BUREAU OF RECLAMATION

Long-Term Operation – Public Draft Alternatives

Appendix H – Conservation Measure Deconstruction

Central Valley Project, California

Interior Region 10 – California-Great Basin

Mission Statements

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

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

Long-Term Operation – Public Draft Alternatives

Appendix H – Conservation Measure Deconstruction

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Tables

1. Introduction

This conservation measure deconstruction appendix analyzes actions to minimize or compensate for project effects from the seasonal operations of the Central Valley Project and State Water Project or to benefit or promote the recovery of listed species. While conservation measures intend to benefit at least one species, they may have additional effects on other life stages or to other species. The magnitude of the adverse effect from the seasonal operation stressor and the magnitude of the effect of the conservation measure informs the effectiveness of minimization and compensation or the potential change in the status of species in the environmental baseline.

Appendix D, *Seasonal Operations Deconstruction*, describes the linkages between conceptual models, seasonal operations, and resulting stressors on federally listed fish species to identify the potential adverse effects from the operation of the Central Valley Project (CVP) and State Water Project (SWP). Appendix E, *Exploratory Modeling*, explores modeling to understand the capabilities of the system to accomplish seasonal operations for the multiple purposes of fish, water supply, and power generation. Appendix F, *Alternatives Modeling*, provides the resulting seasonal operation with actions that will be in all alternatives described as common components and placeholders for actions with a variable component. Appendix G, *Specific Facility and Water Operations Deconstruction*, deconstructs stressors for the local effects of facility maintenance or for water operations not covered in seasonal operations. This appendix evaluates each of the conservation measures in common components for potential beneficial and adverse effects using the same conceptual models described in Appendix D. This appendix is organized by watershed and action, consistent with Appendix F. Subsequent appendixes describe variable components.

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2. Sacramento River

Variable and common components not addressed in this Appendix are as follows:

- Seasonal Operation Stressors on Aquatic Species: Appendix D
- Shasta Cold Water Pool Management: Appendix L, *Shasta Coldwater Pool Management*

The remaining conservation measures are described in the following subsections.

2.1 Ramping Rates

Appendix D identifies that seasonal operations may affect the stranding risk stressor listed fish species. Ramping rates address the stranding risk stressor on juvenile salmonids by minimizing the rate and timing of flow decreases. Rapid changes in river elevation from ramping reservoir releases up or down can impact aquatic biota. Sudden flow decreases can strand fishes and macroinvertebrates (Dauwalter 2013) depending on factors such as the distance downstream of the dam, season, time of day, substrate type, channel slope, channel morphology, and wetted history (how long the habitat was wetted prior to the event) (Young et al. 2011;). Research on the Columbia River indicates that the highest probability of stranding is initiated by large magnitude flow reductions in the afternoon during mid-summer, at low water levels near the shore that has been inundated for a long period (Irvin et al. 2015). Ramping rates can be expressed in terms of absolute or percent of river flow or as rates of changes in river stage. They can be derived via experimental approaches in mesocosms, flumes, or net pens, or via in-river monitoring of fish response to flows. Although some locales have developing standard ramping rates (see Fisheries and Oceans Canada DFO Generic Standard Ramping Rate Table 6.1 in Cathcart 2005 as cited in Table 1 of Lewis and Healey), appropriate ramping rates may be idiosyncratic to a given location, depending on its physical and biological characteristics, and may have to consider other factors such as the benefits of natural flow variability and various operational constraints.

Specific to the Sacramento River and releases from Keswick Dam, ramping rates were initially proposed in WRO 90-5 and then expressed in the 1993 NMFS Biological Opinion as, “During the ramping down of Keswick Dam releases, the Bureau must ensure fisheries monitoring is conducted in nearshore areas along upper Sacramento River between stream flows of 4,000 and 3,250 cfs.” The 2004 Biological Opinion added the additional stipulations relative to Keswick releases and specified restrictions at night.
Species potentially affected by ramping rates include winter-run Chinook salmon, spring-run Chinook salmon, and steelhead in the upper Sacramento River. Changes in flows attenuate further downstream from diffusion and accretions.

2.1.1 Winter-Run Chinook Salmon

Adults are migrating, holding, and spawning in the Sacramento River during this period.

Eggs may be present in the Sacramento River during this period.

Juveniles are present during this period.

2.1.2 Spring-Run Chinook Salmon

Adults are migrating, holding, and spawning in the Sacramento River during this period.

Eggs are present in the Sacramento River during this period.

Juveniles are rearing and migrating during this period.

Yearlings are rearing and migrating during this period.

2.1.3 Steelhead

Adults are present during this period.

Eggs are present in the Sacramento River during this period.

Juveniles are rearing and migrating during this period.

2.2 Minimum Instream Flows

Appendix D identifies that seasonal operations may affect stressors on listed fish species. Minimum instream flows help avoid or minimize these stressors. Reclamation will target Keswick releases of at least 3,250 cfs for minimum instream flows. Condition 2 of Order 90-5 requires a release of 3,250 cfs from September through February, except during critical dry years or emergencies. Species potentially affected by minimum instream flows include winter-run Chinook salmon, spring-run Chinook salmon, and steelhead.

2.2.1 Winter-Run Chinook Salmon

Adults are present during this period.

Eggs are not present in the Sacramento River during this period.

Juveniles are present during this period.

2.2.2 Spring-Run Chinook Salmon

Adults are migrating, holding, and spawning in the Sacramento River.

Eggs are present in the Sacramento River.

Juveniles are rearing and migrating during this period.

Yearlings are rearing and migrating during this period.

2.2.3 Steelhead

Adults are migrating and holding in the Sacramento River.

Eggs are present in the Sacramento River.

Juveniles are rearing and migrating in the Sacramento River.

2.3 Spring Pulse Flows

Spring pulse flows are a variable component analyzed in Appendix J, *Winter and Spring Pulses and Delta Outflow: Smelt, Chinook Salmon, and Steelhead Migration and Survival*. Although the magnitude of the effects may vary, Reclamation expects the direction of the effects to be consistent for all the options. Spring pulse flows address stressors on outmigration cues for juvenile Chinook salmon. Pulse flows affect habitat attributes, resulting in outmigration cues that can result in changes in juvenile salmonid survival. Species potentially affected by spring pulse flows include winter-run Chinook salmon, spring-run Chinook salmon, and steelhead.

2.3.1 Winter-Run Chinook Salmon

Adults are holding in the Sacramento River during this period.

Eggs are not present in the Sacramento River during this period but may be affected.

Juveniles are not present in the Sacramento River during this period.

2.3.2 Spring-Run Chinook Salmon

Adults are migrating and holding in the Sacramento River during this period.

Eggs are not present in the Sacramento River during this period.

Juveniles are rearing and migrating during this period.

Yearlings are migrating during this period.

2.3.3 Steelhead

Adults are present during this period.

Eggs are not present in the Sacramento River during this period but may be affected.

Juveniles are rearing and migrating during this period.

2.3.4 Green Sturgeon

Adults are migrating, spawning, and holding in the upper Sacramento River during this period.

Eggs are present in the upper Sacramento River.

Larvae are present in the upper Sacramento River.

Juveniles are present in the upper Sacramento River.

2.4 Fall and Winter Instream Flows

Fall and winter instream flows balance winter-run Chinook salmon redd dewatering stressors with fall-run Chinook salmon considerations. Reclamation proposes to decrease Keswick Dam releases in the fall in a manner that minimizes winter-run and fall-run Chinook salmon redd dewatering and conserves Shasta Lake storage. Species potentially impacted by fall and winter instream flows include winter-run Chinook salmon, spring-run Chinook salmon, and steelhead.

2.4.1 Winter-Run Chinook Salmon

Adults are migrating, holding, and spawning in the Sacramento River.

Eggs are present in the Sacramento River.

Juveniles are present in the Sacramento River.

2.4.2 Spring-Run Chinook Salmon

Adults are migrating, holding, and spawning in the Sacramento River.

Eggs are present in the Sacramento River.

Juveniles are present in the Sacramento River.

Yearlings are present in the Sacramento River.

2.4.3 Steelhead

Adults are not present.

Eggs are not present.

Juveniles are rearing and migrating during this period.

2.5 Rice Decomposition Smoothing

Rice decomposition smoothing supports fall-run Chinook salmon while balancing winter-run redd dewatering stressors. With lower October and November flows, fall-run Chinook salmon are less likely to spawn in shallow areas that would be subject to dewatering during winter base flows. These early reductions balance the potential for dewatering late-spawning winter-run Chinook salmon. Species potentially impacted by rice decomposition smoothing include winter-run Chinook salmon.

2.5.1 Winter-Run Chinook Salmon

Adults are spawning in the Sacramento River.

Eggs are present in the Sacramento River.

Juveniles are present in the Sacramento River.

2.6 Tributary Habitat Restoration

Tributary habitat restoration is a variable component addressed in Appendix O, *Tributary Habitat Restoration*. Although the magnitude may change, we expect the direction of the effects to be consistent for all the options. This action addresses the competition, introgression, and broodstock removal; spawning habitat; sedimentation and gravel quantity; redd quality; refuge habitat; food availability and quality; and predation and competition stressors. Reclamation proposes to construct and maintain spawning and rearing habitat and improve facilities through competitive grants consistent with priorities developed through the Central Valley Project Improvement Act (CVPIA) Science Integration Team. Species potentially impacted by tributary habitat restoration include winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and Green Sturgeon.
On the Sacramento River, Table 1 shows the recent and anticipated projects.

Table 1. Recent and Anticipated Sacramento River Spawning and Rearing Projects

Year	Project	Spawning Maintain (acres)	Spawning Add (acres)	Rearing Add (acres)	Floodplain Add (acres)
2024	Meridian Farms Pump Replacement	0	0	6.8	0
2022	East Sand Slough	0	0	7.1	0
2022	NOFO Shea Side	0	1.7	2.5	0
2022	Sacramento River - East Sand Slough restoration	0	0	5	5
2022	Sacramento River Tisdale Weir Sturgeon and Salmonid Passage	0	0	0.5	0
2021	Anderson River Park Phase II & III	0	0.5	2.9	1.0
2021	Sacramento River habitat restoration at Anderson river park	0	0.2	4	0
2021	Sacramento River salmonid spawning and rearing habitat restoration	3	0	3	0
2021	South Cypress	0	1.0	5.2	0
2020	Anderson River Park Phase I	0	0.5	1.5	1.0
2020	Reading	0	0	8.0	5.0
2020	Rio Vista	0	0.25	2.0	0

2020	Sacramento River salmonid habitat restoration at Reading/Rancheria Island	0	0.2	3.3	8
2019	NOFO Keswick Gravel	18.7	0	0	0
2019	NOFO Market Street Gravel	3	0	0	0
2019	Restore rearing and spawning side channels in the upper Sacramento river	0	0	1.3	0
2019	Sacramento River improve spawning habitat above temperature control point	5	0	0	0
2018	Natural and artificial rearing structures in the Upper Sacramento River	0	0	0.4	0
2017	Sacramento River salmonid spawning and rearing habitat improvement	0	0	2	0

2.6.1 Winter-Run Chinook Salmon

Adults are migrating, holding, and spawning in the Sacramento River.

Eggs are present in the Sacramento River.

Juveniles are present in the Sacramento River during this period.

2.6.2 Spring-Run Chinook Salmon

Adults are migrating, holding, and spawning in the Sacramento River.

Eggs are present in the Sacramento River.

Juveniles are rearing and migrating during this period.

Yearlings are rearing and migrating during this period.

2.6.3 Steelhead

Adults are present.

Eggs are present.

Juveniles are present.

2.6.4 Green Sturgeon

Adults are migrating, holding, and spawning in the Sacramento River.

Eggs are present in the upper Sacramento River.

Larvae are present in the upper Sacramento River.

Juveniles are present in the upper Sacramento River.

2.7 Winter-Run Chinook Salmon Conservation Hatchery Intervention

Conservation hatchery intervention, as described in Appendix F, addresses water temperature, dissolved oxygen, and thiamine stressors. Reclamation, through Governance, may increase production at the Livingston-Stone National Fish Hatchery during drought conditions to maintain populations when environmental conditions exceed species tolerances downstream of Keswick. Species potentially impacted by winter-run conservation hatchery intervention include winter-run Chinook salmon.

2.7.1 Winter-Run Chinook Salmon

Adults are migrating, holding, and spawning in the Sacramento River.

Eggs are present in the Sacramento River.

Juveniles are present in the Sacramento River during this period.

3. Clear Creek

Variable and common components not addressed in this appendix are as follows:

- Seasonal Operation Stressors on Aquatic Species: Appendix D
- Specific Facility and Water Operations Deconstruction: Appendix G, Section 2, *Spring Creek Debris Dam, Sacramento River*

The remaining conservation measures are described in the following subsections.

3.1 Ramping Rates

Appendix D identifies that seasonal operations may affect the stranding risk stressor on listed fish species. As described in Section 2.1, *Ramping Rates*, ramping rates address the stranding risk stressor by minimizing the rate of flow decreases during controlled flow reduction. In Clear Creek, ramping rates addresses the stranding risk stressor on juveniles and yearling salmonids. Reclamation will limit down-ramping rates to 25 cfs per hour.

Reclamation, through Governance, may develop faster down-ramping rates on a case-by-case basis. Flow actions will include measures to mitigate for juvenile stranding risk (e.g., nighttime down ramping, slow down-ramping rates). These measures will be contained within the allotted water volumes for minimum instream flows and pulse flows.

Down-ramping rates are limited by Whiskeytown Dam infrastructure. Flow reductions (down ramping) can potentially induce stranding of juvenile salmonids on Clear Creek.

3.1.1 Spring-Run Chinook Salmon

Adults are migrating, holding, and spawning in Clear Creek during this period.

Eggs are present during this period.

Juveniles are rearing and migrating during this period.

Yearlings are rearing and migrating during this period.

3.1.2 Steelhead

Adults are migrating, holding, and spawning in Clear Creek during this period.

Eggs are present during this period.

Juveniles are rearing and migrating during this period.

3.2 Minimum Instream Flows

Appendix D identified that seasonal operations may affect stressors on listed fish species. Minimum instream flows help avoid or minimize these stressors. Minimum instream flows address refuge habitat, food availability and quality, and predation and competition stressors for juveniles and yearling salmonids. Reclamation will release water through Whiskeytown Dam to provide intra-annual variation to emulate natural processes. Flows will have a 200 cfs average annual flow that oscillates over a 1-year period, with releases transitioning from 300 cfs in the winter, down to 100 cfs in the summer, and back to 300 cfs by the following winter. In critical years, Reclamation will target 150 cfs based on available water from Trinity Reservoir and attempt to maintain above 100 cfs.

Reclamation, through Governance, will schedule the hydrograph to maximize multi-species benefits. An annual schedule will be developed by February 1 and updated through May on a case-by-case basis. The flow schedule is dependent, at times, upon agreement by Redding Electric Utility for use of their facilities.

The seasonally variable hydrograph emulates a more natural flow regime, which is expected to better support natural anadromous fish production. Minimum flows per Instream Flow Preservation Agreement (2000) are shown below.

Table 2. Table Title Minimum instream flows in Normal and Critical water year types.

Period	Normal Year	Critical Year
January – October	50 cfs	50 cfs
November – December	100 cfs	70 cfs

3.2.1 Spring-Run Chinook Salmon

Adults are migrating, holding, and spawning in Clear Creek.

Eggs are present in Clear Creek.

Juveniles are rearing and migrating during this period.

Yearlings are rearing during this period.

3.2.2 Steelhead

Adults are migrating, holding, and spawning in Clear Creek.

Eggs are present in Clear Creek.

Juveniles are rearing and migrating during this period.

3.3 Pulse Flows

As described in Appendix F, pulse flows address the stressors on migration cues. Except in years with significant uncontrolled spill, Reclamation will release up to 10,000 acre-feet from Whiskeytown Dam for channel maintenance, spring attraction flows, and to meet other physical and biological objectives. In critical years, Reclamation will release up to 5,000 acre-feet.

Reclamation, through Governance, will develop pulse flows schedules, which include measures (e.g., nighttime down ramping, slow down-ramping rates, etc.) to mitigate for potential risks (e.g., potential juvenile fish stranding). The pulse flows are not to exceed safe outlet works capacity of Whiskeytown Dam, currently 840 cfs, and to be scheduled on or after February 1.

Over the past decade, these pulse flows have typically been scheduled for May and June, which corresponds to the peak migration timing of spring-run Chinook salmon into Clear Creek. Pulses intended to promote geomorphic activities will be most effective if coordinated with natural precipitation events and will likely require quick implementation if a predicted storm is truly eminent. Managed spring attraction pulse flows released from Whiskeytown Dam have been shown to cause spring-run Chinook salmon to enter Clear Creek from the Sacramento River (Bottaro and Chamberlain 2019).

3.3.1 Spring-Run Chinook Salmon

Adults are migrating, holding, and spawning in Clear Creek.

Eggs are not present during this period.

Juveniles are rearing and migrating during this period.

Yearlings are not present during this period.

3.3.2 Steelhead

Adults are migrating, holding, and spawning in Clear Creek.

Eggs are present in Clear Creek.

Juveniles are rearing and migrating during this period.

3.4 Water Temperature Management

Water temperature management addresses adult and juvenile water temperature stressors and egg incubation stressors. Reclamation will target Whiskeytown Dam releases to not exceed the mean daily temperatures at Igo gage:

- 61° F from June 1 through August 15
- 60° F from August 16 through September 15

- 56° from September 15 through November 15

Water temperature management on Clear Creek is implemented through changes in guard gate configurations and flow manipulations. In dry, critical, or transfer curtailment years, Reclamation may not be able to meet these temperatures and will operate Whiskeytown Dam as close to these temperatures as practical.

Additional flows may be required to meet temperature objectives. Reclamation will determine if additional water is available for temperature management and notify the members of Governance. If temperature exceedances are encountered (i.e., 2 consecutive days of mean daily temp exceedance), then Reclamation may add 25 cfs to the seasonally variable hydrograph. If additional water is not available, Reclamation may, through Governance, reshape the remaining seasonally variable hydrograph to make this water available. Reshaping will consider maintaining redds.

Within Clear Creek, spring-run Chinook salmon hold from May through September and benefit from stable and cool water temperatures. Spring-run Chinook salmon spawning typically occurs in September. Eggs benefit from stable and cool water during their incubation. All other anadromous salmonids within Clear Creek spawn from October through March and have similar egg incubation water temperature requirements. Meeting temperature targets in Clear Creek requires sufficient cold water in Whiskeytown Reservoir. Cold water within Whiskeytown Reservoir is dependent on trans-basin deliveries from the Trinity River imported through the Carr tunnel. When deliveries are high, cool water is generally available throughout the year for Clear Creek. When deliveries are curtailed, reservoir temperatures can rise above preferred levels. This leads to difficulties in managing summer and fall temperatures in Clear Creek. Additional water releases increase flow rate and thermal mass, reducing water warming below Whiskeytown Dam.

3.4.1 Spring-Run Chinook Salmon

Adults are migrating, holding, and spawning in Clear Creek.

Eggs are present in Clear Creek.

Juveniles are rearing and migrating during this period.

Yearlings are rearing during this period.

3.4.2 Steelhead

Adults are migrating, holding, and spawning in Clear Creek.

Eggs are not present in Clear Creek.

Juveniles are rearing and migrating during this period.

3.5 Tributary Habitat Restoration

Tributary habitat restoration is a variable component addressed in appendix O. Although the magnitude may change, we expect the direction of the effects to be consistent for all the options. Reclamation proposes to construct and maintain spawning and rearing habitat and to improve facilities through competitive grants consistent with priorities developed through the CVPIA Science Integration Team. Habitat restoration addresses the competition, introgression, and broodstock removal; spawning habitat; sedimentation and gravel quantity; redd quality; refuge habitat; food availability and quality; and predation and competition stressors. Species potentially impacted by tributary habitat restoration in Clear Creek include spring-run Chinook salmon and steelhead.

On Clear Creek, Table 3 shows the recent and anticipated projects.

Table 3. Recent and Anticipated Clear Creek Spawning and Rearing Projects.

Calendar Year	Site Name	Gravel (tons)	Side Channel (miles)	Inundated Area (acres)
2021	Whiskeytown Dam Site	1,013		
2021	Dog Gulch	1,976		
2021	Above Phase 3A	2,022		
2020	Phase 3C Channel Restoration	-	0.5	1
2020	Guardian Rock	2,505		
2020	Clear Cr Rd Bridge	1,006		
2020	Phase 2A/Gold Dredge	2,896		
2019	Paige Bar	4,887		
2019	Clear Cr Rd Bridge	995		
2019	Above Phase 3A	2,500		
2018	Dog Gulch	2,000		
2018	Guardian Rock	2,000		
2018	Placer Bridge	2,500		
2018	Clear Cr Rd Bridge	1,000		
2017	Paige Bar	2,000		
2017	Guardian Rock	1,998		
2017	Placer Bridge	2,021		
2017	3B Rootwads	3,000		

3.5.1 Spring-Run Chinook Salmon

Adults are migrating, holding, and spawning in Clear Creek.

Eggs are present in Clear Creek.

Juveniles are rearing and migrating during this period.

Yearlings are rearing and migrating during this period.

3.5.2 Steelhead

Adults are migrating, holding, and spawning in Clear Creek.

Eggs are present in Clear Creek.

Juveniles are rearing and migrating during this period.

3.6 Segregation Weir

The segregation weir addresses competition, introgression, and broodstock removal stressor in adults and redd quality stressors for eggs. In late August through early November, a segregation weir will be placed on Clear Creek based on channel cross-section suitability for weir placement and the distribution of adult spring-run Chinook salmon holding locations, typically between the Clear Creek Gorge Cascade and Clear Creek Road Bridge. Placement of the weir would occur before fall-run Chinook salmon enter Clear Creek to avoid hybridization with spawning spring-run Chinook salmon and redd superimposition. Removal of the weir would occur after the peak of fall-run Chinook salmon spawning when the risk of redd superimposition is very low.

The weir location and timing protect most of the spring-run Chinook salmon utilizing Clear Creek, while minimizing effects on other salmonids. Adult spring-run Chinook salmon that do not migrate above the segregation weir by the time it is installed will be subject to poor water quality (e.g., high water temps) and are more likely to experience pre-spawn mortality, genetic introgression with fall-run Chinook salmon, or loss of redd integrity due to superimposition from fall-run redd construction.

3.6.1 Spring-Run Chinook Salmon

Adults are migrating, holding, and spawning in Clear Creek.

Eggs are present in Clear Creek.

Juveniles are rearing and migrating during this period.

Yearlings are rearing during this period.

4. American River

Components of the Proposed Action not addressed in this Appendix are found as follows:

- Seasonal Operation Stressors on Aquatic Species: Appendix D

The remaining conservation measures are described in the following subsections.

4.1 Ramping Rates

Appendix D identified that seasonal operations may affect the stranding risk stressor on listed fish species. As described in Section 2.1 above, ramping rates address the stranding risk stressor by minimizing the rate of flow decreases during controlled flow reduction.

Reclamation will ramp down releases in the American River below Nimbus Dam as follows in Table 4.

Table 4. American River Ramping Rates

Lower American River Daily Rate of Change (cfs)	Amount of decrease in 24 hrs (cfs)	Maximum change per step (cfs)
20,000 to 16,000	4,000	1,350
16,000 to 13,000	3,000	1,000
13,000 to 11,000	2,000	700
11,000 to 9,500	1,500	500
9,500 to 8,300	1,200	400
8,300 to 7,300	1,000	350
7,300 to 6,400	900	300
6,400 to 5,650	750	250
5,650 to 5,000	650	250
<5,000	500	100

Ramping may vary from these requirements during flood control or if needed for facility operational concerns. Reclamation, through Governance, may develop a faster down-ramping rate on a case-by-case basis to implement temporary flow reductions for critical monitoring or maintenance needs.

4.1.1 Steelhead

Adults are present in the American River.

Eggs are present in the American River.

Juveniles are present in the American River.

4.2 Minimum Instream Flow

Appendix D identifies that seasonal operations may affect stressors on listed fish species. Minimum instream flows help avoid or minimize these stressors. This is a variable component analyzed in Appendix M, *Folsom Reservoir Flow and Temperature Management*. Although the magnitude may change, we expect the direction of the effects to be consistent for all the options. For lower American River flows (below Nimbus Dam), Reclamation proposes to adopt a minimum flow schedule and Minimum Release Requirement (MRR) range from 500 to 2000 cfs based on time of year and annual hydrology. The flow schedule is intended to improve cold-water pool and habitat conditions for steelhead and fall-run Chinook salmon.

4.2.1 Steelhead

Adults are present in the American River.

Eggs are present in the American River.

Juveniles are present in the American River.

4.3 Spring Pulse Flow

Spring pulse flows are a variable component analyzed in Appendix M. Although the magnitude may change, we expect the direction of the effects to be consistent for all the options. Reclamation would facilitate/implement a spring pulse flow event under certain conditions when the water has been made available from non-CVP sources or no such flow event has occurred already in the spring. The purpose of providing pulse flows in the lower American River during below normal and dry water years is to encourage juvenile salmonid (fall-run Chinook salmon and steelhead) emigration prior to relatively low-flow conditions and associated unsuitable thermal conditions later in the spring in the river (and downstream in the lower Sacramento River).

4.3.1 Steelhead

Adults are present in the American River.

Eggs are present in the American River.

Juveniles are rearing to outmigration in the American River.

4.4 Redd Dewatering Protective Adjustment

Redd dewatering protective adjustment (RDPA) is a variable component analyzed in Appendix M. Although the magnitude may change, we expect the direction of the effects to be consistent for all the options. Reclamation would operate Folsom and Nimbus Dams for flow releases while implementing RDPA. These adjustments (not releases) are designed to protect against changes in the MRR that may result in dewatering of fall-run Chinook salmon or steelhead redds.

The RDPA supports fall-run Chinook salmon and addresses the steelhead stranding and dewatering stressor. In January, the MRR can only decrease and cannot be less than 70 percent of the December MRR. In February, the MRR cannot be less than 70 percent of the December MRR.

Based on the January MRR, Table 5 shows the minimum flow for steelhead redds through May. If the February MRR is higher than January, the February MRR is used through May.

Table 5. Steelhead RDPA-based MRR for February through May.

January or February MRR (cfs)	Steelhead Redd MRR through May (cfs)
≤700	500
800	520
900	580
1,000	640
1,100	710
1,200	780
1,300	840
1,400	950
1,500	1,030
1,600	1,100
1,700	1,180
1,800	1,250

Reclamation, through Governance, will schedule MRR releases consistent with the implementation of RDPAs to limit potential redd dewatering from January through May. Values between those in the table would be linearly interpolated. The maximum MRR in January through May is 1,750 cfs, but 1,800 cfs is included in the table for interpolation.

The purpose of RDPAs is to protect fall-run Chinook salmon redds in January and February and steelhead redds in February through May from changes due to the MRR. Releases can be above the MRR in the fall and winter where the MRR does not control.

The fall-run Chinook salmon RDPA affects winter MRRs in two ways: there is a restriction on increases in MRR for January and in decreases in MRR for January and February. In recognition of the uncertainty of the January SRI forecast, increases are precluded in MRR from December to January. Fall-run Chinook salmon redds are constructed in October through December, and the fall-run Chinook salmon fry emerge through February. Rather than have a condition where a January-forecasted SRI resulted in an increase in MRR, only to see a decrease in MRR with the February B120 forecast, only reductions are allowed in the January MRR from the December MRR. To avoid large decreases, the January or February MRR could not be less than 70% of the December MRR. The MRR is the larger of the forecast RDPA or steelhead RDPA.

4.4.1 Steelhead

Adults are present in the American River.

Eggs are present in the American River.

Juveniles are present in the American River.

4.5 Tributary Habitat Restoration

Tributary habitat restoration is a variable component addressed in Appendix O. Although the magnitude may change, we expect the direction of the effects to be consistent for all the options. Reclamation proposes to construct and maintain spawning and rearing habitat and to improve facilities through competitive grants consistent with priorities developed through the CVPIA Science Integration Team. This action addresses the competition, introgression, and broodstock removal, spawning habitat, sedimentation and gravel quantity, redd quality, refuge habitat, food availability and quality, and predation and competition stressors.

4.5.1 Steelhead

Adults are present.

Eggs are present.

Juveniles are present.

4.6 Folsom Reservoir Flow and Temperature Management

This is a variable component analyzed in Appendix M. Although the magnitude may change, we expect the direction of the effects to be consistent for all the options.

Reclamation would manage the Folsom/Nimbus Dam complex and the water temperature control shutters at Folsom Dam to maintain a daily average water temperature of 65°F (or other temperature as determined by the temperature modeling) or lower at Watt Avenue Bridge from May 15 through October 31, to provide suitable conditions for juvenile steelhead rearing in the lower American River, if cold water is available.

4.6.1 Steelhead

Adults are present in the American River.

Eggs are present in the American River.

Juveniles are present in the American River.

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5. Delta

Variable and common components not addressed in this Appendix are as follows:

- Seasonal Operation Stressors on Aquatic Species: Appendix D

The remaining conservation measures are described in the following subsections.

5.1 Delta Cross Channel Gates Closures

The Delta Cross Channel (DCC) is a controlled diversion channel between the Sacramento River and Snodgrass Slough. When the DCC gates are open, water is diverted from the Sacramento River through an excavated channel into Snodgrass Slough and then flows through natural tidal channels for about 50 miles to the vicinity of Jones Pumping Plant and Banks Pumping Plant.

Reclamation operates the DCC gates to improve water movement from the Sacramento River to the export facilities at the Jones Pumping Plant and Banks Pumping Plant; improve water quality in the central and south Sacramento–San Joaquin Delta (Delta); and reduce salinity intrusion rates in the western Delta. Reclamation may close the gates during the late fall, winter, and spring to: (1) protect outmigrating salmonids from entering the interior Delta; (2) facilitate the D-1641 Rio Vista flow objectives for fish passage; and (3) reduce potential scouring and flooding that might occur in the channels on the downstream side of the gates when Sacramento River flows exceed certain flows criteria.

As described in Appendix F, the DCC gates may be closed based on the following indices.

Indices: Juvenile Chinook salmon at or above the minimum winter-run size based on the length-at-date Delta model used at a particular sampling location, and below the maximum size (for any run of salmon) considered by the length-at-date Delta model, on a given sampling date, are considered "older juveniles."

- *The Knights Landing Catch Index (KLCI)*: Index based on reported catch of older juveniles at the Knights Landing rotary screw trapping location and is calculated as the total catch of older juveniles (adjusted, as necessary, for partial cone operations) divided by the number of "trap days" (adjusted, as necessary, for downtime resulting from, for example, debris removal) since the last sampling event. This calculation for older juveniles/trap day is implemented as ([total number of older juveniles/% cone sampling effort]/total hours fished) × (24 hours fished/trap day).
- *The Sacramento Catch Index (SCI):* Both the Sacramento trawl (at Sherwood Harbor) and the Sacramento seine data are used to derive the SCI. The reported catch of older juvenile Chinook salmon is used to generate an SCI; a separate index for the seine data and a separate index for the trawl data.
    - The seine version of the catch index is standardized to eight hauls; therefore, the index is calculated as: (total number of older juveniles captured/# hauls) × 8. The

Sacramento Seine route is based on eight sites: Verona, Elkhorn, Sand Cove, Discovery Park, American River, Miller Park, Sherwood Harbor, and Garcia Bend.

- The trawl version of the catch index is standardized to 10 tows; therefore, the index is calculated as: (total number of older juveniles captured/# tows) × 10.

Observations of daily increases in catch indices are typically associated with increased flows at Wilkins Slough and tributaries to the upper Sacramento River, cooler water temperatures at these locations, and entry of migrating juvenile winter-run and spring-run Chinook salmon (Del Rosario et al. 2013; Low and White 2006).

Closure of the Delta Cross Channel when adult fall-run Chinook salmon attraction flows pass through the Lower Mokelumne River can reduce straying of Chinook salmon between the Mokelumne and American Rivers and increase the abundance of fall-run Chinook salmon returning to the Mokelumne River and its hatchery. Limiting closure to weekdays minimizes impacts to recreation.

5.1.1 Winter-Run Chinook Salmon

Adults are migrating in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing and migrating during this period.

5.1.2 Spring-Run Chinook Salmon

Adults are migrating in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing and migrating during this period.

Yearlings are migrating during this period.

5.1.3 Steelhead

Adults are present in the winter and summer in the Delta.

Eggs are not present in the Delta.

Juveniles are present in spring and fall in the Delta.

5.1.4 Green Sturgeon

Adults are present in the Delta.

Larvae are not present in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing in the Delta.

5.2 Tracy Fish Collection Facility and Skinner Delta Fish Protective Facility

Reclamation operates the Tracy Facility and California Department of Water Resources (DWR) operates the Skinner Delta Fish Protective Facility to address entrainment of species before export facilities.

5.2.1 Tracy Fish Collection Facility

Reclamation separates fish from entrainment into the Jones Pumping Plant at the Tracy Fish Collection Facility (TFCF). From November 1 through May 14, when Delta hydraulic conditions allow, the louvers are operated for salmon at approximately three feet per second. DWR separates fish from entrainment into Banks Pumping Plant at the Skinner Delta Fish Protection Facility. The sampling protocols for the Skinner Fish Facility (SFF) are similar to the TFCF.

The TFCF uses behavioral barriers consisting of primary louvers and four rotating traveling screens aligned in a single row 7 degrees to the flow of the water to guide entrained fish into holding tanks before transport by truck to release sites at the confluence of the Delta. The TFCF was designed to handle smaller fish (less than 200 mm) that would have difficulty fighting the strong pumping plant-induced flows, as the intake is essentially open to the Delta and impacted by tidal action. The number of pumps (units) running at the Jones Pumping Plant dictates the flow and velocity at the TFCF. There are six units at Jones Pumping Plant but a maximum of five can used; each unit increases the velocity through the TFCF primary channel by approximately 0.5 ft/sec.

The primary louvers are in the primary channel just downstream of the trash rack structure. The traveling water screen is in the secondary channel.

The louvers allow water to pass through onto the pumping plant, but the openings between the slats are tight enough and angled against the flow of water to prevent most fish from passing between them and to enable the fish to enter one of four bypass entrances along the louver arrays.

Tracy salvage affects Delta smelt, longfin smelt, winter-run chinook salmon, spring -run chinook salmon, steelhead, and green sturgeon.

5.2.2 Skinner Delta Fish Protective Facility

DWR separates fish from entrainment into the Harvey O. Banks Pumping Plant at the Skinner Delta Fish Protective Facility. Water pumped by the Banks Pumping Plant flows out of Clifton Court Forebay and enters an intake canal before heading towards the Skinner Fish Facility. At the SFF, a debris boom first deflects large floating debris towards a conveyor for removal. Water and fish then flow through a trash rack with vertical bars spaced 2-inches apart and spanning the

width of the intake canal at the entrance to the SFF. Behavioral barriers consisting of louvers and screens are then used to guide and collect fish. The primary louver system is divided into three-and-one-half bays arranged in a V-shaped configuration. A series of wing gates are located at the upstream end of each bay in front of the primary louvers and are used to regulate velocities flowing through the primary bays by opening and closing bays, changing the effective width of the facility. The wing gates are also used to isolate bays for cleaning and maintenance to prevent fish losses during these activities. After entering the bypasses at the end of each bay, fish are transported to a secondary system consisting of two secondary channels. Secondary Channel #1 uses a series of louvers identical to the primary louvers to guide fish into a secondary bypass, while Secondary Channel #2 uses a system of two bays consisting of panels of perforated plate (4-mm openings) to guide fish into the secondary bypass. Water and fish leave the secondary channels through the secondary channel bypasses and finally enter the holding tank buildings. Under normal operations, Holding Tank Building (HTB) #1 receives water from Secondary Channel #2, and HTB #2 receives water from Secondary Channel #1.

The water export rate at Banks Pumping Plant and the number of open primary bays determines the flow and velocities in the SFF primary bays, and the facility is operated to achieve approach velocities for striped bass of approximately 1 to 2.5 ft/sec from May 15 through October 31, and approximately 3 to 3.5 ft/sec for Chinook salmon from November 1 through May 14 (D-1485 Table II Preferred operational criteria for the State Fish Protective Facility). The pumping rate at Banks Pumping Plant also determines the number of holding tanks in operation, with additional tanks operated as pumping rate increases.

5.2.3 Winter-Run Chinook Salmon

Adults are present from the winter through the summer in the Delta.

Eggs are not present in the Delta.

Juveniles are present from the fall to the spring in the Delta.

5.2.1 Spring-Run Chinook Salmon

Adults are migrating in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing and migrating during this period.

Yearlings are migrating during this period.

5.2.2 Steelhead

Adults are present in the winter and summer in the Delta.

Eggs are not present in the Delta.

Juveniles are present in spring and fall in the Delta.

5.2.3 Green Sturgeon

Adults are present in the Delta.

Larvae are not present in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing in the Delta.

5.3 Tidal Habitat Restoration

Tidal Habitat Restoration is a variable component analyzed in Appendix P, *Delta Habitat*. Although the magnitude may change, Reclamation expects the direction of the effects to be consistent for all the options analyzed. Tidal habitat restoration addresses habitat loss and food availability and visibility stressors. Benefits from tidal restoration are realized year around.

In general, construction does not result in stressors to fish species since it is completed prior to the beaching of the restoration site. Breaching of the site would occur during the appropriate in-water period to avoid or minimize presence of listed fish species. Construction of restoration sites would be subject to future consultation.

5.3.1 Winter-Run Chinook Salmon

Adults are present from the winter through the summer in the Delta.

Eggs are not present in the Delta.

Juveniles are present from the fall to the spring in the Delta.

5.3.2 Spring-Run Chinook Salmon

Adults are migrating in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing and migrating during this period.

Yearlings are migrating during this period.

5.3.3 Steelhead

Adults are present in the winter and summer in the Delta.

Eggs are not present in the Delta.

Juveniles are present in spring and fall in the Delta.

5.3.4 Green Sturgeon

Adults are present in the Delta.

Larvae are not present in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing in the Delta.

5.3.5 Delta Smelt

Adults are present.

Eggs and **larvae** are present.

Juveniles are present.

5.3.6 Longfin Smelt

Adults are present.

Eggs and **larvae** are present.

Juveniles are present.

5.4 Old and Middle River Management

Old and Middle River Management is a variable component analyzed in Appendix I, *Old and Middle River Flow Management*. Although the magnitude may change, Reclamation expects the direction of the effects to be consistent for all the options analyzed. The management of Old and Middle River reverse flows, in consideration of other environmental variables, such as turbidity and temperature, can minimize or avoid the entrainment of fish in the south Delta and at the CVP and SWP salvage facilities.

5.4.1 Winter-Run Chinook Salmon

Adults are present from the winter through the summer in the Delta.

Eggs are not present in the Delta.

Juveniles are present from the fall to the spring in the Delta.

5.4.2 Spring-Run Chinook Salmon

Adults are migrating in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing and migrating during this period.

Yearlings are migrating during this period.

5.4.3 Steelhead

Adults are present in the winter and summer in the Delta.

Eggs are not present in the Delta.

Juveniles are present in spring and fall in the Delta.

5.4.4 Green Sturgeon

Adults are present in the Delta.

Larvae are not present in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing in the Delta.

5.4.5 Delta Smelt

Adults are present.

Eggs and **larvae** are present.

Juveniles are present.

5.4.6 Longfin Smelt

Adults are present.

Eggs and **larvae** are present.

Juveniles are present.

5.5 Summer and Fall Delta Outflow and Habitat

Summer and fall Delta outflow and habitat is a variable component analyzed in Appendix K, *Summer and Fall Delta Outflow and Habitat*. Although the magnitude may change, Reclamation expects the direction of the effects to be consistent for all the options analyzed. Summer and Fall Delta Outflow and Habitat action is intended to increase the spatial overlap of key Delta Smelt habitat attributes through moving the low salinity zone habitat westward by releases from

reservoirs and limitations on exports, and by routing of freshwater flows for habitat connectivity and food web productivity. Summer Fall Habitat Action address the size and location of the low salinity zone on adults, juveniles, and larvae by decreasing habitat alteration. Summer Fall Habitat Action address stressors on adults, juveniles, and larvae Delta Smelt.

5.5.1 Winter-Run Chinook Salmon

Adults are not present during this period.

Eggs are not present in the Delta but may be affected.

Juveniles are present from the fall to the spring in the Delta.

5.5.2 Spring-Run Chinook Salmon

Adults are migrating in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing and migrating during this period.

Yearlings are migrating during this period.

5.5.3 Steelhead

Adults are migrating in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing and migrating in the Delta.

5.5.4 Green Sturgeon

Adults are present in the Delta.

Larvae are not present in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing in the Delta.

5.5.5 Delta Smelt

Adults are present.

Eggs are not present, and **larvae** are present.

Juveniles are present.

5.5.6 Longfin Smelt

Adults are present.

Eggs and **larvae** are not present.

Juveniles are present.

5.6 Spring Outflow

Spring Outflow is a variable component analyzed in Appendix J. Although the magnitude may change, Reclamation expects the direction of the effects to be consistent for all the options analyzed. The action addresses the stressors on fish species by providing for greater seasonal outflow during the spring. Freshwater flow to the estuary during the winter and spring months shows a persistent significant correlation with smelt abundance.

5.6.1 Winter-Run Chinook Salmon

Adults are present during this period.

Eggs are not present in the Delta but may be affected.

Juveniles are present from the fall to the spring in the Delta.

5.6.2 Spring-Run Chinook Salmon

Adults are migrating in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing and migrating during this period.

Yearlings are migrating during this period.

5.6.3 Steelhead

Adults are migrating in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing and migrating in the Delta.

5.6.4 Green Sturgeon

Adults are present in the Delta.

Larvae are not present in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing in the Delta.

5.6.5 Delta Smelt

Adults are present.

Eggs and **larvae** are present.

Juveniles are present.

5.6.6 Longfin Smelt

Adults are present.

Eggs and **larvae** are present.

Juveniles are present.

5.7 Suisun Marsh Preservation Agreement

The Suisun Marsh Salinity Control Gates (SMSCG) are located on Montezuma Slough about two miles downstream from the confluence of the Sacramento and San Joaquin rivers, near Collinsville. The objective of SMSCG operation is to decrease the salinity of the water in Montezuma Slough. Tidal operations of the gates (closed during flood tide and opened during ebb tide) control salinity by restricting the flow of higher salinity water from Grizzly Bay into Montezuma Slough during flood tides and retaining lower salinity Sacramento River water from the ebb tides. Operation of the gates in this fashion lowers salinity in Suisun Marsh channels and results in a net movement of water from east to west through Suisun Marsh.

The SMSCG structure consists of three radial gates, flashboards, and a boat lock, which span the entire 465-foot width of Montezuma Slough. The SMSCG are operated on an as-needed basis to meet D-1641 and Suisun Marsh Preservation Agreement water quality standards in Montezuma Slough. In addition, the SMSCG is operated to meet the 2019 Biological Opinions on Long-Term and Coordinated Operations of the CVP and SWP (NMFS 2019; USFWS 2019) and the 2020 Incidental Take Permit for Operations of the SWP (CDFW 2020). The water quality standards for SMSCG operations includes the period between October through May. Operations are determined from data at D-1641 compliance stations, Suisun Marsh Preservation Agreement control stations, hydrologic conditions, weather, Delta outflow, tide, fishery considerations, and other factors. The duration of gate operation may range from no use to full use for the entire October through May period. Assuming no significant long-term changes in the operational data mentioned above, gate operations (outside of additional actions described under Delta Smelt Summer-Fall Habitat Action) will continue as necessary to meet D-1641 and Suisun Marsh Preservation Agreement standards. During drought conditions, gate operations are more likely to span the entire October through May period to meet D-1641 standards. The Suisun Marsh Preservation Agreement also has a provision for operating the gates in September when the 7-day running average mean daily high tide salinity at any compliance station or the S-35 Control

Station is 17.0 mS/cm or greater. The running averages for September 1 through September 6 of each year are determined using salinity data from the last six days of the preceding August.

There is a 66-foot-wide maintenance channel through the SMSCG structure. During the operation season, flashboards are installed across the maintenance channel, the boat lock is operated, as needed, and the radial gates are operated tidally to maintain downstream flow as needed to maintain water quality. When the SMSCG facilities are not in operation, the flashboards are removed from the maintenance channel, the boat lock is closed, and the three radial gates are held open. During years with implementation of gate actions described under the Delta Smelt Summer-Fall Habitat Action, or when required maintenance prevents removal, flashboards may be left in place year-round or as needed to meet operation criteria. When flashboards are in place, boat locks will be in operation.

The SMSCG boat lock portion of the gate will be held partially open when flashboards are in place and during SMSCG operation to allow for continuous salmonid and green sturgeon passage opportunity. After an engineering solution is implemented to prevent boaters from entering the boat lock prior to the operator closing it, the gate will be held open at all times. However, currently, the boat lock gates may be closed temporarily to stabilize flows to facilitate safe passage of watercraft through the facility and for required maintenance activities. Boat passage through the structure averages 10 minutes, in which one side of the boat lock gate is closed, the vessel enters the passage, the other boat lock gate is closed behind the vessel, operators wait until flow has stabilized, and the gate is then opened for the boat to enter the side of Montezuma Slough they are traveling towards. In addition, a separate Section 7 consultation for the Suisun Marsh Salinity Gates Refurbishment Project (NMFS 2013; NMFS 2019; NMFS File Number WCRO-2022-01701) authorizes alternative operations of the SMSCG boat locks for 15 days during the project.

The Roaring River Distribution System (RRDS) was constructed to provide lower salinity water to 5,000 acres of privately-managed, and 3,000 acres of CDFW-managed, wetlands on Simmons, Hammond, Van Sickle, Wheeler, and Grizzly Islands. The RRDS includes a 40-acre intake pond that supplies water to Roaring River Slough and 16 miles of interior levees along water diversion gates supply water to landowner ponds. Water is diverted through a bank of eight 60-inch-diameter culverts equipped with fish screens into the Hammond Pond on high tides to raise the water surface elevation in RRDS above the adjacent managed wetlands. The intake to the RRDS is screened to prevent entrainment of fish larger than approximately 25 mm. Since the listing of Delta Smelt in 2009, RRDS diversion rates have been controlled to maintain a maximum approach velocity of 0.2 feet/second at the intake fish screen, except for a five-week contiguous period (five-week flood-up window) when RRDS diversion rate will be controlled to maintain a maximum approach velocity of 0.7 feet/second for fall flood-up operations. The dates of the five-week flood-up window may change annually due to waterfowl season dates changing each year and corresponding flood-up needs but will occur during the months of September through November.

5.7.1 Winter-Run Chinook Salmon

Adults are present during this period.

Eggs are not present in the Delta but may be affected.

Juveniles are present from the fall to the spring in the Delta.

5.7.2 Spring-Run Chinook Salmon

Adults are migrating in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing and migrating during this period.

Yearlings are migrating during this period.

5.7.3 Steelhead

Adults are migrating in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing and migrating in the Delta.

5.7.4 Green Sturgeon

Adults are present in the Delta.

Larvae are not present in the Delta.

Eggs are not present in the Delta.

Juveniles are rearing in the Delta.

5.7.5 Delta Smelt

Adults are present.

Eggs and **larvae** are present.

Juveniles are present.

5.7.6 Longfin Smelt

Adults are present.

Eggs and **larvae** are present.

Juveniles are present.

6. Stanislaus River

Variable and common components not addressed in this Appendix are found as follows:

- Seasonal Operation Stressors on Aquatic Species: Appendix D
- Stanislaus Stepped Release Plan: Appendix N, *New Melones Stepped Release Plan*

The remaining conservation measures are described in the following subsections.

6.1 Ramping Rates

Appendix D identified that seasonal operations may affect the stranding risk stressor on listed fish species. As described in Section 2.1 above, ramping rates address the stranding risk stressor by minimizing the rate of flow decreases during controlled flow reduction. Reclamation will coordinate releases on the Stanislaus River as shown in Table 6.

Table 6. Goodwin Dam Ramping Rates

Goodwin Release Range (Cubic Feet Second [cfs])	Standard Rate of Increase (cfs per 2 hours)	Standard Rate of Decrease (cfs per 2 hours)	C and D WYT Rate of Increase (cfs per 2 hours)	C and D WYT Rate of Decrease (cfs per 2 hours)
At or above 4,500	25	250	No change	No change
2,000 to 4,499	500	250	No change	No change
500 to 1,999	250	100	500	200
300 to 499	100	50	200	100

Reclamation, through the Stanislaus Watershed Team, may develop a faster down-ramping rate on a case-by-case basis to implement temporary flow reductions for critical monitoring or maintenance needs.

Faster ramping rates in critical and dry water year types provide more flexibility for shaping flow volumes of water for the purposes of improving biological benefits. Consideration for ramping rates that promote recruitment of native riparian vegetation on floodplain surfaces should be implemented when instream flow budgets are sufficient.

6.1.1 Steelhead

Adults are present during this period in the Stanislaus River.

Eggs are present in the Stanislaus River.

Juveniles are present in the Stanislas River.

6.2 Minimum Instream Flows

Appendix D identified that seasonal operations may affect stressors on listed fish species. Minimum instream flows help avoid or minimize these stressors. This is a variable component. Reclamation proposes to operate New Melones Reservoir to provide minimum releases at Goodwin Dam according to a Stepped Release Plan. Although the magnitude may change, we expect the direction of the effects to be consistent for all the options

6.2.1 Steelhead

Adults are present in the Stanislaus River.

Eggs are present in the Stanislaus River.

Juveniles are present in the Stanislas River.

6.3 Spring Pulse Flows

This is a variable component analyzed in Appendix M. Although the magnitude may change, we expect the direction of the effects to be consistent for all the options to help cue outmigration and improve migratory habitat downstream. Spring pulse flow benefits may also include inundation of shallow-water habitat and temperature buffering to benefit salmonids.

6.3.1 Steelhead

Adults are present in the winter through next summer in the Stanislaus River.

Eggs are present in the winter through next spring in the Stanislaus River.

Juveniles are present in the Stanislaus River.

6.4 Fall Pulse Flows

Fall pulse flows are a part of variable component analyzed in Appendix N. Although the magnitude may change, we expect the direction of the effects to be consistent for all the options of the Stanislaus Stepped Release Plan (2022/23) and are intended to improve instream conditions and provide an attraction cue for adult salmonids returning to spawn. One function of

the fall pulse flow is to help buffer water temperatures to provide conditions suitable for the migration and holding of adult salmonids.

6.4.1 Steelhead

Adults are present in the winter through next summer in the Stanislaus River.

Eggs are present in the winter through next spring in the Stanislaus River.

Juveniles are present in the Stanislas River.

6.5 Winter Instability Flows

Winter Instability Flows (WIF) in January and February are a part of variable component analyzed in Appendix N. Although the magnitude may change, we expect the direction of the effects to be consistent for all the options of the Stanislaus Stepped Release Plan (2022/23), to simulate natural variability in the winter hydrograph and to enhance access to varied rearing habitats. Mimicking small storm flow events, these WIF provide outmigration cues for juvenile steelhead and enhanced mobilization of juvenile fall-run Chinook. For WIF, Reclamation proposes to use steeper ramping rates in critical and dry water year types and within certain flow criteria to increase hydraulic variability with minimum volumes of water and therefore increase biological benefit.

6.5.1 Steelhead

Adults are present in the winter through next summer in the Stanislaus River.

Eggs are present in the winter through next spring in the Stanislaus River.

Juveniles are present in the Stanislas River.

6.6 Tributary Habitat Restoration

Tributary habitat restoration is a variable component addressed in Appendix O. Although the magnitude may change, we expect the direction of the effects to be consistent for all the options. This action addresses the competition, introgression, and broodstock removal; spawning habitat; refuge habitat; food availability and quality; sedimentation; and predation and competition stressors. Reclamation proposes to construct and maintain spawning and rearing habitat and to improve facilities through competitive grants consistent with priorities developed through the CVPIA Science Integration Team.

6.6.1 Steelhead

Adults are present in the winter through next summer in the Stanislaus River.

Eggs are present in the winter through next spring in the Stanislaus River.

Juveniles are present in the Stanislaus River.

7. San Joaquin River

Components of the Proposed Action not addressed in this Appendix are found as follows:

- Seasonal Operation Stressors on Aquatic Species: Appendix D

The remaining conservation measures are described in the following subsections.

The San Joaquin River includes adult migration and holding, adult spawning and emigration, egg incubation and fry emergence, and juvenile rearing and outmigration of Steelhead.

7.1 Tributary Habitat Restoration

Tributary habitat restoration is a variable component addressed in Appendix O. Although the magnitude may change, we expect the direction of the effects to be consistent for all the options. Reclamation proposes to construct and maintain spawning and rearing habitat.

7.1.1 Steelhead

Adults are present during winter and spring through summer in the San Joaquin River.

Eggs are present during winter and spring in the San Joaquin River.

Juveniles are present in the San Joaquin River.

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