UP	-	10.0
12/22/2023 - 12/23/2023	12/23/2023 - 12/24/2023	12/23/2023	12/24/2023	TRUE	Off Season	Wet	46.0	0.00	5.0	17.0	20.6	-	UP	-	12.0
12/23/2023 - 12/24/2023	12/24/2023 - 12/25/2023	12/24/2023	12/25/2023	TRUE	Off Season	Wet	32.9	0.00	5.0	20.0	21.8	-	UP	-	15.0
12/24/2023 - 12/25/2023	12/25/2023 - 12/26/2023	12/25/2023	12/26/2023	TRUE	Off Season	Wet	27.4	0.00	5.0	20.0	21.9	-	UP	-	15.0
12/25/2023 - 12/26/2023	12/26/2023 - 12/27/2023	12/26/2023	12/27/2023	TRUE	Off Season	Wet	23.5	0.00	5.0	20.0	21.4	-	UP	-	15.0
12/26/2023 - 12/27/2023	12/27/2023 - 12/28/2023	12/27/2023	12/28/2023	TRUE	Off Season	Wet	22.4	0.00	5.0	19.0	20.7	-	UP	-	14.0
12/27/2023 - 12/28/2023	12/28/2023 - 12/29/2023	12/28/2023	12/29/2023	TRUE	Off Season	Wet	23.4	0.00	5.0	27.0	28.5	-	UP	-	22.0
12/28/2023 - 12/29/2023	12/29/2023 - 12/30/2023	12/29/2023	12/30/2023	TRUE	Off Season	Wet	32.7	0.00	5.0	42.0	43.5	0.9	UP	-	37.0
12/29/2023 - 12/30/2023	12/30/2023 - 12/31/2023	12/30/2023	12/31/2023	TRUE	Off Season	Wet	128.5	0.00	5.0	35.0	32.3	0.0	UP	2.7	30.0
12/30/2023 - 12/31/2023	12/31/2023 - 01/01/2024	12/31/2023	1/1/2024	TRUE	Off Season	Wet	138.8	0.00	5.0	26.0	27.0	-	UP	-	21.0
12/31/2023 - 01/01/2024	01/01/2024 - 01/02/2024	1/1/2024	1/2/2024	TRUE	In-Migration	Wet	73.2	0.00	25.0	34.0	26.3	3.6	UP	4.2	9.0
01/01/2024 - 01/02/2024	01/02/2024 - 01/03/2024	1/2/2024	1/3/2024	TRUE	In-Migration	Wet	47.5	0.00	25.0	132.0	32.3	2.2	UP	97.5	107.0
01/02/2024 - 01/03/2024	01/03/2024 - 01/04/2024	1/3/2024	1/4/2024	TRUE	In-Migration	Wet	320.9	5.04	30.0	52.0	32.6	0.9	UP	18.5	22.0
01/03/2024 - 01/04/2024	01/04/2024 - 01/05/2024	1/4/2024	1/5/2024	TRUE	In-Migration	Wet	206.9	14.42	39.4	43.0	38.1	7.7	UP	-	3.6
01/04/2024 - 01/05/2024	01/05/2024 - 01/06/2024	1/5/2024	1/6/2024	TRUE	In-Migration	Wet	83.9	0.00	25.0	33.0	33.8	0.0	UP	-	8.0
01/05/2024 - 01/06/2024	01/06/2024 - 01/07/2024	1/6/2024	1/7/2024	TRUE	In-Migration	Wet	54.8	0.00	25.0	32.0	29.2	3.3	UP	-	7.0
01/06/2024 - 01/07/2024	01/07/2024 - 01/08/2024	1/7/2024	1/8/2024	TRUE	In-Migration	Wet	97.3	0.00	25.0	32.0	25.8	7.3	UP	-	7.0
01/07/2024 - 01/08/2024	01/08/2024 - 01/09/2024	1/8/2024	1/9/2024	TRUE	In-Migration	Wet	63.8	0.00	25.0	34.0	34.9	0.0	UP	-	9.0
01/08/2024 - 01/09/2024	01/09/2024 - 01/10/2024	1/9/2024	1/10/2024	TRUE	In-Migration	Wet	43.2	0.00	25.0	31.0	28.3	3.4	UP	-	6.0
01/09/2024 - 01/10/2024	01/10/2024 - 01/11/2024	1/10/2024	1/11/2024	TRUE	In-Migration	Wet	36.0	0.00	25.0	32.0	27.9	3.7	UP	0.4	7.0
01/10/2024 - 01/11/2024	01/11/2024 - 01/12/2024	1/11/2024	1/12/2024	TRUE	In-Migration	Wet	87.4	0.00	25.0	32.0	25.1	8.0	UP	-	7.0
01/11/2024 - 01/12/2024	01/12/2024 - 01/13/2024	1/12/2024	1/13/2024	TRUE	In-Migration	Wet	95.5	0.00	25.0	32.0	26.8	4.6	UP	0.6	7.0

RD1 Bypass Compliance Report

Input Measuring Period (noon to noon)	Bypass Compliance Period (noon to noon)	Input Measuring Period End (at noon)	Bypass Compliance Period End (at noon)	Compliance Met (True/False)	Migration Season	Wet/Dry Season	Niles In-flow, CFS	SFPUC Required Bypass at RD1, CFS	Required Bypass Flow, CFS	Total Bypass Flow (fishway flow, auxiliary flow, overspill), CFS	Fishway Flow, CFS	Auxiliary Flow, CFS	Dam Up/Down	RD1 Dam Overspill, CFS	Excess Bypass, CFS
01/12/2024 - 01/13/2024	01/13/2024 - 01/14/2024	1/13/2024	1/14/2024	TRUE	In-Migration	Wet	48.5	0.00	25.0	155.0	31.8	2.5	UP	120.7	130.0
01/13/2024 - 01/14/2024	01/14/2024 - 01/15/2024	1/14/2024	1/15/2024	TRUE	In-Migration	Wet	248.8	24.34	49.3	160.0	34.6	0.1	UP	125.3	110.7
01/14/2024 - 01/15/2024	01/15/2024 - 01/16/2024	1/15/2024	1/16/2024	TRUE	In-Migration	Wet	173.1	25.00	50.0	70.0	33.5	-	UP	36.5	20.0
01/15/2024 - 01/16/2024	01/16/2024 - 01/17/2024	1/16/2024	1/17/2024	TRUE	In-Migration	Wet	83.1	0.00	25.0	148.0	34.3	-	UP	113.7	123.0
01/16/2024 - 01/17/2024	01/17/2024 - 01/18/2024	1/17/2024	1/18/2024	TRUE	In-Migration	Wet	205.0	21.21	46.2	120.0	34.3	-	UP	85.7	73.8
01/17/2024 - 01/18/2024	01/18/2024 - 01/19/2024	1/18/2024	1/19/2024	TRUE	In-Migration	Wet	176.2	24.83	49.8	61.0	33.0	-	UP	28.0	11.2
01/18/2024 - 01/19/2024	01/19/2024 - 01/20/2024	1/19/2024	1/20/2024	TRUE	In-Migration	Wet	87.7	0.00	25.0	59.0	33.0	-	UP	26.0	34.0
01/19/2024 - 01/20/2024	01/20/2024 - 01/21/2024	1/20/2024	1/21/2024	TRUE	In-Migration	Wet	77.1	0.00	25.0	142.0	34.3	-	UP	107.7	117.0
01/20/2024 - 01/21/2024	01/21/2024 - 01/22/2024	1/21/2024	1/22/2024	TRUE	In-Migration	Wet	170.1	25.00	50.0	633.0	24.5	0.7	UP	607.8	583.0
01/21/2024 - 01/22/2024	01/22/2024 - 01/23/2024	1/22/2024	1/23/2024	TRUE	In-Migration	Wet	673.6	25.00	50.0	1,321.0	17.9	0.1	UP	1,303.0	1,271.0
01/22/2024 - 01/23/2024	01/23/2024 - 01/24/2024	1/23/2024	1/24/2024	TRUE	In-Migration	Wet	1,312.5	25.00	50.0	325.0	34.4	-	UP	290.6	275.0
01/23/2024 - 01/24/2024	01/24/2024 - 01/25/2024	1/24/2024	1/25/2024	TRUE	In-Migration	Wet	296.1	25.00	50.0	612.0	33.8	-	UP	578.2	562.0
01/24/2024 - 01/25/2024	01/25/2024 - 01/26/2024	1/25/2024	1/26/2024	TRUE	In-Migration	Wet	574.5	25.00	50.0	266.0	32.7	-	DOWN	233.3	216.0
01/25/2024 - 01/26/2024	01/26/2024 - 01/27/2024	1/26/2024	1/27/2024	TRUE	In-Migration	Wet	226.2	25.00	50.0	178.0	26.8	-	UP	151.2	128.0
01/26/2024 - 01/27/2024	01/27/2024 - 01/28/2024	1/27/2024	1/28/2024	TRUE	In-Migration	Wet	147.6	25.00	50.0	130.0	31.9	-	UP	98.1	80.0
01/27/2024 - 01/28/2024	01/28/2024 - 01/29/2024	1/28/2024	1/29/2024	TRUE	In-Migration	Wet	102.3	25.00	50.0	106.0	32.8	-	UP	73.2	56.0
01/28/2024 - 01/29/2024	01/29/2024 - 01/30/2024	1/29/2024	1/30/2024	TRUE	In-Migration	Wet	80.0	0.00	25.0	62.0	45.2	-	UP	16.8	37.0
01/29/2024 - 01/30/2024	01/30/2024 - 01/31/2024	1/30/2024	1/31/2024	TRUE	In-Migration	Wet	72.0	0.00	25.0	86.0	46.3	-	UP	39.7	61.0
01/30/2024 - 01/31/2024	01/31/2024 - 02/01/2024	1/31/2024	2/1/2024	TRUE	In-Migration	Wet	68.1	0.00	25.0	273.0	38.5	-	UP	234.5	248.0
01/31/2024 - 02/01/2024	02/01/2024 - 02/02/2024	2/1/2024	2/2/2024	TRUE	In-Migration	Wet	282.8	25.00	50.0	449.0	40.5	-	UP	408.5	399.0
02/01/2024 - 02/02/2024	02/02/2024 - 02/03/2024	2/2/2024	2/3/2024	TRUE	In-Migration	Wet	411.1	25.00	50.0	379.0	39.8	-	UP	339.2	329.0
02/02/2024 - 02/03/2024	02/03/2024 - 02/04/2024	2/3/2024	2/4/2024	TRUE	In-Migration	Wet	393.2	25.00	50.0	581.0	27.4	-	DOWN	553.6	531.0
02/03/2024 - 02/04/2024	02/04/2024 - 02/05/2024	2/4/2024	2/5/2024	TRUE	In-Migration	Wet	515.4	25.00	50.0	1,667.0	-	-	DOWN	1,667.0	1,617.0
02/04/2024 - 02/05/2024	02/05/2024 - 02/06/2024	2/5/2024	2/6/2024	TRUE	In-Migration	Wet	1,726.8	25.00	50.0	1,029.0	39.2	-	UP	989.8	979.0
02/05/2024 - 02/06/2024	02/06/2024 - 02/07/2024	2/6/2024	2/7/2024	TRUE	In-Migration	Wet	1,125.9	25.00	50.0	748.0	43.7	-	UP	704.3	698.0
02/06/2024 - 02/07/2024	02/07/2024 - 02/08/2024	2/7/2024	2/8/2024	TRUE	In-Migration	Wet	724.8	25.00	50.0	1,327.0	13.2	0.0	UP	1,313.8	1,277.0
02/07/2024 - 02/08/2024	02/08/2024 - 02/09/2024	2/8/2024	2/9/2024	TRUE	In-Migration	Wet	1,399.3	25.00	50.0	889.0	43.7	0.0	UP	845.3	839.0
02/08/2024 - 02/09/2024	02/09/2024 - 02/10/2024	2/9/2024	2/10/2024	TRUE	In-Migration	Wet	892.8	25.00	50.0	741.0	42.4	-	UP	698.6	691.0
02/09/2024 - 02/10/2024	02/10/2024 - 02/11/2024	2/10/2024	2/11/2024	TRUE	In-Migration	Wet	715.5	25.00	50.0	668.0	41.9	-	UP	626.1	618.0
02/10/2024 - 02/11/2024	02/11/2024 - 02/12/2024	2/11/2024	2/12/2024	TRUE	In-Migration	Wet	642.3	25.00	50.0	447.0	39.9	-	UP	407.1	397.0
02/11/2024 - 02/12/2024	02/12/2024 - 02/13/2024	2/12/2024	2/13/2024	TRUE	In-Migration	Wet	409.2	25.00	50.0	200.0	37.1	0.0	UP	162.8	150.0
02/12/2024 - 02/13/2024	02/13/2024 - 02/14/2024	2/13/2024	2/14/2024	TRUE	In-Migration	Wet	189.0	25.00	50.0	276.0	36.3	0.0	DOWN	239.7	226.0
02/13/2024 - 02/14/2024	02/14/2024 - 02/15/2024	2/14/2024	2/15/2024	TRUE	In-Migration	Wet	198.5	25.00	50.0	758.0	33.8	0.0	DOWN	724.2	708.0
02/14/2024 - 02/15/2024	02/15/2024 - 02/16/2024	2/15/2024	2/16/2024	TRUE	In-Migration	Wet	760.1	25.00	50.0	945.0	39.9	0.1	DOWN	904.9	895.0
02/15/2024 - 02/16/2024	02/16/2024 - 02/17/2024	2/16/2024	2/17/2024	TRUE	In-Migration	Wet	944.6	22.39	47.4	762.0	35.1	0.1	DOWN	726.8	714.6
02/16/2024 - 02/17/2024	02/17/2024 - 02/18/2024	2/17/2024	2/18/2024	TRUE	In-Migration	Wet	739.8	17.99	43.0	724.0	34.0	-	DOWN	690.0	681.0
02/17/2024 - 02/18/2024	02/18/2024 - 02/19/2024	2/18/2024	2/19/2024	TRUE	In-Migration	Wet	712.8	19.92	44.9	1,214.0	19.8	-	DOWN	1,194.2	1,169.1
02/18/2024 - 02/19/2024	02/19/2024 - 02/20/2024	2/19/2024	2/20/2024	TRUE	In-Migration	Wet	1,249.0	25.00	50.0	909.0	31.8	-	DOWN	877.2	859.0
02/19/2024 - 02/20/2024	02/20/2024 - 02/21/2024	2/20/2024	2/21/2024	TRUE	In-Migration	Wet	880.7	25.00	50.0	598.0	34.8	0.0	DOWN	563.2	548.0
02/20/2024 - 02/21/2024	02/21/2024 - 02/22/2024	2/21/2024	2/22/2024	TRUE	In-Migration	Wet	575.6	25.00	50.0	619.0	42.9	0.0	DOWN	576.1	569.0
02/21/2024 - 02/22/2024	02/22/2024 - 02/23/2024	2/22/2024	2/23/2024	TRUE	In-Migration	Wet	605.2	25.00	50.0	572.0	42.3	-	DOWN	529.7	522.0
02/22/2024 - 02/23/2024	02/23/2024 - 02/24/2024	2/23/2024	2/24/2024	TRUE	In-Migration	Wet	554.2	25.00	50.0	524.0	41.7	-	DOWN	482.3	474.0
02/23/2024 - 02/24/2024	02/24/2024 - 02/25/2024	2/24/2024	2/25/2024	TRUE	In-Migration	Wet	503.6	25.00	50.0	492.0	41.3	-	DOWN	450.7	442.0
02/24/2024 - 02/25/2024	02/25/2024 - 02/26/2024	2/25/2024	2/26/2024	TRUE	In-Migration	Wet	476.1	25.00	50.0	468.0	40.6	0.0	DOWN	427.4	418.0
02/25/2024 - 02/26/2024	02/26/2024 - 02/27/2024	2/26/2024	2/27/2024	TRUE	In-Migration	Wet	449.6	25.00	50.0	368.0	33.4	0.3	UP	334.3	318.0
02/26/2024 - 02/27/2024	02/27/2024 - 02/28/2024	2/27/2024	2/28/2024	TRUE	In-Migration	Wet	437.3	23.99	49.0	294.0	33.7	3.4	UP	256.8	245.0
02/27/2024 - 02/28/2024	02/28/2024 - 02/29/2024	2/28/2024	2/29/2024	TRUE	In-Migration	Wet	281.3	20.29	45.3	159.0	36.7	21.2	UP	101.1	113.7
02/28/2024 - 02/29/2024	02/29/2024 - 03/01/2024	2/29/2024	3/1/2024	TRUE	In-Migration	Wet	148.2	17.41	42.4	202.0	37.3	17.0	UP	147.7	159.6
02/29/2024 - 03/01/2024	03/01/2024 - 03/02/2024	3/1/2024	3/2/2024	TRUE	In-Migration	Wet	205.9	25.00	50.0	849.0	24.7	-	DOWN	824.3	799.0
03/01/2024 - 03/02/2024	03/02/2024 - 03/03/2024	3/2/2024	3/3/2024	TRUE	In-Migration	Wet	857.9	25.00	50.0	1,116.0	26.5	0.4	DOWN	1,089.1	1,066.0
03/02/2024 - 03/03/2024	03/03/2024 - 03/04/2024	3/3/2024	3/4/2024	TRUE	In-Migration	Wet	1,156.5	25.00	50.0	691.0	39.8	1.4	UP	649.8	641.0
03/03/2024 - 03/04/2024	03/04/2024 - 03/05/2024	3/4/2024	3/5/2024	TRUE	In-Migration	Wet	811.4	25.00	50.0	670.0	40.6	-	UP	629.5	620.0
03/04/2024 - 03/05/2024	03/05/2024 - 03/06/2024	3/5/2024	3/6/2024	TRUE	In-Migration	Wet	706.4	25.00	50.0	445.0	38.5	2.0	UP	404.5	395.0
03/05/2024 - 03/06/2024	03/06/2024 - 03/07/2024	3/6/2024	3/7/2024	TRUE	In-Migration	Wet	580.9	25.00	50.0	857.0	20.7	3.5	UP	832.8	807.0
03/06/2024 - 03/07/2024	03/07/2024 - 03/08/2024	3/7/2024	3/8/2024	TRUE	In-Migration	Wet	928.8	25.00	50.0	540.0	41.7	0.0	UP	498.3	490.0
03/07/2024 - 03/08/2024	03/08/2024 - 03/09/2024	3/8/2024	3/9/2024	TRUE	In-Migration	Wet	566.5	25.00	50.0	457.0	41.3	0.1	UP	415.6	407.0
03/08/2024 - 03/09/2024	03/09/2024 - 03/10/2024	3/9/2024	3/10/2024	TRUE	In-Migration	Wet	480.9	25.00	50.0	419.0	45.2	0.0	UP	373.7	369.0
03/09/2024 - 03/10/2024	03/10/2024 - 03/11/2024	3/10/2024	3/11/2024	TRUE	In-Migration	Wet	438.7	25.00	50.0	402.0	40.3	-	UP	361.7	352.0
03/10/2024 - 03/11/2024	03/11/2024 - 03/12/2024	3/11/2024	3/12/2024	TRUE	In-Migration	Wet	417.1	25.00	50.0	292.0	39.1	-	UP	252.9	242.0
03/11/2024 - 03/12/2024	03/12/2024 - 03/13/2024	3/12/2024	3/13/2024	TRUE	In-Migration	Wet	286.1	25.00	50.0	172.0	37.4	7.2	UP	127.4	122.0
03/12/2024 - 03/13/2024	03/13/2024 - 03/14/2024	3/13/2024	3/14/2024	TRUE	In-Migration	Wet	174.4	25.00	50.0	71.0	32.5	29.8	UP	8.7	21.0
03/13/2024 - 03/14/2024	03/14/2024 - 03/15/2024	3/14/2024	3/15/2024	TRUE	In-Migration	Wet	134.3	22.15	47.2	75.0	33.2	32.1	UP	9.6	27.8
03/14/2024 - 03/15/2024	03/15/2024 - 03/16/2024	3/15/2024	3/16/2024	TRUE	In-Migration	Wet	122.1	18.94	43.9	44.0	23.1	20.5	UP	0.4	0.1
03/15/2024 - 03/16/2024	03/16/2024 - 03/17/2024	3/16/2024	3/17/2024	TRUE	In-Migration	Wet	113.6	17.20	42.2	50.0	23.7	25.4	UP	0.9	7.8
03/16/2024 - 03/17/2024	03/17/2024 - 03/18/2024	3/17/2024	3/18/2024	TRUE	In-Migration	Wet	99.1	0.00	25.0	34.0	23.1	11.3	UP	-	9.0
03/17/2024 - 03/18/2024	03/18/2024 - 03/19/2024	3/18/2024	3/19/2024	TRUE	In-Migration	Wet	93.1	0.00	25.0	35.0	23.7	11.6	UP	-	10.0
03/18/2024 - 03/19/2024	03/19/2024 - 03/20/2024	3/19/2024	3/20/2024	TRUE	In-Migration	Wet	89.4	0.00	25.0	36.0	24.7	11.3	UP	-	11.0

RD1 Bypass Compliance Report

Input Measuring Period (noon to noon)	Bypass Compliance Period (noon to noon)	Input Measuring Period End (at noon)	Bypass Compliance Period End (at noon)	Compliance Met (True/False)	Migration Season	Wet/Dry Season	Niles In-flow, CFS	SFPUC Required Bypass at RD1, CFS	Required Bypass Flow, CFS	Total Bypass Flow (fishway flow, auxiliary flow, overspill), CFS	Fishway Flow, CFS	Auxiliary Flow, CFS	Dam Up/Down	RD1 Dam Overspill, CFS	Excess Bypass, CFS
03/19/2024 - 03/20/2024	03/20/2024 - 03/21/2024	3/20/2024	3/21/2024	TRUE	In-Migration	Wet	87.8	0.00	25.0	36.0	26.5	9.7	UP	-	11.0
03/20/2024 - 03/21/2024	03/21/2024 - 03/22/2024	3/21/2024	3/22/2024	TRUE	In-Migration	Wet	85.2	0.00	25.0	36.0	26.2	9.6	UP	0.2	11.0
03/21/2024 - 03/22/2024	03/22/2024 - 03/23/2024	3/22/2024	3/23/2024	TRUE	In-Migration	Wet	82.7	0.00	25.0	36.0	26.3	8.9	UP	0.8	11.0
03/22/2024 - 03/23/2024	03/23/2024 - 03/24/2024	3/23/2024	3/24/2024	TRUE	In-Migration	Wet	127.1	13.31	38.3	219.0	37.4	0.1	UP	181.5	180.7
03/23/2024 - 03/24/2024	03/24/2024 - 03/25/2024	3/24/2024	3/25/2024	TRUE	In-Migration	Wet	292.5	25.00	50.0	175.0	36.7	-	UP	138.3	125.0
03/24/2024 - 03/25/2024	03/25/2024 - 03/26/2024	3/25/2024	3/26/2024	TRUE	In-Migration	Wet	229.8	25.00	50.0	77.0	35.6	12.2	UP	29.1	27.0
03/25/2024 - 03/26/2024	03/26/2024 - 03/27/2024	3/26/2024	3/27/2024	TRUE	In-Migration	Wet	139.5	24.93	49.9	58.0	28.6	27.0	UP	2.5	8.1
03/26/2024 - 03/27/2024	03/27/2024 - 03/28/2024	3/27/2024	3/28/2024	TRUE	In-Migration	Wet	113.1	19.90	44.9	59.0	25.3	31.5	UP	2.2	14.1
03/27/2024 - 03/28/2024	03/28/2024 - 03/29/2024	3/28/2024	3/29/2024	TRUE	In-Migration	Wet	123.5	19.62	44.6	64.0	29.7	31.5	UP	2.9	19.4
03/28/2024 - 03/29/2024	03/29/2024 - 03/30/2024	3/29/2024	3/30/2024	TRUE	In-Migration	Wet	136.0	21.83	46.8	147.0	35.4	14.8	UP	96.7	100.2
03/29/2024 - 03/30/2024	03/30/2024 - 03/31/2024	3/30/2024	3/31/2024	TRUE	In-Migration	Wet	192.7	25.00	50.0	153.0	36.8	21.0	UP	95.2	103.0
03/30/2024 - 03/31/2024	03/31/2024 - 04/01/2024	3/31/2024	4/1/2024	TRUE	In-Migration	Wet	174.7	25.00	50.0	105.0	36.2	22.2	UP	46.5	55.0
03/31/2024 - 04/01/2024	04/01/2024 - 04/02/2024	4/1/2024	4/2/2024	TRUE	Out-Migration	Wet	129.7	32.28	44.3	107.0	68.8	25.7	UP	12.5	62.7
04/01/2024 - 04/02/2024	04/02/2024 - 04/03/2024	4/2/2024	4/3/2024	TRUE	Out-Migration	Wet	119.9	26.43	38.4	64.0	36.2	25.4	UP	2.5	25.6
04/02/2024 - 04/03/2024	04/03/2024 - 04/04/2024	4/3/2024	4/4/2024	TRUE	Out-Migration	Wet	105.3	22.28	34.3	65.0	36.4	25.4	UP	3.2	30.7
04/03/2024 - 04/04/2024	04/04/2024 - 04/05/2024	4/4/2024	4/5/2024	TRUE	Out-Migration	Wet	104.1	20.76	32.8	312.0	43.8	6.2	UP	262.0	279.2
04/04/2024 - 04/05/2024	04/05/2024 - 04/06/2024	4/5/2024	4/6/2024	TRUE	Out-Migration	Wet	348.3	34.08	46.1	289.0	44.3	-	UP	244.7	242.9
04/05/2024 - 04/06/2024	04/06/2024 - 04/07/2024	4/6/2024	4/7/2024	TRUE	Out-Migration	Wet	291.2	37.11	49.1	180.0	43.0	8.6	UP	128.4	130.9
04/06/2024 - 04/07/2024	04/07/2024 - 04/08/2024	4/7/2024	4/8/2024	TRUE	Out-Migration	Wet	178.6	28.95	40.9	122.0	41.6	17.2	UP	63.2	81.1
04/07/2024 - 04/08/2024	04/08/2024 - 04/09/2024	4/8/2024	4/9/2024	TRUE	Out-Migration	Wet	128.2	24.84	36.8	104.0	35.7	32.3	UP	36.0	67.2
04/08/2024 - 04/09/2024	04/09/2024 - 04/10/2024	4/9/2024	4/10/2024	TRUE	Out-Migration	Wet	111.2	22.15	34.1	88.0	35.4	25.9	UP	26.7	53.9
04/09/2024 - 04/10/2024	04/10/2024 - 04/11/2024	4/10/2024	4/11/2024	TRUE	Out-Migration	Wet	96.4	19.74	31.7	81.0	35.3	25.1	UP	20.6	49.3
04/10/2024 - 04/11/2024	04/11/2024 - 04/12/2024	4/11/2024	4/12/2024	TRUE	Out-Migration	Wet	95.2	17.96	30.0	77.0	35.2	25.1	UP	16.7	47.0
04/11/2024 - 04/12/2024	04/12/2024 - 04/13/2024	4/12/2024	4/13/2024	TRUE	Out-Migration	Wet	89.5	16.68	28.7	73.0	34.9	25.1	UP	13.0	44.3
04/12/2024 - 04/13/2024	04/13/2024 - 04/14/2024	4/13/2024	4/14/2024	TRUE	Out-Migration	Wet	85.6	17.08	29.1	186.0	37.3	10.2	UP	138.5	156.9
04/13/2024 - 04/14/2024	04/14/2024 - 04/15/2024	4/14/2024	4/15/2024	TRUE	Out-Migration	Wet	199.9	23.10	35.1	128.0	36.3	21.8	UP	69.9	92.9
04/14/2024 - 04/15/2024	04/15/2024 - 04/16/2024	4/15/2024	4/16/2024	TRUE	Out-Migration	Wet	134.6	19.94	31.9	86.0	35.3	22.9	UP	27.8	54.1
04/15/2024 - 04/16/2024	04/16/2024 - 04/17/2024	4/16/2024	4/17/2024	TRUE	Out-Migration	Wet	97.3	16.50	28.5	70.0	33.2	21.3	UP	15.6	41.5
04/16/2024 - 04/17/2024	04/17/2024 - 04/18/2024	4/17/2024	4/18/2024	TRUE	Out-Migration	Wet	85.2	14.26	26.3	71.0	44.7	0.1	UP	26.2	44.7
04/17/2024 - 04/18/2024	04/18/2024 - 04/19/2024	4/18/2024	4/19/2024	TRUE	Out-Migration	Wet	80.2	12.71	24.7	64.0	42.8	0.1	UP	21.2	39.3
04/18/2024 - 04/19/2024	04/19/2024 - 04/20/2024	4/19/2024	4/20/2024	TRUE	Out-Migration	Wet	75.2	11.71	23.7	61.0	44.7	-	UP	16.3	37.3
04/19/2024 - 04/20/2024	04/20/2024 - 04/21/2024	4/20/2024	4/21/2024	TRUE	Out-Migration	Wet	70.9	10.80	22.8	62.0	39.1	19.8	UP	3.1	39.2
04/20/2024 - 04/21/2024	04/21/2024 - 04/22/2024	4/21/2024	4/22/2024	TRUE	Out-Migration	Wet	66.5	9.70	21.7	60.0	35.2	22.5	UP	2.3	38.3
04/21/2024 - 04/22/2024	04/22/2024 - 04/23/2024	4/22/2024	4/23/2024	TRUE	Out-Migration	Wet	62.7	9.03	21.0	57.0	31.1	24.3	UP	1.5	36.0
04/22/2024 - 04/23/2024	04/23/2024 - 04/24/2024	4/23/2024	4/24/2024	TRUE	Out-Migration	Wet	61.3	8.43	20.4	56.0	28.5	25.5	UP	2.0	35.6
04/23/2024 - 04/24/2024	04/24/2024 - 04/25/2024	4/24/2024	4/25/2024	TRUE	Out-Migration	Wet	59.9	7.69	19.7	60.0	25.6	32.3	UP	2.1	40.3
04/24/2024 - 04/25/2024	04/25/2024 - 04/26/2024	4/25/2024	4/26/2024	TRUE	Out-Migration	Wet	68.2	7.30	19.3	59.0	24.6	32.5	UP	1.9	39.7
04/25/2024 - 04/26/2024	04/26/2024 - 04/27/2024	4/26/2024	4/27/2024	TRUE	Out-Migration	Wet	66.5	7.19	19.2	58.0	23.8	32.6	UP	1.6	38.8
04/26/2024 - 04/27/2024	04/27/2024 - 04/28/2024	4/27/2024	4/28/2024	TRUE	Out-Migration	Wet	67.3	7.31	19.3	55.0	22.5	31.1	UP	1.4	35.7
04/27/2024 - 04/28/2024	04/28/2024 - 04/29/2024	4/28/2024	4/29/2024	TRUE	Out-Migration	Wet	64.2	6.55	18.5	49.0	22.7	24.9	UP	1.3	30.5
04/28/2024 - 04/29/2024	04/29/2024 - 04/30/2024	4/29/2024	4/30/2024	TRUE	Out-Migration	Wet	67.3	7.31	19.3	26.0	26.3	0.4	UP	-	6.7
04/29/2024 - 04/30/2024	04/30/2024 - 05/01/2024	4/30/2024	5/1/2024	TRUE	Out-Migration	Wet	45.6	5.21	17.2	92.0	13.4	-	UP	78.6	74.8
04/30/2024 - 05/01/2024	05/01/2024 - 05/02/2024	5/1/2024	5/2/2024	TRUE	Out-Migration	Wet	51.7	4.85	16.8	30.0	33.3	-	UP	-	13.2
05/01/2024 - 05/02/2024	05/02/2024 - 05/03/2024	5/2/2024	5/3/2024	TRUE	Out-Migration	Wet	53.5	4.32	16.3	37.0	37.5	-	UP	-	20.7
05/02/2024 - 05/03/2024	05/03/2024 - 05/04/2024	5/3/2024	5/4/2024	TRUE	Out-Migration	Wet	46.6	4.23	16.2	33.0	34.0	-	UP	-	16.8
05/03/2024 - 05/04/2024	05/04/2024 - 05/05/2024	5/4/2024	5/5/2024	TRUE	Out-Migration	Wet	45.1	3.79	15.8	186.0	37.3	2.2	UP	146.5	170.2
05/04/2024 - 05/05/2024	05/05/2024 - 05/06/2024	5/5/2024	5/6/2024	TRUE	Out-Migration	Wet	281.0	18.84	30.8	87.0	33.7	24.4	UP	28.9	56.2
05/05/2024 - 05/06/2024	05/06/2024 - 05/07/2024	5/6/2024	5/7/2024	TRUE	Out-Migration	Wet	111.0	10.36	22.4	55.0	30.5	25.5	UP	-	32.6
05/06/2024 - 05/07/2024	05/07/2024 - 05/08/2024	5/7/2024	5/8/2024	TRUE	Out-Migration	Wet	75.8	6.77	18.8	34.0	26.3	9.7	UP	-	15.2
05/07/2024 - 05/08/2024	05/08/2024 - 05/09/2024	5/8/2024	5/9/2024	TRUE	Out-Migration	Wet	68.8	5.14	17.1	34.0	26.8	8.2	UP	-	16.9
05/08/2024 - 05/09/2024	05/09/2024 - 05/10/2024	5/9/2024	5/10/2024	TRUE	Out-Migration	Wet	63.2	4.27	16.3	32.0	24.8	8.4	UP	-	15.7
05/09/2024 - 05/10/2024	05/10/2024 - 05/11/2024	5/10/2024	5/11/2024	TRUE	Out-Migration	Wet	58.1	3.66	15.7	25.0	26.6	0.3	UP	-	9.3
05/10/2024 - 05/11/2024	05/11/2024 - 05/12/2024	5/11/2024	5/12/2024	TRUE	Out-Migration	Wet	55.6	3.14	15.1	24.0	24.0	1.7	UP	-	8.9
05/11/2024 - 05/12/2024	05/12/2024 - 05/13/2024	5/12/2024	5/13/2024	TRUE	Out-Migration	Wet	54.6	2.69	14.7	23.0	24.8	0.6	UP	-	8.3
05/12/2024 - 05/13/2024	05/13/2024 - 05/14/2024	5/13/2024	5/14/2024	TRUE	Out-Migration	Wet	53.2	2.24	14.2	24.0	26.3	-	UP	-	9.8
05/13/2024 - 05/14/2024	05/14/2024 - 05/15/2024	5/14/2024	5/15/2024	TRUE	Out-Migration	Wet	52.8	2.04	14.0	26.0	27.7	-	UP	-	12.0
05/14/2024 - 05/15/2024	05/15/2024 - 05/16/2024	5/15/2024	5/16/2024	TRUE	Out-Migration	Wet	53.2	1.84	13.8	32.0	28.9	4.7	UP	-	18.2
05/15/2024 - 05/16/2024	05/16/2024 - 05/17/2024	5/16/2024	5/17/2024	TRUE	Out-Migration	Wet	52.5	1.52	13.5	44.0	30.4	13.9	UP	-	30.5
05/16/2024 - 05/17/2024	05/17/2024 - 05/18/2024	5/17/2024	5/18/2024	TRUE	Out-Migration	Wet	51.6	1.44	13.4	44.0	29.2	14.5	UP	0.4	30.6
05/17/2024 - 05/18/2024	05/18/2024 - 05/19/2024	5/18/2024	5/19/2024	TRUE	Out-Migration	Wet	49.1	1.20	13.2	43.0	24.4	18.0	UP	0.6	29.8
05/18/2024 - 05/19/2024	05/19/2024 - 05/20/2024	5/19/2024	5/20/2024	TRUE	Out-Migration	Wet	37.7	1.12	13.1	25.0	25.1	0.7	UP	-	11.9
05/19/2024 - 05/20/2024	05/20/2024 - 05/21/2024	5/20/2024	5/21/2024	TRUE	Out-Migration	Wet	36.2	0.80	12.8	26.0	27.6	0.0	UP	-	13.2
05/20/2024 - 05/21/2024	05/21/2024 - 05/22/2024	5/21/2024	5/22/2024	TRUE	Out-Migration	Wet	44.3	0.67	12.7	29.0	29.4	0.0	UP	-	16.3
05/21/2024 - 05/22/2024	05/22/2024 - 05/23/2024	5/22/2024	5/23/2024	TRUE	Out-Migration	Wet	45.3	0.30	12.3	24.0	25.8	0.0	UP	-	11.7
05/22/2024 - 05/23/2024	05/23/2024 - 05/24/2024	5/23/2024	5/24/2024	TRUE	Out-Migration	Wet	45.8	0.22	12.2	27.0	28.3	0.0	UP	-	14.8
05/23/2024 - 05/24/2024	05/24/2024 - 05/25/2024	5/24/2024	5/25/2024	TRUE	Out-Migration	Wet	45.7	0.00	12.0	26.0	27.5	0.0	UP	-	14.0
05/24/2024 - 05/25/2024	05/25/2024 - 05/26/2024	5/25/2024	5/26/2024	TRUE	Out-Migration	Wet	43.0	0.04	12.0	25.0	26.2	0.0	UP	-	13.0

RD1 Bypass Compliance Report

Input Measuring Period (noon to noon)	Bypass Compliance Period (noon to noon)	Input Measuring Period End (at noon)	Bypass Compliance Period End (at noon)	Compliance Met (True/False)	Migration Season	Wet/Dry Season	Niles In-flow, CFS	SFPUC Required Bypass at RD1, CFS	Required Bypass Flow, CFS	Total Bypass Flow (fishway flow, auxiliary flow, overspill), CFS	Fishway Flow, CFS	Auxiliary Flow, CFS	Dam Up/Down	RD1 Dam Overspill, CFS	Excess Bypass, CFS
05/25/2024 - 05/26/2024	05/26/2024 - 05/27/2024	5/26/2024	5/27/2024	TRUE	Out-Migration	Wet	36.3	0.37	12.4	25.0	25.6	-	UP	-	12.6
05/26/2024 - 05/27/2024	05/27/2024 - 05/28/2024	5/27/2024	5/28/2024	TRUE	Out-Migration	Wet	33.1	0.00	12.0	24.0	24.7	-	UP	-	12.0
05/27/2024 - 05/28/2024	05/28/2024 - 05/29/2024	5/28/2024	5/29/2024	TRUE	Out-Migration	Wet	32.2	0.00	12.0	18.0	19.6	0.1	UP	-	6.0
05/28/2024 - 05/29/2024	05/29/2024 - 05/30/2024	5/29/2024	5/30/2024	TRUE	Out-Migration	Wet	35.9	0.00	12.0	24.0	24.8	0.0	UP	-	12.0
05/29/2024 - 05/30/2024	05/30/2024 - 05/31/2024	5/30/2024	5/31/2024	TRUE	Out-Migration	Wet	41.2	0.00	12.0	22.0	23.3	-	UP	-	10.0
05/30/2024 - 05/31/2024	05/31/2024 - 06/01/2024	5/31/2024	6/1/2024	TRUE	Out-Migration	Wet	36.5	0.00	12.0	22.0	23.1	-	UP	-	10.0
05/31/2024 - 06/01/2024	06/01/2024 - 06/02/2024	6/1/2024	6/2/2024	TRUE	Off Season	Wet	35.3	0.00	5.0	23.0	24.1	-	UP	-	18.0
06/01/2024 - 06/02/2024	06/02/2024 - 06/03/2024	6/2/2024	6/3/2024	TRUE	Off Season	Wet	34.3	0.00	5.0	23.0	23.5	-	UP	-	18.0
06/02/2024 - 06/03/2024	06/03/2024 - 06/04/2024	6/3/2024	6/4/2024	TRUE	Off Season	Wet	29.1	0.00	5.0	23.0	22.8	-	UP	0.2	18.0
06/03/2024 - 06/04/2024	06/04/2024 - 06/05/2024	6/4/2024	6/5/2024	TRUE	Off Season	Wet	35.4	0.00	5.0	24.0	23.2	-	UP	0.8	19.0
06/04/2024 - 06/05/2024	06/05/2024 - 06/06/2024	6/5/2024	6/6/2024	TRUE	Off Season	Wet	38.6	0.00	5.0	26.0	23.9	-	UP	2.1	21.0
06/05/2024 - 06/06/2024	06/06/2024 - 06/07/2024	6/6/2024	6/7/2024	TRUE	Off Season	Wet	35.4	0.00	5.0	27.0	24.2	-	UP	2.8	22.0
06/06/2024 - 06/07/2024	06/07/2024 - 06/08/2024	6/7/2024	6/8/2024	TRUE	Off Season	Wet	37.9	0.00	5.0	27.0	23.9	-	UP	3.1	22.0
06/07/2024 - 06/08/2024	06/08/2024 - 06/09/2024	6/8/2024	6/9/2024	TRUE	Off Season	Wet	37.8	0.00	5.0	28.0	24.5	-	UP	3.5	23.0
06/08/2024 - 06/09/2024	06/09/2024 - 06/10/2024	6/9/2024	6/10/2024	TRUE	Off Season	Wet	36.7	0.00	5.0	26.0	22.8	-	UP	3.2	21.0
06/09/2024 - 06/10/2024	06/10/2024 - 06/11/2024	6/10/2024	6/11/2024	TRUE	Off Season	Wet	34.2	0.00	5.0	27.0	23.2	-	UP	3.8	22.0
06/10/2024 - 06/11/2024	06/11/2024 - 06/12/2024	6/11/2024	6/12/2024	TRUE	Off Season	Wet	35.6	0.00	5.0	28.0	23.8	-	UP	4.2	23.0
06/11/2024 - 06/12/2024	06/12/2024 - 06/13/2024	6/12/2024	6/13/2024	TRUE	Off Season	Wet	32.1	0.00	5.0	27.0	23.3	-	UP	3.7	22.0
06/12/2024 - 06/13/2024	06/13/2024 - 06/14/2024	6/13/2024	6/14/2024	TRUE	Off Season	Wet	32.7	0.00	5.0	26.0	23.0	-	UP	3.0	21.0
06/13/2024 - 06/14/2024	06/14/2024 - 06/15/2024	6/14/2024	6/15/2024	TRUE	Off Season	Wet	35.8	0.00	5.0	26.0	23.4	-	UP	2.6	21.0
06/14/2024 - 06/15/2024	06/15/2024 - 06/16/2024	6/15/2024	6/16/2024	TRUE	Off Season	Wet	34.3	0.00	5.0	25.0	23.5	-	UP	1.5	20.0
06/15/2024 - 06/16/2024	06/16/2024 - 06/17/2024	6/16/2024	6/17/2024	TRUE	Off Season	Wet	32.6	0.00	5.0	24.0	23.2	-	UP	0.8	19.0
06/16/2024 - 06/17/2024	06/17/2024 - 06/18/2024	6/17/2024	6/18/2024	TRUE	Off Season	Wet	32.4	0.00	5.0	22.0	22.6	-	UP	-	17.0
06/17/2024 - 06/18/2024	06/18/2024 - 06/19/2024	6/18/2024	6/19/2024	TRUE	Off Season	Wet	26.4	0.00	5.0	19.0	20.8	-	UP	-	14.0
06/18/2024 - 06/19/2024	06/19/2024 - 06/20/2024	6/19/2024	6/20/2024	TRUE	Off Season	Wet	23.2	0.00	5.0	15.0	18.1	-	UP	-	10.0
06/19/2024 - 06/20/2024	06/20/2024 - 06/21/2024	6/20/2024	6/21/2024	TRUE	Off Season	Wet	22.1	0.00	5.0	20.0	21.8	-	UP	-	15.0
06/20/2024 - 06/21/2024	06/21/2024 - 06/22/2024	6/21/2024	6/22/2024	TRUE	Off Season	Wet	22.2	0.00	5.0	19.0	21.3	-	UP	-	14.0
06/21/2024 - 06/22/2024	06/22/2024 - 06/23/2024	6/22/2024	6/23/2024	TRUE	Off Season	Wet	29.0	0.00	5.0	20.0	21.9	-	UP	-	15.0
06/22/2024 - 06/23/2024	06/23/2024 - 06/24/2024	6/23/2024	6/24/2024	TRUE	Off Season	Wet	37.8	0.00	5.0	19.0	21.3	0.6	UP	-	14.0
06/23/2024 - 06/24/2024	06/24/2024 - 06/25/2024	6/24/2024	6/25/2024	TRUE	Off Season	Wet	37.6	0.00	5.0	36.0	23.5	12.1	UP	0.5	31.0
06/24/2024 - 06/25/2024	06/25/2024 - 06/26/2024	6/25/2024	6/26/2024	TRUE	Off Season	Wet	32.8	0.00	5.0	36.0	25.3	9.9	UP	0.8	31.0
06/25/2024 - 06/26/2024	06/26/2024 - 06/27/2024	6/26/2024	6/27/2024	TRUE	Off Season	Wet	27.7	0.00	5.0	29.0	21.9	7.8	UP	-	24.0
06/26/2024 - 06/27/2024	06/27/2024 - 06/28/2024	6/27/2024	6/28/2024	TRUE	Off Season	Wet	25.8	0.00	5.0	26.0	20.8	5.3	UP	-	21.0
06/27/2024 - 06/28/2024	06/28/2024 - 06/29/2024	6/28/2024	6/29/2024	TRUE	Off Season	Wet	25.4	0.00	5.0	20.0	22.1	0.0	UP	-	15.0
06/28/2024 - 06/29/2024	06/29/2024 - 06/30/2024	6/29/2024	6/30/2024	TRUE	Off Season	Wet	26.8	0.00	5.0	21.0	22.5	-	UP	-	16.0
06/29/2024 - 06/30/2024	06/30/2024 - 07/01/2024	6/30/2024	7/1/2024	TRUE	Off Season	Wet	21.4	0.00	5.0	25.0	24.0	2.4	UP	-	20.0
06/30/2024 - 07/01/2024	07/01/2024 - 07/02/2024	7/1/2024	7/2/2024	TRUE	Off Season	Wet	20.8	0.00	5.0	75.0	10.8	2.9	DOWN	61.4	70.0
07/01/2024 - 07/02/2024	07/02/2024 - 07/03/2024	7/2/2024	7/3/2024	TRUE	Off Season	Wet	23.9	0.00	5.0	23.0	20.3	-	DOWN	2.7	18.0
07/02/2024 - 07/03/2024	07/03/2024 - 07/04/2024	7/3/2024	7/4/2024	TRUE	Off Season	Wet	23.0	0.00	5.0	18.0	18.7	-	DOWN	-	13.0
07/03/2024 - 07/04/2024	07/04/2024 - 07/05/2024	7/4/2024	7/5/2024	TRUE	Off Season	Wet	20.4	0.00	5.0	13.0	14.7	-	DOWN	-	8.0
07/04/2024 - 07/05/2024	07/05/2024 - 07/06/2024	7/5/2024	7/6/2024	TRUE	Off Season	Wet	15.0	0.00	5.0	9.0	12.2	-	DOWN	-	4.0
07/05/2024 - 07/06/2024	07/06/2024 - 07/07/2024	7/6/2024	7/7/2024	TRUE	Off Season	Wet	13.2	0.00	5.0	10.0	12.7	-	DOWN	-	5.0
07/06/2024 - 07/07/2024	07/07/2024 - 07/08/2024	7/7/2024	7/8/2024	TRUE	Off Season	Wet	14.1	0.00	5.0	9.0	11.8	-	DOWN	-	4.0
07/07/2024 - 07/08/2024	07/08/2024 - 07/09/2024	7/8/2024	7/9/2024	TRUE	Off Season	Wet	12.9	0.00	5.0	16.0	15.6	-	DOWN	0.4	11.0
07/08/2024 - 07/09/2024	07/09/2024 - 07/10/2024	7/9/2024	7/10/2024	TRUE	Off Season	Wet	22.0	0.00	5.0	25.0	20.2	-	DOWN	4.8	20.0
07/09/2024 - 07/10/2024	07/10/2024 - 07/11/2024	7/10/2024	7/11/2024	TRUE	Off Season	Wet	26.5	0.00	5.0	23.0	19.2	-	DOWN	3.8	18.0
07/10/2024 - 07/11/2024	07/11/2024 - 07/12/2024	7/11/2024	7/12/2024	TRUE	Off Season	Wet	24.9	0.00	5.0	22.0	18.4	-	DOWN	3.6	17.0
07/11/2024 - 07/12/2024	07/12/2024 - 07/13/2024	7/12/2024	7/13/2024	TRUE	Off Season	Wet	24.8	0.00	5.0	21.0	18.8	-	DOWN	2.2	16.0
07/12/2024 - 07/13/2024	07/13/2024 - 07/14/2024	7/13/2024	7/14/2024	TRUE	Off Season	Wet	24.6	0.00	5.0	13.0	14.4	-	DOWN	-	8.0
07/13/2024 - 07/14/2024	07/14/2024 - 07/15/2024	7/14/2024	7/15/2024	TRUE	Off Season	Wet	15.1	0.00	5.0	7.0	10.7	-	DOWN	-	2.0
07/14/2024 - 07/15/2024	07/15/2024 - 07/16/2024	7/15/2024	7/16/2024	TRUE	Off Season	Wet	13.4	0.00	5.0	15.0	17.1	-	DOWN	-	10.0
07/15/2024 - 07/16/2024	07/16/2024 - 07/17/2024	7/16/2024	7/17/2024	TRUE	Off Season	Wet	22.4	0.00	5.0	19.0	19.9	-	DOWN	-	14.0
07/16/2024 - 07/17/2024	07/17/2024 - 07/18/2024	7/17/2024	7/18/2024	TRUE	Off Season	Wet	24.5	0.00	5.0	19.0	20.3	-	DOWN	-	14.0
07/17/2024 - 07/18/2024	07/18/2024 - 07/19/2024	7/18/2024	7/19/2024	TRUE	Off Season	Wet	24.9	0.00	5.0	16.0	17.8	-	DOWN	-	11.0
07/18/2024 - 07/19/2024	07/19/2024 - 07/20/2024	7/19/2024	7/20/2024	TRUE	Off Season	Wet	20.7	0.00	5.0	12.0	15.9	-	DOWN	-	7.0
07/19/2024 - 07/20/2024	07/20/2024 - 07/21/2024	7/20/2024	7/21/2024	TRUE	Off Season	Wet	19.5	0.00	5.0	9.0	13.1	-	DOWN	-	4.0
07/20/2024 - 07/21/2024	07/21/2024 - 07/22/2024	7/21/2024	7/22/2024	TRUE	Off Season	Wet	15.4	0.00	5.0	7.0	11.3	-	DOWN	-	2.0
07/21/2024 - 07/22/2024	07/22/2024 - 07/23/2024	7/22/2024	7/23/2024	TRUE	Off Season	Wet	13.6	0.00	5.0	8.0	11.7	-	DOWN	-	3.0
07/22/2024 - 07/23/2024	07/23/2024 - 07/24/2024	7/23/2024	7/24/2024	TRUE	Off Season	Wet	15.7	0.00	5.0	12.0	14.0	-	DOWN	-	7.0
07/23/2024 - 07/24/2024	07/24/2024 - 07/25/2024	7/24/2024	7/25/2024	TRUE	Off Season	Wet	18.3	0.00	5.0	12.0	13.3	-	DOWN	-	7.0
07/24/2024 - 07/25/2024	07/25/2024 - 07/26/2024	7/25/2024	7/26/2024	TRUE	Off Season	Wet	17.9	0.00	5.0	11.0	13.2	-	DOWN	-	6.0
07/25/2024 - 07/26/2024	07/26/2024 - 07/27/2024	7/26/2024	7/27/2024	TRUE	Off Season	Wet	17.6	0.00	5.0	10.0	12.7	-	DOWN	-	5.0
07/26/2024 - 07/27/2024	07/27/2024 - 07/28/2024	7/27/2024	7/28/2024	TRUE	Off Season	Wet	15.6	0.00	5.0	5.0	9.9	-	DOWN	-	-
07/27/2024 - 07/28/2024	07/28/2024 - 07/29/2024	7/28/2024	7/29/2024	TRUE	Off Season	Wet	12.7	0.00	5.0	6.0	10.6	-	DOWN	-	1.0
07/28/2024 - 07/29/2024	07/29/2024 - 07/30/2024	7/29/2024	7/30/2024	TRUE	Off Season	Wet	13.0	0.00	5.0	11.0	14.8	-	DOWN	-	6.0
07/29/2024 - 07/30/2024	07/30/2024 - 07/31/2024	7/30/2024	7/31/2024	TRUE	Off Season	Wet	19.2	0.00	5.0	18.0	19.0	-	DOWN	-	13.0
07/30/2024 - 07/31/2024	07/31/2024 - 08/01/2024	7/31/2024	8/1/2024	TRUE	Off Season	Wet	23.4	0.00	5.0	20.0	20.5	-	DOWN	-	15.0

RD1 Bypass Compliance Report

Input Measuring Period (noon to noon)	Bypass Compliance Period (noon to noon)	Input Measuring Period End (at noon)	Bypass Compliance Period End (at noon)	Compliance Met (True/False)	Migration Season	Wet/Dry Season	Niles In-flow, CFS	SFPUC Required Bypass at RD1, CFS	Required Bypass Flow, CFS	Total Bypass Flow (fishway flow, auxiliary flow, overspill), CFS	Fishway Flow, CFS	Auxiliary Flow, CFS	Dam Up/Down	RD1 Dam Overspill, CFS	Excess Bypass, CFS
07/31/2024 - 08/01/2024	08/01/2024 - 08/02/2024	8/1/2024	8/2/2024	TRUE	Off Season	Wet	24.7	0.00	5.0	20.0	20.6	-	DOWN	-	15.0
08/01/2024 - 08/02/2024	08/02/2024 - 08/03/2024	8/2/2024	8/3/2024	TRUE	Off Season	Wet	24.7	0.00	5.0	20.0	20.4	-	DOWN	-	15.0
08/02/2024 - 08/03/2024	08/03/2024 - 08/04/2024	8/3/2024	8/4/2024	TRUE	Off Season	Wet	24.3	0.00	5.0	13.0	15.9	-	DOWN	-	8.0
08/03/2024 - 08/04/2024	08/04/2024 - 08/05/2024	8/4/2024	8/5/2024	TRUE	Off Season	Wet	17.4	0.00	5.0	9.0	13.5	-	DOWN	-	4.0
08/04/2024 - 08/05/2024	08/05/2024 - 08/06/2024	8/5/2024	8/6/2024	TRUE	Off Season	Wet	15.8	0.00	5.0	22.0	16.3	-	DOWN	5.7	17.0
08/05/2024 - 08/06/2024	08/06/2024 - 08/07/2024	8/6/2024	8/7/2024	TRUE	Off Season	Wet	25.7	0.00	5.0	28.0	-	-	DOWN	28.0	23.0
08/06/2024 - 08/07/2024	08/07/2024 - 08/08/2024	8/7/2024	8/8/2024	TRUE	Off Season	Wet	26.7	0.00	5.0	27.0	-	-	DOWN	27.0	22.0
08/07/2024 - 08/08/2024	08/08/2024 - 08/09/2024	8/8/2024	8/9/2024	TRUE	Off Season	Wet	26.2	0.00	5.0	27.0	-	-	DOWN	27.0	22.0
08/08/2024 - 08/09/2024	08/09/2024 - 08/10/2024	8/9/2024	8/10/2024	TRUE	Off Season	Wet	25.7	0.00	5.0	27.0	-	-	DOWN	27.0	22.0
08/09/2024 - 08/10/2024	08/10/2024 - 08/11/2024	8/10/2024	8/11/2024	TRUE	Off Season	Wet	26.1	0.00	5.0	16.0	-	-	DOWN	16.0	11.0
08/10/2024 - 08/11/2024	08/11/2024 - 08/12/2024	8/11/2024	8/12/2024	TRUE	Off Season	Wet	16.8	0.00	5.0	12.0	-	-	DOWN	12.0	7.0
08/11/2024 - 08/12/2024	08/12/2024 - 08/13/2024	8/12/2024	8/13/2024	TRUE	Off Season	Wet	15.5	0.00	5.0	22.0	-	-	DOWN	22.0	17.0
08/12/2024 - 08/13/2024	08/13/2024 - 08/14/2024	8/13/2024	8/14/2024	TRUE	Off Season	Wet	24.9	0.00	5.0	27.0	-	-	DOWN	27.0	22.0
08/13/2024 - 08/14/2024	08/14/2024 - 08/15/2024	8/14/2024	8/15/2024	TRUE	Off Season	Wet	25.8	0.00	5.0	26.0	-	-	DOWN	26.0	21.0
08/14/2024 - 08/15/2024	08/15/2024 - 08/16/2024	8/15/2024	8/16/2024	TRUE	Off Season	Wet	25.6	0.00	5.0	24.0	-	-	DOWN	24.0	19.0
08/15/2024 - 08/16/2024	08/16/2024 - 08/17/2024	8/16/2024	8/17/2024	TRUE	Off Season	Wet	23.8	0.00	5.0	25.0	-	-	DOWN	25.0	20.0
08/16/2024 - 08/17/2024	08/17/2024 - 08/18/2024	8/17/2024	8/18/2024	TRUE	Off Season	Wet	24.9	0.00	5.0	15.0	-	-	DOWN	15.0	10.0
08/17/2024 - 08/18/2024	08/18/2024 - 08/19/2024	8/18/2024	8/19/2024	TRUE	Off Season	Wet	16.2	0.00	5.0	11.0	-	-	DOWN	11.0	6.0
08/18/2024 - 08/19/2024	08/19/2024 - 08/20/2024	8/19/2024	8/20/2024	TRUE	Off Season	Wet	15.6	0.00	5.0	12.0	-	-	DOWN	12.0	7.0
08/19/2024 - 08/20/2024	08/20/2024 - 08/21/2024	8/20/2024	8/21/2024	TRUE	Off Season	Wet	16.6	0.00	5.0	17.0	-	-	DOWN	17.0	12.0
08/20/2024 - 08/21/2024	08/21/2024 - 08/22/2024	8/21/2024	8/22/2024	TRUE	Off Season	Wet	22.4	0.00	5.0	16.0	-	-	DOWN	16.0	11.0
08/21/2024 - 08/22/2024	08/22/2024 - 08/23/2024	8/22/2024	8/23/2024	TRUE	Off Season	Wet	21.3	0.00	5.0	15.0	-	-	DOWN	15.0	10.0
08/22/2024 - 08/23/2024	08/23/2024 - 08/24/2024	8/23/2024	8/24/2024	TRUE	Off Season	Wet	21.0	0.00	5.0	15.0	-	-	DOWN	15.0	10.0
08/23/2024 - 08/24/2024	08/24/2024 - 08/25/2024	8/24/2024	8/25/2024	TRUE	Off Season	Wet	21.3	0.00	5.0	12.0	-	-	DOWN	12.0	7.0
08/24/2024 - 08/25/2024	08/25/2024 - 08/26/2024	8/25/2024	8/26/2024	TRUE	Off Season	Wet	17.8	0.00	5.0	9.0	-	-	DOWN	9.0	4.0
08/25/2024 - 08/26/2024	08/26/2024 - 08/27/2024	8/26/2024	8/27/2024	TRUE	Off Season	Wet	16.1	0.00	5.0	12.0	-	-	DOWN	12.0	7.0
08/26/2024 - 08/27/2024	08/27/2024 - 08/28/2024	8/27/2024	8/28/2024	TRUE	Off Season	Wet	21.3	0.00	5.0	14.0	-	-	DOWN	14.0	9.0
08/27/2024 - 08/28/2024	08/28/2024 - 08/29/2024	8/28/2024	8/29/2024	TRUE	Off Season	Wet	19.5	0.00	5.0	19.0	-	-	DOWN	19.0	14.0
08/28/2024 - 08/29/2024	08/29/2024 - 08/30/2024	8/29/2024	8/30/2024	TRUE	Off Season	Wet	27.7	0.00	5.0	24.0	-	-	DOWN	24.0	19.0
08/29/2024 - 08/30/2024	08/30/2024 - 08/31/2024	8/30/2024	8/31/2024	TRUE	Off Season	Wet	29.5	0.00	5.0	25.0	-	-	DOWN	25.0	20.0
08/30/2024 - 08/31/2024	08/31/2024 - 09/01/2024	8/31/2024	9/1/2024	TRUE	Off Season	Wet	29.4	0.00	5.0	14.0	-	-	DOWN	14.0	9.0
08/31/2024 - 09/01/2024	09/01/2024 - 09/02/2024	9/1/2024	9/2/2024	TRUE	Off Season	Wet	19.7	0.00	5.0	9.0	-	-	DOWN	9.0	4.0

APPENDIX B
2023-2024 Fisheries Operations Log

Operations Log
2023-2024 Reporting Period

Date	RD1 Dam Up/Down	RD3 Dam Up/Down	Diversion Occuring	Average Daily Diversion Flow (CFS)	RD1 Active Gates	RD3 Active Gates	Notes
9/1/2024	Down	Down	Not Diverting	0			
8/31/2024	Down	Down	Not Diverting	0			
8/30/2024	Down	Down	Not Diverting	0			
8/29/2024	Down	Down	Not Diverting	0			
8/28/2024	Down	Down	Not Diverting	0			
8/27/2024	Down	Down	Not Diverting	0			
8/26/2024	Down	Down	Not Diverting	0			
8/25/2024	Down	Down	Not Diverting	0			
8/24/2024	Down	Down	Not Diverting	0			
8/23/2024	Down	Down	Not Diverting	0			
8/22/2024	Down	Down	Not Diverting	0			
8/21/2024	Down	Down	Not Diverting	0			
8/20/2024	Down	Down	Not Diverting	0			
8/19/2024	Down	Down	Not Diverting	0			
8/18/2024	Down	Down	Not Diverting	0			
8/17/2024	Down	Down	Not Diverting	0			
8/16/2024	Down	Down	Not Diverting	0			
8/15/2024	Down	Down	Not Diverting	0			
8/14/2024	Down	Down	Not Diverting	0			
8/13/2024	Down	Down	Not Diverting	0			
8/12/2024	Down	Down	Not Diverting	0			
8/11/2024	Down	Down	Not Diverting	0			
8/10/2024	Down	Down	Not Diverting	0			
8/9/2024	Down	Down	Not Diverting	0			
8/8/2024	Down	Down	Not Diverting	0			
8/7/2024	Down	Down	Not Diverting	0			
8/6/2024	Up	Down	Not Diverting	0	1		
8/5/2024	Up	Down	Not Diverting	0	1		
8/4/2024	Up	Down	Not Diverting	0	1		
8/3/2024	Up	Down	Not Diverting	0	1		
8/2/2024	Up	Down	Not Diverting	0	1		
8/1/2024	Up	Down	Not Diverting	0	1		
7/31/2024	Up	Down	Not Diverting	0	1		
7/30/2024	Up	Down	Not Diverting	0	1		
7/29/2024	Up	Down	Not Diverting	0	1		
7/28/2024	Up	Down	Not Diverting	0	1		
7/27/2024	Up	Down	Not Diverting	0	1		
7/26/2024	Up	Down	Not Diverting	0	1		
7/25/2024	Up	Down	Not Diverting	0	1		
7/24/2024	Up	Down	Not Diverting	0	1		
7/23/2024	Up	Down	Not Diverting	0	1		
7/22/2024	Up	Down	Not Diverting	0	1		
7/21/2024	Up	Down	Not Diverting	0	1		
7/20/2024	Up	Down	Not Diverting	0	1		
7/19/2024	Up	Down	Not Diverting	0	1		
7/18/2024	Up	Down	Not Diverting	0	1		
7/17/2024	Up	Down	Not Diverting	0	1		
7/16/2024	Up	Down	Not Diverting	0	1		
7/15/2024	Up	Down	Not Diverting	0	1		
7/14/2024	Up	Down	Not Diverting	0	1		
7/13/2024	Up	Down	Not Diverting	0	1		
7/12/2024	Up	Down	Not Diverting	0	1		
7/11/2024	Up	Down	Not Diverting	0	1		
7/10/2024	Up	Down	Not Diverting	0	1		
7/9/2024	Up	Down	Not Diverting	0	1		
7/8/2024	Up	Down	Not Diverting	0	1		
7/7/2024	Up	Down	Not Diverting	0	1		
7/6/2024	Up	Down	Not Diverting	0	1		
7/5/2024	Down	Down	Not Diverting	0	1		
7/4/2024	Down	Down	Not Diverting	0	1		
7/3/2024	Down	Down	Not Diverting	0	1		
7/2/2024	Up	Down	Not Diverting	0	1		
7/1/2024	Up	Down	Not Diverting	0	1, 2, 3, 4, Juvenile Splwy		
6/30/2024	Up	Up	Not Diverting	0	4	1	
6/28/2024	Up	Up	Not Diverting	0	4	1	
6/27/2024	Up	Up	Not Diverting	0	4	1	
6/26/2024	Up	Up	Not Diverting	0	4	1, 2	
6/25/2024	Up	Up	Not Diverting	0	4, 5	2	
6/24/2024	Up	Up	Not Diverting	0	4, 5	2	
6/23/2024	Up	Up	Not Diverting	0	4	2	
6/22/2024	Up	Up	Not Diverting	0	4	2	
6/21/2024	Up	Up	Not Diverting	0	4	2	
6/20/2024	Up	Up	Not Diverting	0	4, 5	2, 3	
6/19/2024	Up	Up	Not Diverting	0	5	3	
6/18/2024	Up	Up	Not Diverting	0	5	3	
6/17/2024	Up	Up	Not Diverting	0	5	3	
6/16/2024	Up	Up	Diverting	0	5	3	Diversion was inadvertent and due to routine maintenance of the facility.
6/15/2024	Up	Up	Not Diverting	0	5	3	
6/14/2024	Up	Up	Not Diverting	0	5	3	
6/13/2024	Up	Up	Not Diverting	0	5	3	
6/12/2024	Up	Up	Not Diverting	0	5	3	

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Alameda Creek Fish Passage Program
2023-2024

Date	RD1 Dam Up/Down	RD3 Dam Up/Down	Diversion Occuring	Average Daily Diversion Flow (CFS)	RD1 Active Gates	RD3 Active Gates	Notes
6/11/2024	Up	Up	Not Diverting	0	5	3	
6/10/2024	Up	Up	Not Diverting	0	5	3	
6/9/2024	Up	Up	Not Diverting	0	4, 5	3	
6/8/2024	Up	Up	Not Diverting	0	4	3	
6/7/2024	Up	Up	Not Diverting	0	4	3	
6/6/2024	Up	Up	Not Diverting	0	4	3	
6/5/2024	Up	Up	Not Diverting	0	4	3	
6/4/2024	Up	Up	Not Diverting	0	4	3	
6/3/2024	Up	Up	Not Diverting	0	4	3	
6/2/2024	Up	Up	Not Diverting	0	4	3	
6/1/2024	Up	Up	Not Diverting	0	4	3	
5/31/2024	Up	Up	Diverting	7	4	3	
5/30/2024	Up	Up	Diverting	11	4	3	
5/29/2024	Up	Up	Diverting	9	4, 5, Low Flow Splwy	3, 4	
5/28/2024	Up	Up	Diverting	9	5	3, 4	
5/27/2024	Up	Up	Diverting	5	5	3, 4	
5/26/2024	Up	Up	Diverting	1	5	3, 4	
5/25/2024	Up	Up	Diverting	4	5	3, 4, 5	
5/24/2024	Up	Up	Diverting	6	5, Low Flow Splwy	3, 4, 5	
5/23/2024	Up	Up	Not Diverting	0	5, Low Flow Splwy	4, 5	
5/22/2024	Up	Up	Not Diverting	0	5, Low Flow Splwy	3, 4	
5/21/2024	Up	Up	Not Diverting	0	5, Low Flow Splwy	3	
5/20/2024	Up	Up	Not Diverting	0	5, Low Flow Splwy	3	
5/19/2024	Up	Up	Not Diverting	0	5	3	
5/18/2024	Up	Up	Not Diverting	0	5	3	
5/17/2024	Up	Up	Not Diverting	0	5	3	
5/16/2024	Up	Up	Not Diverting	0	5	3, 4	
5/15/2024	Up	Up	Diverting	6	5	4	
5/14/2024	Up	Up	Diverting	11	5	4	
5/13/2024	Up	Up	Diverting	11	5	4	
5/12/2024	Up	Up	Diverting	15	5	4	
5/11/2024	Up	Up	Diverting	19	4, 5	3, 4	
5/10/2024	Up	Up	Diverting	20	4, 5	3	
5/9/2024	Up	Up	Diverting	20	5	3	
5/8/2024	Up	Up	Diverting	20	5	3	
5/7/2024	Up	Up	Diverting	22	5	3, 4	
5/6/2024	Up	Up	Diverting	22	5	4	
5/5/2024	Up	Up	Diverting	8	5, Low Flow Splwy	3, 4, 5	
5/4/2024	Up	Up	Not Diverting	0	2, Low Flow Splwy	5	
5/3/2024	Up	Up	Not Diverting	0	2	5	
5/2/2024	Up	Up	Not Diverting	0	2	5	
5/1/2024	Up	Up	Not Diverting	0	1, 2	5	
4/30/2024	Up	Up	Diverting	1	1, 4	3, 5	
4/29/2024	Up	Up	Diverting	0	4	3, 4	
4/28/2024	Up	Up	Not Diverting	0	4	4	
4/27/2024	Up	Up	Not Diverting	0	4	4	
4/26/2024	Up	Up	Not Diverting	0	4	4	
4/25/2024	Up	Up	Not Diverting	0	4	4	
4/24/2024	Up	Up	Not Diverting	0	4	4	
4/23/2024	Up	Up	Not Diverting	0	4	4	
4/22/2024	Up	Up	Not Diverting	0	4	4	
4/21/2024	Up	Up	Not Diverting	0	4	4	
4/20/2024	Up	Up	Not Diverting	0	4, Juvenile Splwy	4	
4/19/2024	Up	Up	Diverting	0	4	4	
4/18/2024	Up	Up	Not Diverting	0	4, Juvenile Splwy	4	
4/17/2024	Up	Up	Diverting	3	4, 5, Juvenile Splwy	4	
4/16/2024	Up	Up	Diverting	9	5	4	
4/15/2024	Up	Up	Diverting	9	5	4	
4/14/2024	Up	Up	Diverting	9	5	4	
4/13/2024	Up	Up	Diverting	9	5	4	
4/12/2024	Up	Up	Diverting	9	5	4	
4/11/2024	Up	Up	Diverting	9	5	4, 5	
4/10/2024	Up	Up	Diverting	4	5	4	
4/9/2024	Up	Up	Diverting	0	5	4	
4/8/2024	Up	Up	Diverting	0	4, 5	4	
4/7/2024	Up	Up	Diverting	0	4	4	
4/6/2024	Up	Up	Diverting	0	4	4	
4/5/2024	Up	Up	Not Diverting	0	4	4	
4/4/2024	Up	Up	Diverting	12	4	4	
4/3/2024	Up	Up	Diverting	32	4	4	
4/2/2024	Up	Up	Diverting	26	4, 5, Juvenile Splwy	4	
4/1/2024	Up	Up	Diverting	20	5, Juvenile Splwy	4	
3/31/2024	Up	Up	Diverting	21	5	4	
3/30/2024	Up	Up	Diverting	25	5	4	
3/29/2024	Up	Up	Diverting	42	5	4	
3/28/2024	Up	Up	Diverting	59	4, 5	4	
3/27/2024	Up	Up	Diverting	62	4, 5	3, 4	
3/26/2024	Up	Up	Diverting	68	5	3, 4	
3/25/2024	Up	Up	Diverting	56	5	3, 4	
3/24/2024	Up	Up	Diverting	55	5	3, 4	
3/23/2024	Up	Up	Diverting	54	4, 5	3	
3/22/2024	Up	Up	Diverting	41	4	3	

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Date	RD1 Dam Up/Down	RD3 Dam Up/Down	Diversion Occuring	Average Daily Diversion Flow (CFS)	RD1 Active Gates	RD3 Active Gates	Notes
3/21/2024	Up	Up	Diverting	44	4	3	
3/20/2024	Up	Up	Diverting	43	4	3	
3/19/2024	Up	Up	Diverting	32	4	3	
3/18/2024	Up	Up	Diverting	49	4	3	
3/17/2024	Up	Up	Diverting	52	4	3	
3/16/2024	Up	Up	Diverting	60	4, 5	3	
3/15/2024	Up	Up	Diverting	77	5	3	
3/14/2024	Up	Up	Diverting	25	5	3	
3/13/2024	Up	Down	Not Diverting	0	5	1, 2, 3	
3/12/2024	Up	Down	Not Diverting	0	5		
3/11/2024	Up	Down	Not Diverting	0	5		
3/10/2024	Up	Down	Not Diverting	0	4, 5		
3/9/2024	Up	Down	Not Diverting	0	4, 5		
3/8/2024	Up	Down	Not Diverting	0	5		
3/7/2024	Down	Down	Not Diverting	0	1, 5		
3/6/2024	Up	Down	Diverting	21	5		
3/5/2024	Up	Down	Diverting	95	5		
3/4/2024	Up	Down	Not Diverting	0	5		
3/3/2024	Down	Down	Not Diverting	0	1, 2, 3, 5		
3/2/2024	Up	Down	Not Diverting	0	1, 5		
3/1/2024	Up	Down	Not Diverting	0	5		
2/29/2024	Up	Down	Not Diverting	0	5		
2/28/2024	Up	Down	Not Diverting	0	5		
2/27/2024	Up	Down	Not Diverting	0	5		
2/26/2024	Up	Down	Not Diverting	0	1, 3, 4, 5		
2/25/2024	Up	Down	Not Diverting	0	1		
2/24/2024	Up	Down	Not Diverting	0	1		
2/23/2024	Up	Down	Not Diverting	0	1		
2/22/2024	Up	Down	Not Diverting	0	1		
2/21/2024	Up	Down	Not Diverting	0	1, 2		
2/20/2024	Down	Down	Not Diverting	0	1, 2		
2/19/2024	Down	Down	Not Diverting	0	1, 2		
2/18/2024	Down	Down	Not Diverting	0	1		
2/17/2024	Down	Down	Not Diverting	0	1		
2/16/2024	Down	Down	Not Diverting	0	1		
2/15/2024	Down	Down	Not Diverting	0	1		
2/14/2024	Up	Down	Not Diverting	0	1, 2, 3, 4, 5		
2/13/2024	Up	Down	Not Diverting	0	5		
2/12/2024	Up	Down	Not Diverting	0	5		
2/11/2024	Up	Down	Not Diverting	0	5		
2/10/2024	Up	Down	Not Diverting	0	5		
2/9/2024	Up	Down	Not Diverting	0	5		
2/8/2024	Up	Down	Not Diverting	0	2, 5		
2/7/2024	Up	Down	Not Diverting	0	5		
2/6/2024	Up	Down	Not Diverting	0	3, 4, 5		
2/5/2024	Down	Down	Not Diverting	0	2, 3		
2/4/2024	Up	Down	Not Diverting	0	5		
2/3/2024	Up	Down	Diverting	29	5		
2/2/2024	Up	Down	Diverting	30	5		
2/1/2024	Up	Down	Not Diverting	0	5		
1/31/2024	Up	Up	Not Diverting	0	3, 5	1	
1/30/2024	Up	Up	Not Diverting	0	3	1	
1/29/2024	Up	Down	Not Diverting	0	3, 4	1	
1/28/2024	Up	Down	Not Diverting	0	4		
1/27/2024	Up	Down	Not Diverting	0	4		
1/26/2024	Up	Down	Not Diverting	0	4		
1/25/2024	Up	Down	Not Diverting	0	4, 5		
1/24/2024	Up	Down	Not Diverting	0	4, 5		
1/23/2024	Down	Down	Not Diverting	0	4, 5		
1/22/2024	Up	Down	Not Diverting	0	2, 3, 5		
1/21/2024	Up	Down	Not Diverting	0	5		
1/20/2024	Up	Down	Not Diverting	0	5		
1/19/2024	Up	Down	Diverting	8	5		
1/18/2024	Up	Down	Diverting	18	5		
1/17/2024	Up	Down	Diverting	40	5		
1/16/2024	Up	Down	Not Diverting	0	5		
1/15/2024	Up	Down	Not Diverting	0	5		
1/14/2024	Up	Down	Diverting	36	4, 5		
1/13/2024	Up	Up	Diverting	16	4, 5	1	
1/12/2024	Up	Down	Diverting	19	4, 5	1	
1/11/2024	Up	Down	Diverting	51	3, 4		
1/10/2024	Up	Up	Diverting	5	3	1	
1/9/2024	Up	Down	Diverting	12	3	1	
1/8/2024	Up	Down	Diverting	26	3, 4		
1/7/2024	Up	Down	Diverting	44	3, 4, 5		
1/6/2024	Up	Down	Diverting	20	3		
1/5/2024	Up	Down	Diverting	28	3		
1/4/2024	Up	Down	Diverting	123	3, 4, 5		
1/3/2024	Up	Down	Diverting	207	4, 5		
1/2/2024	Up	Up	Diverting	28	2, 3, 4, 5	1	
1/1/2024	Up	Down	Diverting	15	4, 5	1	
12/31/2023	Up	Down	Diverting	58	3, 4, 5		

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Date	RD1 Dam Up/Down	RD3 Dam Up/Down	Diversion Occuring	Average Daily Diversion Flow (CFS)	RD1 Active Gates	RD3 Active Gates	Notes
12/30/2023	Up	Down	Diverting	126	2, 3, 4, 5, Juvenile Splwy		
12/29/2023	Both	Both	Diverting	16	2, 3	1	
12/28/2023	Both	Both	Not Diverting	0	3	1	
12/27/2023	Up	Up	Not Diverting	0	3	1	
12/26/2023	Up	Up	Not Diverting	0	3	1	
12/25/2023	Up	Up	Not Diverting	0	3	1	
12/24/2023	Up	Up	Not Diverting	0	3	1	
12/23/2023	Up	Up	Not Diverting	0	3	1	
12/22/2023	Up	Down	Diverting	40	2, 3	1	
12/21/2023	Up	Down	Diverting	185	3, 4, 5		
12/20/2023	Up	Down	Diverting	226	3, 4, 5		
12/19/2023	Up	Down	Diverting	230	5		
12/18/2023	Up	Up	Diverting	115	3, 4, 5	1	
12/17/2023	Up	Up	Not Diverting	0	3	1	
12/16/2023	Both	Up	Not Diverting	0	3	1	
12/15/2023	Up	Up	Not Diverting	0	3	1	
12/14/2023	Up	Up	Not Diverting	0	3	1	
12/13/2023	Up	Up	Not Diverting	0	3, 4	1	
12/12/2023	Up	Up	Not Diverting	0	4	1	
12/11/2023	Up	Up	Not Diverting	0	4	1	
12/10/2023	Up	Up	Not Diverting	0	4	1	
12/9/2023	Up	Up	Not Diverting	0	4	1	
12/8/2023	Up	Up	Not Diverting	0	3, 4	1	
12/7/2023	Up	Up	Not Diverting	0	4, 5	1	
12/6/2023	Up	Up	Not Diverting	0	5	1	
12/5/2023	Up	Up	Not Diverting	0	5	1	
12/4/2023	Up	Up	Not Diverting	0	5	1	
12/3/2023	Up	Up	Not Diverting	0	5	1	
12/2/2023	Up	Up	Not Diverting	0	5	1	
12/1/2023	Up	Up	Not Diverting	0	5	1	
11/30/2023	Up	Up	Not Diverting	0	4, 5	1	
11/29/2023	Up	Up	Not Diverting	0	5	1	
11/28/2023	Up	Up	Not Diverting	0	5	1	
11/27/2023	Up	Up	Not Diverting	0	5	1	
11/26/2023	Up	Up	Not Diverting	0	5	1	
11/25/2023	Up	Up	Not Diverting	0	5	1	
11/24/2023	Up	Up	Diverting	3	5	1	
11/23/2023	Up	Up	Not Diverting	0	5	1	
11/22/2023	Up	Up	Not Diverting	0	5	1	
11/21/2023	Up	Down	Diverting	1	5	1	
11/20/2023	Up	Down	Not Diverting	0	5	1	
11/19/2023	Up	Down	Diverting	27	3, 5		
11/18/2023	Up	Down	Diverting	21	3		
11/17/2023	Up	Down	Not Diverting	0	3	1	
11/16/2023	Up	Down	Diverting	15	3		
11/15/2023	Up	Down	Diverting	33	3, 5		
11/14/2023	Up	Up	Diverting	9	5	1	
11/13/2023	Up	Up	Diverting	6	5	1	
11/12/2023	Up	Up	Diverting	6	5		
11/11/2023	Up	Up	Diverting	6	5		
11/10/2023	Up	Down	Diverting	6	5		
11/9/2023	Up	Down	Diverting	13	5		
11/8/2023	Up	Down	Diverting	29	5		
11/7/2023	Up	Down	Diverting	26	4, 5		
11/6/2023	Up	Down	Not Diverting	0	4		
11/5/2023	Up	Down	Not Diverting	0	3, 4		
11/4/2023	Up	Up	Not Diverting	0	3	1	
11/3/2023	Up	Up	Not Diverting	0	3	1	
11/2/2023	Up	Up	Not Diverting	0	3	1	
11/1/2023	Up	Up	Not Diverting	0	3	1	
10/31/2023	Up	Up	Not Diverting	0	3	1	
10/30/2023	Up	Up	Not Diverting	0	3	1	
10/29/2023	Up	Up	Not Diverting	0	3	1	
10/28/2023	Up	Down	Not Diverting	0	3, 4	1	
10/27/2023	Up	Down	Diverting	7	4		
10/26/2023	Up	Down	Diverting	14	4		
10/25/2023	Up	Down	Diverting	15	4		
10/24/2023	Up	Down	Diverting	18	4		
10/23/2023	Up	Down	Diverting	7	3, 4, 5		
10/22/2023	Up	Down	Diverting	30	5		
10/21/2023	Up	Down	Diverting	7	5, Low Flow Splwy		
10/20/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/19/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/18/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/17/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/16/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/15/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/14/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/13/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/12/2023	Up	Down	Not Diverting	0	Low Flow Splwy		

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Date	RD1 Dam Up/Down	RD3 Dam Up/Down	Diversion Occuring	Average Daily Diversion Flow (CFS)	RD1 Active Gates	RD3 Active Gates	Notes
10/11/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/10/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/9/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/8/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/7/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/6/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/5/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/4/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/3/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/2/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
10/1/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/30/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/29/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/28/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/27/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/26/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/25/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/24/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/23/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/22/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/21/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/20/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/19/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/18/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/17/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/16/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/15/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/14/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/13/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/12/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/11/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/10/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/9/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/8/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/7/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/6/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/5/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/4/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/3/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/2/2023	Up	Down	Not Diverting	0	Low Flow Splwy		
9/1/2023	Up	Down	Not Diverting	0	Low Flow Splwy		