

# FINAL State Water Project Incidental Take Permit Risk Assessment for Winter-run and Spring-run Chinook Salmon

## Section 1: Overview

Date: 4/27/2021

### Life Stages Present:

Winter-run Chinook Salmon (juvenile)

Winter-run Chinook Salmon (adult)

Spring-run Chinook Salmon (juvenile)

Spring-run Chinook Salmon (adult)

### Advice to the Water Operations Management Team (WOMT):

No advice is warranted.

For the week beginning 4/27/2021, Delta Outflow X2 is currently controlling exports.

Combined exports were 1,200 cfs on 4/27/2021 and are projected to range from 1,200 cfs to 1,400 cfs during the week resulting in projected Old and Middle River Index (OMRI) of -500 cfs to -1,500 cfs. These projected OMRI values are more positive than what would be required if State Water Project Incidental Take Permit Conditions of Approval (COA) thresholds were to be exceeded.

SaMT does not anticipate COA 8.6.1 (WR Single-year Loss Threshold) to be exceeded this OMR management season due to low cumulative loss of natural origin and hatchery origin winter-run Chinook salmon (WR) at the export facilities. Cumulatively, for Water Year (WY) 2021, 5 length at date (LAD) size natural origin WR have been salvaged, resulting in a loss of 8 fish, and 7 LAD size hatchery WR have been salvaged, resulting in loss of 16 fish. Salvage of hatchery origin WR is preliminary and may be adjusted based on CWT reading corrections.

Although possible, SaMT does not anticipate COA 8.6.3 (Mid- and Late-season Natural WR Daily Loss Threshold) to be exceeded this week primarily due to low natural origin WR salvage and loss to date. Note that the daily loss threshold for combined loss at CVP and SWP for April is 16.74 fish and for May it is 25.42 fish. Based on expansions for salvage and loss, which is higher for the SWP than the CVP, a single older juvenile Chinook salmon could result in a trigger exceedance if salvaged at the SWP facilities.

COA 8.6.4 (Daily Spring-run Chinook Salmon [SR] Hatchery Surrogate Loss Threshold) began 2/1/2021 (see Appendix 4). The first hatchery surrogate release of fall-run Chinook salmon (FR) from Coleman National Fish Hatchery (CNFH) occurred on 3/10/2021. This release, CNFH Group 1, totaled 1,290,150 FR. These fish are 25% marked (322,538) with an adipose fin clip and coded wire tag (CWT). The first hatchery surrogate release from the Feather River Hatchery (FRH), FRH Group 1, of 514,027 SR from Feather River Fish Hatchery was released on 3/19/2021 into the Feather River. These fish are 100% marked with an adipose fin clip and CWT. The second CNFH hatchery surrogate release, CNFH Group 2, of 372,072 FR occurred on 3/24/2021 and 3/26/2021. These fish are 100% marked with an adipose fin clip and CWT. The second FRH release of 500,312 SR, FRH Group 2, occurred on 4/1/2021. These fish are 100% marked with an adipose fin clip and CWT. The final hatchery surrogate release group, CNFH Group 3, occurred on 4/8/2021 and consists of 5,389,856 FR from CNFH, CNFN Group 3. These fish are 25% marked (1,347,465) with an adipose fin clip and CWT. SaMT

anticipates the potential for salvage for all release groups to occur this week but does not anticipate COA 8.6.4 thresholds to be exceeded for the remainder of the OMR management season due to the lack of surrogate release group salvage to date.

#### Risk Assessment:

##### Section 1-A: Sacramento River and Confluence

##### **Assessment of risk of entrainment into the central Delta for WR and SR in the Sacramento River: (8.1.5.1 C ii, iii, iv and 8.1.5.1 B iii)**

- Exposure Risk:
  - WR: Low
  - SR: low
- Routing Risk:
  - WR: Medium
  - SR: Medium
- Overall Entrainment Risk:
  - WR: Low
  - SR: Low
- Change in risk of entrainment into the central Delta (increased/decreased risk compared to last week):
  - WR: Exposure risk into the central Delta is low, consistent with the previous week's estimate, based on an estimated 0-2% of the natural origin WR population yet to enter the Delta. The estimate of hatchery origin WR upstream of the Delta has been reduced from 0-5% last week to 0-2% this week based on detections of acoustic tagged fish. Overall, the acoustic tag detection data are static implying that the hatchery origin WR have moved through the Delta. Central Delta entrainment risk for the remaining WR yet to enter the Delta is difficult to evaluate based on variable modeled projections of interior Delta routing, forecasted Sacramento River flows at Freeport, and export operations, resulting in a medium risk level. The overall risk of routing into the Delta is low based on the combination of exposure and routing risks.
  - SR: Exposure risk into the central Delta is low this week (reduced from high last week) based on the SaMT estimate of 5% of natural origin SR yet to enter the Delta. Acoustic tag data from FRH Spring-run Release Groups 1 and 2 has been static implying that most of these fish have moved into the Delta and are no longer exposed to central Delta entrainment. However, there is uncertainty associated with the distribution of and movement patterns of SR both upstream and in the Delta particularly for rearing SR. Estimation of distribution is also confounded by size overlap between hatchery origin FR and natural origin SR which are both present and co-mingled throughout the system. The routing risk remains the same as last week, at a medium level, for the same rationale as for WR based on the same conditions. The overall risk of SR entrainment into the interior Delta is low this week based on the combination of exposure and routing risks.

##### Section 1-B: Facilities Risk

##### **Central Valley Project/State Water Project (CVP/SWP) facilities entrainment risk for WR and SR in the central Delta over the next week (8.1.5.1 D iii, iv, v)**

- Exposure Risk:
  - WR: Medium
  - SR: Medium
- Reporting OMR/Export Risk: (Bins based on DSM2 scenarios for the current week)
  - Baseline OMR (-1,200 cfs)
    - WR: Low
    - SR: Low
  - Scenario 1 OMR (- 1,100 cfs)
    - WR: Low
    - SR: Medium
  - Scenario 2 N/A
    - WR: N/A
    - SR: N/A
- Overall Entrainment Risk:
  - WR: Low
  - SR: Low
- Change in risk of entrainment into the facilities (increased/decreased risk compared to last week):
  - WR: WR exposure risk is medium this week, consistent with the previous week's estimate, based on an estimated 10-25% of WR population remaining in the Delta. SaMT estimated that 73-90% of natural origin WR have exited the Delta past Chipps Island and are no longer exposed to entrainment at the export facilities. Hatchery origin WR acoustic tag data indicate that the majority of these fish have exited the Delta and are no longer exposed to entrainment at the export facilities. SaMT estimates that 10-15% of the hatchery origin WR remain in the Delta and that 83-90% have exited the Delta past Chipps Island. Overall, SaMT projects the weekly salvage to remain low for salmonids, including natural origin and hatchery origin WR. The COA 8.6.3 (Mid- and Late-season Natural WR Daily Loss Threshold) for older juvenile Chinook salmon is triggered when combined daily loss from CVP and SWP exceeds 16.74 fish from 4/1/2021 through 4/30/2021. Because the expansion for salvage and loss is higher at the SWP than the CVP, one older juvenile Chinook salmon captured in salvage at the SWP salvage facility could result in the COA 8.6.3 threshold being exceeded. The daily loss threshold for older juvenile Chinook salmon increases to 25.42 fish from 5/1/2021 through 5/31/2021. OMRI is projected to be more positive than what would be required if a threshold were to be exceeded. The overall facilities entrainment risk for WR is a low level based on the SaMT evaluation that a reduced number of WR are present in the south Delta and vulnerable to entrainment. This conclusion is also reflective of the low cumulative salvage to date for natural origin and hatchery origin WR in recent weeks.
  - SR: Exposure risk remains at medium this week, consistent with the previous week's estimate. While SaMT estimates that 65-75% of the juvenile SR population is present in the Delta, there are indications that overall numbers of SR in the Delta may be low resulting in an overall entrainment risk of low. While SR LAD salvage over the last month, 113 LAD SR in April, has occurred, salvage of hatchery origin FR overlapping SR LAD may account for a significant portion of this total leading to uncertainty. The conclusion of low overall salvage risk is also

reflective of low salvage of hatchery origin SR and reflective of projected OMRI values which may be even less negative than in recent weeks.

### Section 1-C: Annual Loss Threshold Risk

- Annual loss threshold risk and Alternative Actions (8.1.5.1. E I, ii, iii and 8.1.5.1 F I, ii)
  - Loss at the SWP and CVP facilities compared to the estimated remaining population in Delta and upstream of the Delta: No salvage of natural origin or hatchery origin WR LAD has occurred over the past week.
    - Define risk of hitting a threshold, 50%, or 75%, or 100%, and likelihood of exceeding a threshold:
      - Natural origin WR: 3,863 [1.17% of the final natural origin WR Juvenile Production Estimate (JPE)]
        - Current Annual Loss: 8
        - 50% Threshold based on natural WR JPE: 1,931
          - Risk of exceeding threshold: Not likely.
        - 75% Threshold based on natural WR JPE: 2,897
          - Risk of exceeding threshold: Not likely.
        - 100% Threshold based on natural WR JPE: 3,862
          - Risk of exceeding threshold: Not likely.
      - Hatchery WR: 117 (0.12% of the Final Livingston Stone National Fish Hatchery (LSNFH) hatchery release JPE)
        - Current Annual Loss: 16<sup>1</sup>
        - 50% Threshold based on hatchery WR JPE: 59
          - Risk of exceeding threshold: Low
        - 75% Threshold based on hatchery WR JPE: 88
          - Risk of exceeding threshold: Low
        - 100% Threshold based on hatchery WR JPE: 117
          - Risk of exceeding threshold: Low

### Section 1-D: Daily Loss Threshold Risk

- Daily loss threshold risk and Alternative Actions
  - Loss at the SWP and CVP facilities compared to estimated remaining population in Delta and upstream of the Delta:
    - Daily loss thresholds hit and subsequent loss and associated operations:
      - COA 8.6.3 Mid- and Late-season Natural WR Daily Loss Threshold (defined as natural origin older juvenile Chinook salmon<sup>2</sup>):
        - January:  $0.0000635 * 330,130 = 20.96$
        - February:  $0.0000991 * 330,130 = 32.72$
        - March:  $0.000146 * 330,130 = 48.20$
        - April:  $0.0000507 * 330,130 = 16.74$

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<sup>1</sup> Loss is currently based on Delta Model length-at-date data and is subject to revision based on reading of CWTs.

<sup>2</sup> Condition applies to all older juvenile Chinook salmon is defined as any Chinook salmon that is above the minimum length for WR, according to the Delta Model length-at-date criteria used to assign individuals to race.

- May:  $0.000077 * 330,130 = 25.42$
- Natural Origin Older Juvenile Chinook Salmon- Highest daily loss: 4.33
  - Risk of exceeding threshold: Low
- COA 8.6.4 Daily SR Hatchery Surrogate Loss Threshold<sup>3</sup>:
  - Hatchery Origin Young-of-Year (YOY) SR Surrogates
    - FRH Group 1: 514,027 released 3/19/2021
      - 0.25% threshold = 1285.07 fish
      - Cumulative Loss: 0
      - Risk of exceeding threshold: Low
    - FRH Group 2: 500,312 released on 4/1/2021
      - 0.25% threshold = 1,250.78 fish
      - Cumulative Loss: 0
      - Risk of exceeding threshold: Low
  - Hatchery Origin YOY FR Surrogates
    - CNFH Group 1: 322,538 released on 3/10/2021
      - 0.25% threshold = 806.35 fish
      - Cumulative Loss: 0
      - Risk of exceeding threshold: Low
    - CHNF Group 2: 372,072 released on 3/24/2021 and 3/26/2021
      - 0.25% threshold = 930.18
      - Cumulative Loss = 0
      - Risk of exceeding threshold: Low
    - CHNF Group 3: 1,347,465 released on 4/8/2021
      - 0.25% threshold = 3,368.66
      - Cumulative Loss = 0
      - Risk of exceeding threshold: Low

## Section 2: Basis for Advice:

The 2020 [Incidental Take Permit for Long-Term Operation of the State Water Project in the Sacramento-San Joaquin Delta 2081-2019-066-00](#) (SWP ITP) states that advice to Water Operations Management Team (WOMT) shall be consistent with the Project Description, COA in the ITP, and the applicable ESA authorizations. This week's advice is based on the following COAs which are currently applicable:

*List relevant COA number and title based on species/life stage, time of year, etc.*

*8.1.4 Collaborative Approach to Real-time Risk Assessment. Beginning no later than October 1 through the end of OMR Management (see Condition of Approval 8.8) the Smelt and Salmon Monitoring Teams shall meet weekly, or more often as required, to consider survey data, salvage data, and other pertinent biotic and abiotic factors and prepare risk assessments as described in Conditions of Approval 8.1.1, 8.1.2, 8.1.5.1 and 8.1.5.2.*

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<sup>3</sup> The number of fish released in each group represents the number of fish with an adipose fin clip and CWT.

*The Smelt and Salmon Monitoring Teams shall prepare operations advice for the WOMT as required by Conditions of Approval 8.3.1, 8.3.3, 8.4.1, 8.4.2, 8.5.1, 8.5.2, 8.6.1, 8.6.2, 8.6.3, 8.6.4, 8.7, and 8.8, including advice on operations. The Smelt and Salmon Monitoring Teams shall each prepare risk assessments and operations advice. Within each team, staff jointly develop the risk assessment and supporting documentation to accompany operations advice (see Conditions of Approval 8.1.5.1 and 8.1.5.2). DWR and CDFW Smelt and Salmon Monitoring Team staff may conclude different operations advice is warranted, in which case the difference shall be noted and elevated as described in this Condition of Approval.*

*The Smelt and Salmon Monitoring Teams shall communicate their advice to WOMT. The WOMT shall then confer and attempt to reach a resolution and agreed-upon Project operations. If a resolution is reached, Permittee shall operate consistent with the decision regarding Project operations from WOMT. If the WOMT does not reach a resolution, the CDFW Director may require Permittee to implement an operational recommendation provided by CDFW. CDFW will provide its operational decision to Permittee in writing. Permittee shall implement the operational decision required by CDFW. Permittee shall ensure that its proportional share (see Condition of Approval 8.10) of the OMR flow requirement as a part of the operational decision is satisfied.*

*8.1.5 Real-time Risk Assessments. The Smelt and Salmon Monitoring Teams (Conditions of Approval 8.1.1 and 8.1.2) shall prepare weekly risk assessments, or more often as required, and operations advice (as required by Conditions of Approval 8.3.1, 8.3.3, 8.4.1, 8.4.2, 8.5.1, 8.5.2, 8.6.1, 8.6.2, 8.6.3, 8.6.4, and 8.7) during their discussions and analyses. The Smelt and Salmon Monitoring Teams shall provide the risk assessments and pertinent supporting information to the WOMT (Condition of Approval 8.1.3) within one business day of each meeting.*

*8.3.2 Salmonid Presence. After January 1 each year, if Conditions of Approval 8.3.1 or 8.3.3 have not already been triggered, the OMR Management season shall begin when the Salmon Monitoring Team first estimates that 5% of the WR or SR population is in the Delta whichever is sooner. Upon initiation of the OMR Management season, Permittee shall reduce exports to achieve, and shall maintain a 14-day average OMR index no more negative than -5,000 cfs, until the OMR Management season ends (see Condition of Approval 8.8). In the event that a salmon daily or single-year loss threshold is exceeded (Conditions of Approval 8.6.1, 8.6.2, 8.6.3, or 8.6.4) prior to the start of OMR Management season the requirements in those Conditions shall control operations.*

*8.6.1 Winter-run Single-year Loss Threshold. In each year, Permittee shall, in coordination with Reclamation, operate the Project to avoid exceeding the following single-year loss thresholds:*

- Natural WR (loss = 1.17% of natural WR JPE)*
- Hatchery WR (loss = 0.12% of hatchery WR JPE)*

*The loss threshold and loss tracking for hatchery WR does not include releases into Battle Creek.*

*Loss of WR at the CVP and SWP salvage facilities shall be calculated based on LAD criteria for run assignment.*

*Annual loss of natural and hatchery WR at the CVP and SWP salvage facilities shall be counted cumulatively beginning November 1 each calendar year through June 30 the following calendar year.*

*WR shall be identified based on the Delta Model LAD criteria. Loss shall be calculated for the South Delta Export Facilities using the 2018 CDFW loss equation (Attachment 6).*

*During the water year, if cumulative loss of natural or hatchery WR exceeds 50% of the annual loss threshold, Permittee shall restrict south Delta exports to maintain a 14-day average OMR index no more negative than -3,500 cfs through the end of OMR Management (see Condition of Approval 8.8). After 14 days of operations to maintain an OMR index no more negative than -3,500 cfs, Permittee may convene the Salmon Monitoring Team to conduct a risk assessment (Condition of Approval 8.1.5.1) and determine whether the risk of entrainment and loss of natural and hatchery WR is no longer present. Risks shall be measured against the potential to exceed the next single-year loss threshold. The results of this risk assessment and associated OMR advice shall be provided to WOMT according to Condition of Approval 8.1.3 and the decision-making process shall follow the process described in Condition of Approval 8.1.4.*

*The -3,500 cfs OMR flow operational criteria, adjusted and informed by this risk assessment, shall remain in effect until the end of OMR Management (Condition of Approval 8.8).*

*During the water year, if cumulative loss of natural or hatchery WR at the CVP and SWP salvage facilities exceeds 75% of the single-year loss threshold, Permittee shall restrict OMR to a 14-day moving average OMR flow index that is no more negative than -2,500 cfs through the end of OMR Management (Condition of Approval 8.7). After 14 days Permittee may convene the Salmon Monitoring Team to conduct a risk assessment (Condition of Approval 8.1.5.1) and determine whether the risk of entrainment and take of natural and hatchery WR is no longer present. The results of this risk assessment and associated OMR advice shall be provided to WOMT according to Condition of Approval 8.1.3 and the decision-making process shall follow the process described in Condition of Approval 8.1.4.*

*The -2,500 cfs OMR flow operational criteria adjusted and informed by this risk assessment shall remain in effect until the end of OMR Management (Condition of Approval 8.8).*

*During the water year, if natural or hatchery WR cumulative loss at the CVP and SWP salvage facilities exceeds the single-year loss threshold, Permittee shall immediately convene the Salmon Monitoring Team to review recent fish distribution information and operations and provide advice regarding future planned Project operations to minimize subsequent loss during that year. The Salmon Monitoring Team shall report the results of this review and advice to the WOMT (see Condition of Approval 8.1.3). Operational decisions shall be made following the process described in Condition of Approval 8.1.4 (Collaborative Real Time Risk Assessment).*

*If the single-year loss threshold is exceeded, Permittee and Reclamation shall also convene an independent panel to review Project operations and the single-year loss threshold prior to November 1, as described in Condition of Approval 8.2. The purpose of the independent panel is to review the actions and decisions contributing to the loss trajectory that lead to an exceedance of the single-year loss threshold, and make recommendations on modifications to Project implementation, or additional actions to be conducted to stay within the single-year loss threshold in subsequent years.*

*Permittee shall, in coordination with Reclamation, continue monitoring and reporting salvage at the CVP and SWP salvage facilities. Permittee and Reclamation shall continue the release and monitoring of yearling Coleman National Fish Hatchery (NFH) late fall-run and yearling SR surrogates. The Salmon Monitoring Team*

*shall use reported real-time salvage counts along with qualitative and quantitative tools to inform risk assessments (see Condition of Approval 8.1.5.1).*

*8.6.3 Mid- and Late-season Natural Winter-run Chinook Salmon Daily Loss Threshold. To minimize entrainment, salvage, and take of natural WR during the peak and end of their migration through the Delta. Permittee shall restrict south Delta exports for five days to achieve a five-day average OMR index no more negative than - 3,500 cfs when daily loss of natural older juveniles at the SWP and CVP salvage facilities exceeds the following thresholds based on the JPE reported in January of the same calendar year:*

- January 1 – January 31: 0.00635 % of the WR JPE*
- February 1 – February 28: 0.00991 % of the WR JPE*
- March 1 – March 31: 0.0146 % of the WR JPE*
- April 1 – April 30: 0.00507 % of the WR JPE*
- May 1 – May 31: 0.0077 % of the WR JPE*

*All natural older juvenile Chinook salmon juveniles shall be identified based on the Delta Model length-at-date criteria. Loss shall be calculated for the South Delta Export Facilities using the equation provided in CDFW 2018 (Attachment 6). This Condition of Approval may be modified through the process described in Condition of Approval 8.6.6 and an amendment to this ITP.*

*8.6.4 Daily Spring-run Chinook Salmon Hatchery Surrogate Loss Threshold. To minimize entrainment of emigrating natural juvenile CHNSR from the Sacramento River and tributaries, including the Feather and Yuba rivers into the channels of the central Delta, south Delta, CCF, and the Banks Pumping Plant, Permittee shall restrict exports based on the presence of hatchery produced CHNSR surrogate groups at the CVP and SWP salvage facilities. CHNSR surrogate groups shall consist of all in-river fall- and spring-run surrogate release groups of Chinook salmon from the Coleman National Fish Hatchery, Feather River Hatchery, and the Nimbus Fish Hatchery. Each water year between February 1 and June 30 Permittee shall reduce south Delta exports for five consecutive days to achieve a five-day average OMR index no more negative than -3,500 cfs when:*

- Feather River Hatchery coded wire tagged (CWT) CHNSR surrogates (includes both spring- and fall-run hatchery release groups) cumulative loss at the at the CVP and SWP salvage facilities is greater than 0.25% for each release group, OR*
- Coleman National Fish Hatchery and Nimbus Fish Hatchery CWT fall-run release groups cumulative loss at the at the CVP and SWP salvage facilities is greater than 0.25% of the total in-river releases for each release group.*

*This Condition of Approval may be modified through the process described in Condition of Approval 8.6.6 and an amendment to this ITP.*

#### **Discussion of Conditions of Approval**

*Provide sentence or two addressing criteria for each Condition of Approval listed in “Basis for Advice” section. Refer to data below where appropriate.*

Per Conditions of Approval 8.1.4 and 8.1.5, SaMT will provide advice and an accompanying risk assessment to WOMT.

Per Conditions of Approval 8.6.1 and 8.6.4, SaMT does not project annual threshold triggers to be exceeded for the remainder of this OMR management season. Export operations are resulting in more positive OMRI than what would be required if ITP COA 8.6.3 older juvenile Chinook daily loss thresholds were to be exceeded.

## Section 3: Hydrology and Operations

Assessment of hydrologic, operational, and meteorological information. 8.1.5.1 A

### Section 3-A: Water Operations C 8.1.5.1 A. i, iii:

- Antecedent Actions: *(e.g., DCC gate closure and actions such as integrated early winter pulse protection, etc.)*  
DCC gates were closed 12/1/2020 and will remain closed until mid-May 2021 per Reclamation's PA description of DCC operations with the exception of potential DCC Gate testing during the first week of May. Testing is not expected to last more than one day.
- Current Controlling Factor(s):
  - SWP: D-1641 Delta Outflow X2
  - CVP: D-1641 Delta Outflow X2
- Water Temperature:
  - Mossdale (MSD): 62.4°F on 4/27/2021
    - Number of days threshold exceeded: Not applicable until June.
  - Prisoners Point (PPT): 63.9°F on 4/27/2021
    - Number of days threshold exceeded: Not applicable until June.
- Tidal Cycle: *(Spring/Neap. Note if tidal cycle has potential to affect south Delta hydrology or X2)*
  - Not discussed
- Turbidity: Not discussed
- Salinity (X2): >81km on 4/27/2021
- Hydraulic Footprint *(Provide brief description of hydrologic footprint and summary of relevant DSM2 results)*: DWR conducted DSM2 modeling runs were conducted this week. Based on discussion of the modeling, SaMT concluded:
  - North Delta into Interior and Central Delta  
Channels: 49 and 434  
No to low measurable changes to flow and velocity between modeled OMR scenarios are anticipated. Based on recent survey data, listed salmonids are present. It is unlikely that listed salmonids would experience behavioral changes between modeled OMR scenarios this week. Despite low exports the zone of influence has expanded further south due to the low hydrology.
  - San Joaquin River and Central Delta into South Delta  
Channels: 6, 21, 107, 124, and 160  
No to low measurable changes to flow and velocity between modeled OMR scenarios are anticipated. Based on recent survey data, listed salmonids are present. It's unlikely that hydrological changes will be detectable by fish. Cumulative net flows within the channels of the South Delta are negative in magnitude.
  - South Delta into Facilities  
Channels: 81, 94, and 148  
No to low measurable changes to flow and velocity between modeled OMR scenarios are anticipated. Based on recent survey data, listed salmonids are present. It's unlikely that

hydrological changes will be detectable by fish. Cumulative net flows within the channels of the South Delta are positive in magnitude and fish moving from the San Joaquin mainstem into the head of Old River will have an increased transit time towards the fish salvage facilities in the second half of the simulation due to Vernalis flows.

Section 3-B: Water Operations Outlook 8.1.5.1 A. ii:

- Outages:
  - SWP: No outages.
  - CVP: No outages.
- Exports: 4/27/2021
  - SWP: 400 cfs
  - CVP: 800 cfs
- Meteorological Forecast: *Precipitation, wind, air temperature. Are conditions (i.e. flow, turbidity, water temp) expected to change?* As per the National Weather Service Area Forecast Discussion on 4/27/2021: *"Dry and much warmer weather through the rest of the week."* Meteorology is not expected to result in responses in Delta hydrology.
- Storm Event Projection: Hydrological conditions will not provide an opportunity for a storm flex change in exports that allows for an OMRI more negative than -5,000 cfs.

Section 3-C: Projected Conditions 8.1.5.1 A. iii:

- DCC Gates position: Closed 12/1/2020 until mid-May 2021 per Reclamation's PA DCC gate operations.
- Sacramento River flow at Freeport: 5,000 to 7,000 cfs
- San Joaquin River flow at Vernalis: 600 to 1,400 cfs
- QWEST: Positive at 1,000 cfs expected to hover are around 0 cfs as inflows diminish.
- Old River at Bacon Island (OBI) Turbidity: *Is turbidity at Bacon Island (OBI) expected to change due to precipitation, wind, operations, or other factors?* Not discussed.
- Freeport Turbidity: *Is turbidity at Freeport (FPT) expected to change due to precipitation, wind, operations, or other factors?* Not discussed.
- Expected changes in South Delta Exports:
  - CCF: 400 cfs
  - Tracy: 800 to 1,000 cfs
- Expected OMRI Values: -500 to -1,500 cfs

Table 1: Comparison of OMR gauge and OMR Index. Due to issues with the Middle River Gauge, USGS daily average is likely in error and the 5-day and 14-day USGS averages are not available.

Date	Averaging Period	USGS gauges (cfs)	Index (cfs)
4/24/2021	Daily	1,600	-1,000
4/24/2021	5-day	Not available	-800
4/24/2021	14-day	Not available	-900
4/26/2021	Daily	Not Applicable	-900
4/26/2021	5-day	Not Applicable	-900
4/26/2021	14-day	Not Applicable	-900

## Section 4: Distribution and Biology

### 8.1.5.1.B Assessment of biological information for WR and SR.

#### Section 4-A: WR Population Status 8.1.5.1.B i

- Adult escapement estimate:
  - Estimate from carcass counts for adults contributing to brood year (BY) 2020 is 6,195 natural origin total adults and 4,093 female spawners.
  - Adults that will contribute to BY 2021 have entered the Delta system and are appearing in the Keswick area.
- Redd distribution and fry emergence timing:
  - WR fry emergence is complete for this season. BY 2020 total passage at Red Bluff Diversion Dam through 4/22/2021 is 2,096,091 fish. Mean cumulative weekly passage of WR through April 22 for the last 18 years of passage data is 100.00% with one standard deviation measuring 0.1%.
- Juvenile production estimate:
  - A final JPE has been provided by NMFS and CDFW for BY 2020 which estimates 330,130 natural-origin juvenile WR will reach the Delta. The final JPE also estimates that 97,888 LSNFH WR and 37,232 Battle Creek Jumpstart WR will reach the Delta.
- Livingston Stone National Fish Hatchery release:
  - See Appendix 3 Hatchery Release Data WY 2021 for more information.
- Distribution of natural WR:
  - % of juveniles upstream of the Delta: 0-2%
  - % of juveniles in Delta: 10-25%
  - % of juveniles past Chipps Island: 73-90%
- Distribution of Livingston Stone National Fish Hatchery Sacramento River WR and Battle Creek WR:
  - % of juveniles upstream of the Delta: 0-2%
  - % of juveniles in Delta: 10-15%
  - % of juveniles past Chipps Island: 83-90%
- Change in risk of entrainment into the central Delta:
  - See Section 1-A: Sacramento River and Confluence

#### Section 4-B: SR Population Status 8.1.5.1.B ii

- Adult escapement estimate: Not available.
  - First early adults that will contribute to BY 2021 have entered the Delta system and are moving upstream.
- Redd distribution and fry emergence timing:
  - Adult SR completed spawning by mid-November.
  - Egg incubation and fry emergence is complete for this season. Juveniles are rearing and migrating.
- Hatchery release (in-river and downstream):
  - See Appendix 3.
- Distribution of natural SR:
  - % of juveniles upstream of the Delta: 5%
  - % of juveniles in Delta: 55-65%
  - % of juveniles past Chipps Island: 30-40%

- Distribution of Feather River Fish Hatchery SR: See Section 8.1.5.1.C
- Change in risk of entrainment into the central Delta:
  - See Section 1-A: Sacramento River and Confluence

#### Section 4-C: Additional Data Sources to Assess Sensitivity to Entrainment into the Central and South Delta 8.1.5.1.C & D

- In-Delta distribution of WR and SR: See Section 4-A: WR population status 8.1.5.1.B i and Section 4-B SR population status 8.1.5.1.B ii.
- Acoustic telemetry: *Summary of acoustic telemetry tracking*
  - Two groups of production LFR were released from CNFH on 1/4/2021 and 1/5/2021. A subset of each group were acoustic tagged, 460 and 141 fish respectively. The first tag detected from the first release group at Tower Bridge occurred five days later (1/9/2021). As of 3/10/2021, 85 fish have been detected at the I-80/50 Bridge with the last arrival detected on 2/3/2021 and 51 have been detected at the Benicia east and west sites with the last arrival detected on 2/7/2021. One fish was detected in Old River at Quimby Island on 1/20/2021. The last detections for this release occurred on 2/7/2021 and the acoustic tag batteries are likely reaching the end of their useful lifetime.
  - Six groups of production WR were released from LSNFH on 1/30/2021. A subset of three groups were acoustic tagged; 134, 131, and 291 fish respectively. The first tag detection occurred at I-80/50 Bridge five days after release (2/5/2021). A total of 49 fish were detected at the I-80/50 Bridge with the last detection occurring on 3/29/2021. Fourteen detections have been recorded in Georgiana Slough with the last detections occurring on 3/21/2021. Thirty-five fish have been detected in the in the Sacramento River south of Georgiana Slough with the last detection on 3/24/2021. Twenty fish have been detected at the Benicia Bridge west receiver with the last detection on 3/30/2021. One fish was detected at Old River at Quimby Island on 3/22/2021.
  - Three groups of jumpstart WR were released into North Fork Battle Creek on 3/8/2021, 3/10/2021, and 3/18/2021. A subset of each group were acoustic tagged with 300 fish per group. Twenty-seven fish have been detected at the I-80/50 Bridge with the last detection occurring on 4/14/2021. Six detections have been recorded in Georgiana Slough with the last detections occurring on 4/1/2021. Eight detections have been recorded in the Sacramento River south of Georgiana Slough with the last detection occurring on 4/5/2021. One fish has been detected at the Benicia Bridge west receiver as of 4/5/2021.
  - The first group of FRH SR were released on 3/19/2021 and a subset of 300 fish were acoustic tagged (SR Surrogate Group – FRH Group 1). A second group of FRH SR were released on 4/1/2021 and 290 fish were acoustic tagged (SR Surrogate Group – FRH Group 2). The last fish detected at the I80/50 Bridge was on 4/9/2021 for a total of 157 fish. Fifteen detections have been recorded in Georgiana Slough with the last detection on 4/3/2021. Thirty-six detections have been recorded in the Sacramento River south of the junction of Georgiana Slough with the last detection on 4/10/2021. Thirteen fish have been detected at the Benicia Bridge west receiver with the last detection occurring on 4/14/2021.
  - Two groups of production FR were released from CNFH (SR Surrogate Group – CNFH Group 2) on 3/24/2021 (released upstream at Battle Creek) and 3/26/2021 (released downstream at Butte City). A subset of 300 fish per group were acoustic tagged. Seventy fish have been

detected at the I-80/50 Bridge with the last detection occurring on 4/25/2021. Seven detections have been recorded in Georgiana Slough with the last detections occurring on 4/5/2021. Twenty-eight detections have been recorded in the Sacramento River south of Georgiana Slough with the last detection occurring on 4/22/2021. Fourteen fish have been detected at the Benicia Bridge west receiver as of 4/21/2021.

- Trawls: *List all relevant trawl surveys and brief overview of data. Insert tables, PDFs or other information as attachment at end of document. Include interruptions to sampling or other relevant information (e.g. canceled surveys, dropped stations, etc.)*
  - See Appendix 1: SaMT Monitoring Program Data
- Rotary Screw Traps: *List all relevant rotary screw trap surveys and brief overview of data. Insert tables, PDFs or other information as attachment at end of document. Include interruptions to sampling or other relevant information (e.g. canceled surveys, dropped stations, etc.)*
  - See Appendix 1: SaMT Monitoring Program Data
- Seines: *List all relevant seine surveys and brief overview of data. Insert tables, PDFs or other information as attachment at end of document. Include interruptions to sampling or other relevant information (e.g. canceled surveys, dropped stations, etc.)*
  - See Appendix 1: SaMT Monitoring Program Data
- Additional hatchery release notifications: *List all relevant hatchery release notifications.*
  - See Appendix 3 Hatchery Release Data WY 2021
- New monitoring (as required by Condition of Approval 7.5.1, 7.5.2, and 7.5.3): *Upstream monitoring results during transfer window, additional rotary screw trap monitoring updates, additional acoustic tag study results, genetic identification results, trap capture efficiency trial results, and pathology results if available and relevant*
  - Not applicable at this time.
- Anticipated emigration to continue into the Delta:
  - See Table 3.
- Flows in the Sacramento River predicted with upcoming storm events:
  - See Section 3-A: Water operations conditions 8.1.5.1 A. i, iii and the routing analysis below.
- DCC gate position:
  - Closed 12/1/2020 until mid-May 2021 per Reclamation's PA description for DCC gate operations.
- Prediction of tidal interaction at Georgiana Slough (*Inflow to Delta from Sacramento River and the interaction of the muting of tidal effects around Georgiana Slough*):
  - See Section 3-A: Water operations conditions 8.1.5.1 A. i, iii and the routing analysis below.
- Precipitation in the forecast for the week and river flows affecting routing into central Delta:
  - See Section 3-B: Water Operations Outlook 8.1.5.1 A. ii: Storm Event Projection.
- Routing analysis:
  - STARS analysis was conducted on 4/25/2021 with results presented in Table 2 below. These results reflect the DCC gate closure through mid-May.

Table 2: STARS Model output.

Date: 4/25/2021	DCC	Georgiana Slough	Sacramento River	Sutter and Steamboat Sloughs
Proportion of Entrainment	Not Applicable	33%	43%	23%
Survival	Not Applicable	14%	46%	33%
Travel Time	Not Applicable	19.7 days	12.5 days	12.7 days

- Trend analysis: *Provide brief description of historic trends if relevant (e.g. salvage patterns, onset of spawning, etc.). Refer to data or publications as needed:*

Table 3: Historic migration and salvage patterns for unclipped WR and SR as reported on SacPAS ([http://www.cbr.washington.edu/sacramento/data/query\\_hrt.html](http://www.cbr.washington.edu/sacramento/data/query_hrt.html) and [http://www.cbr.washington.edu/sacramento/data/query\\_salvage\\_hrt.html](http://www.cbr.washington.edu/sacramento/data/query_salvage_hrt.html)) with associated 95% confidence interval. These values are provided for context only.

Date: 4/25/2021	RBDD RST	Tisdale RST	Knights Landing RST	Sac Trawl	Chipp's Island Trawl	Salvage
WR	100.0% (99.9%,100.0%) BY: 2011 - 2019	100.0% (100.0%,100.0%) BY: 2011 - 2019	99.8% (99.4%,100.3 %) BY: 2011 - 2019	100.0% (100.0%,100.0 %) BY: 2011 - 2019	97.6% (94.2%,101.0%) BY: 2011 - 2019	99.5% (98.8%,100.2 %)
SR	90.4% (82.7%,98.1%) BY: 2011 - 2019	99.1% (98.4%,99.8%) BY: 2011 - 2019	96.9% (93.7%,100.2 %) BY: 2011 - 2019	90.6% (83.0%,98.2%) BY: 2011 - 2019	70.8% (54.4%,87.1%) BY: 2011 - 2019	57.7% (35.5%,79.9%)

- Survival analysis (*e.g. Zeug and Cavallo CWT model*): Not available
- Tillotson entrainment model or other entrainment models as they become available: The WR entrainment tool estimates a median loss of 0 fish and a maximum loss of 0 fish during this week (SacPAS last updated on 4/21/21).
- Salvage trends in relation to OMRI: *Provide overview of salvage data and insert salvage table as attachment at end of document*: See Appendix 2.
- Future export modifications: *Describe anticipated or potential changes to exports*: Export operations are uncertain at this time with the previously stated ranges dependent on meteorology and associated hydrology.

Notes: None

## Appendix 1: SaMT Monitoring Program Data

Table 4: Fish monitoring data for the 4/27/2021 SaMT meeting. The following table presents fish monitoring data summarized over the past week. Unless otherwise noted, reported sizes are fork length. FR = fall-run, WR = winter-run, SR = spring-run, LFR = late-fall-run

Location	GCID RST <sup>1</sup>	Tisdale RST	Knights Landing RST <sup>2</sup>	Beach Seines	Sacramento Trawl <sup>3</sup>	Chippis Is. Midwater Trawl	Mossdale Kodiak Trawl <sup>4</sup>
Sample Date	NA	4/16-4/25	4/20-4/25	4/22-4/23	4/18-4/19, 4/22-4/23	4/18-4/20, 4/22-4/23	NA
Adult Chinook							
Fall-run Chinook		103	48	8	72	81	
Spring-run Chinook		110	8	1	30	527	
Winter-run Chinook							
Late Fall-run Chinook							
Chinook (ad-clip)		22 FR 19 SR	11 FR 1 SR	1	29	15	
Steelhead (wild)							
Steelhead (ad-clip)						2	
Green Sturgeon							
Flows (avg. cfs)		4,690	4,225	Not Applicable	Not Applicable	Not Applicable	Not Applicable
W. Temp. (avg. °F)		64.1	65.3	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Turbidity (avg. NTU)		5.2	5.9	Not Applicable	Not Applicable	Not Applicable	Not Applicable

<sup>1</sup> GCID RST trap malfunctioned on 4/15. No data received this week.

<sup>2</sup> Knights Landing RST cones sampling at 100% effort. \*Clipped SR are FR from CNFH.

<sup>3</sup> DatCall data reported in the 4/18 – 4/24 DJFMP sampling summary.

<sup>4</sup> CDFW typically conducts sampling at this site between Apr-Jun each year. No data received this week.

Table 5: Delta sturgeon tagging and monitoring.

Date	Comments
4/19, 4/22	<ul style="list-style-type: none"> <li>• 3 new tags applied this week.</li> <li>• 10 juvenile GS were detected in the Sacramento River north of Sherman Lake. 3 WS were detected in the Sacramento River north of Sherman Lake, Fremont Weir, and San Joaquin River.</li> </ul>

GS = green sturgeon, WS = white sturgeon

Table 6: CDFW adult monitoring surveys.

Location	American River Carcass Survey	Stanislaus River Carcass Survey
Sample Dates	Concluded for the season	Not Sampled

## Appendix 2: Salvage Data

Table 7: SWP and CVP SaMT update (4/19-4/25/2021). Trend is the current value compared to the previous week. Reduced counts are the percentage of time that routine salvage sample times were less than 30 minutes per two hours of salvage and export operations. Prepared by Geir Aasen on 4/26/2021. These are preliminary results and are subject to revision.

[illegible]

Table 8: Chinook salmon weekly salvage and loss combined for both the SWP and the CVP fish collection facilities between 4/19-4/25/2021. Race is determined by LAD on the date of capture. Hatchery origin fish are determined by the lack of adipose fin. Salvage is equal to the estimated number of fish collected by the CVP and SWP fish protective facilities per unit of time. State Water Project loss is equal to salvage multiplied by 4.33. Central Valley Project loss is equal to salvage multiplied by 0.68. Prepared by Geir Aasen on 4/26/2021. These are preliminary results and are subject to revision.

Category	Salvage	Loss	Trend
Wild winter-run	0	0	→
Wild spring-run	69	100	↗
Wild late Fall-run	0	0	→
Wild fall-run	58	54	↗
Weekly Total	127	155	Not Applicable
Hatchery winter-run	0	0	↘
Hatchery spring-run	21	37	↘
Hatchery late Fall-run	0	0	→
Hatchery fall-run	20	16	↗
Weekly Total	41	54	Not Applicable

Table 9: Chinook salmon cumulative salvage and loss combined for both the SWP and the CVP fish collection facilities across WY 2021. Race is determined by LAD on the date of capture. Hatchery origin fish are determined by the lack of adipose fin. Salvage is equal to the estimated number of fish collected by the CVP and SWP fish protective facilities per unit of time. State Water Project loss is equal to salvage multiplied by 4.33. Central Valley Project loss is equal to salvage multiplied by 0.68. Prepared by Geir Aasen on 4/26/2021. These are preliminary results and are subject to revision.

Category	Cumulative Salvage	Cumulative Loss	Trend
Wild winter-run	5	8	↘
Wild spring-run	117	207	↘
Wild late Fall-run	0	0	→
Wild fall-run	62	57	↗
Season Total	184	273	Not Applicable
Hatchery winter-run	7	16	↘
Hatchery spring-run	374	836	↘
Hatchery late Fall-run	52	86	→
Hatchery fall-run	20	16	↗
Season Total	453	954	Not Applicable

Table 10: Steelhead weekly salvage and loss combined for both the SWP and the CVP fish collection facilities for 4/19-4/25/2021. Hatchery origin fish are determined by the lack of adipose fin. Salvage is equal to the estimated number of fish collected by the CVP and SWP fish protective facilities per unit of time. State Water Project loss is equal to salvage multiplied by 4.33. Central Valley Project loss is equal to salvage multiplied by 0.68. Prepared by Geir Aasen on 4/26/2021. These are preliminary results and are subject to revision.

Category	Salvage	Loss	Trend
Wild steelhead	0	0	↘
Hatchery steelhead	26	54	↘
Weekly Total	26	54	Not Applicable

Table 11: Steelhead cumulative salvage and loss combined for both the SWP and the CVP fish collection facilities across WY 2021. Hatchery origin fish are determined by the lack of adipose fin. Salvage is equal to the estimated number of fish collected by the CVP and SWP fish protective facilities per unit of time. State Water Project loss is equal to salvage multiplied by 4.33. Central Valley Project loss is equal to salvage multiplied by 0.68. Prepared by Geir Aasen on 4/26/2021. These are preliminary results and are subject to revision.

Category	Cumulative Salvage	Cumulative Loss	Trend
Wild steelhead	33	55	↘
Hatchery steelhead	193	295	↘
Season Total	226	351	Not Applicable

## Appendix 3: Hatchery Salmon Release Data WY 2021

Table 12. Hatchery salmon release data for Brood Year 2020 and Water Year 2021.

Release Date	Hatchery	Race	CWT	Marked Release Number	Total Release	Percent Marked	Release Location	Mark	Agency	Release Type
12/3/2020	SCARF	Spring	06-05-22	4,593	4,593	100%	San Joaquin River at Highway 140	CWT and Ad-clip	CDFW	SJRRP
12/3/2020	SCARF	Spring	06-19-66	501	501	100%	San Joaquin River at Highway 140	CWT, Ad-clip, and PIT	CDFW	SJRRP
1/4/2021	CNFH	Late Fall	05-63-47	67,962	67,962	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
1/4/2021	CNFH	Late Fall	05-63-48	67,016	67,016	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
1/4/2021	CNFH	Late Fall	05-63-49	57,104	57,104	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
1/4/2021	CNFH	Late Fall	05-63-50	62,958	62,958	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
1/4/2021	CNFH	Late Fall	05-63-51	74,516	74,516	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
1/4/2021	CNFH	Late Fall	05-63-52	67,174	67,174	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
1/4/2021	CNFH	Late Fall	05-63-53	67,477	67,477	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
1/4/2021	CNFH	Late Fall	05-63-54	58,824	58,824	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
1/4/2021	CNFH	Late Fall	05-63-55	57,548	57,548	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
1/4/2021	CNFH	Late Fall	05-63-56	52,660	52,660	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
1/4/2021	CNFH	Late Fall	05-63-57	52,555	52,555	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
1/8/2021	CNFH	Late Fall	05-63-59	66,912	66,912	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Experimental
1/22/2021	CNFH	Late Fall	05-63-60	57,357	57,357	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Experimental
1/26/2021	SCARF	Spring	06-22-05	53,690	53,690	100%	San Joaquin River at Highway 140	CWT and Ad-clip	CDFW	SJRRP
1/29/2021	CNFH	Late Fall	05-63-58	64,807	64,807	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Experimental
1/30/2021	LNFH	Winter	05-65-32	43,567	43,567	100%	Sacramento River at Caldwell Park Boat Ramp, Redding, CA	CWT and Ad-clip	USFWS	Production
1/30/2021	LNFH	Winter	05-65-33	46,697	46,697	100%	Sacramento River at Caldwell Park Boat Ramp, Redding, CA	CWT and Ad-clip	USFWS	Production
1/30/2021	LNFH	Winter	05-65-34	46,955	46,955	100%	Sacramento River at Caldwell Park Boat Ramp, Redding, CA	CWT and Ad-clip	USFWS	Production

Release Date	Hatchery	Race	CWT	Marked Release Number	Total Release	Percent Marked	Release Location	Mark	Agency	Release Type
1/30/2021	LNFH	Winter	05-65-35	52,202	52,202	100%	Sacramento River at Caldwell Park Boat Ramp, Redding, CA	CWT and Ad-clip	USFWS	Production
1/30/2021	LNFH	Winter	05-65-36	53,478	53,478	100%	Sacramento River at Caldwell Park Boat Ramp, Redding, CA	CWT and Ad-clip	USFWS	Production
1/30/2021	LNFH	Winter	05-65-37	59,267	59,267	100%	Sacramento River at Caldwell Park Boat Ramp, Redding, CA	CWT and Ad-clip	USFWS	Production
2/1/2021	CNFH	Winter	05-58-90	53,620	53,620	100%	North Fork Battle Creek at Wildcat Road Bridge, Manton, CA	CWT, Ad-clip, left pelvic	USFWS	Jumpstart
3/2/2021	SCARF	Spring	06-18-10	118,041	118,041	100%	San Joaquin River at Highway 140	CWT and Ad-clip	CDFW	SJRRP
3/8/2021	CNFH	Winter	05-57-79	79,024	79,024	100%	North Fork Battle Creek at Wildcat Road Bridge, Manton, CA	CWT, Ad-clip, left pelvic	USFWS	Jumpstart
3/10/2021	CNFH	Winter	05-65-39	44,105	44,105	100%	North Fork Battle Creek at Wildcat Road Bridge, Manton, CA	CWT, Ad-clip, left pelvic	USFWS	Jumpstart
3/10/2021	CNFH	Fall	05-65-42	102,854	411,417	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
3/10/2021	CNFH	Fall	05-65-43	106,001	424,003	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
3/10/2021	CNFH	Fall	05-65-46	113,683	454,730	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
3/18/2021	CNFH	Fall	05-65-44	107,840	431,360	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
3/18/2021	CNFH	Fall	05-65-45	116,458	465,830	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
3/18/2021	CNFH	Fall	05-65-47	118,099	472,395	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
3/18/2021	CNFH	Fall	05-65-48	111,097	444,386	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
3/18/2021	CNFH	Fall	05-65-49	115,494	461,977	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
3/18/2021	CNFH	Fall	05-65-50	111,699	446,796	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
3/18/2021	CNFH	Fall	05-65-51	111,702	446,808	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
3/18/2021	CNFH	Fall	05-65-52	115,210	460,839	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
3/18/2021	CNFH	Fall	05-65-53	113,573	454,293	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
3/18/2021	CNFH	Fall	05-65-54	113,865	455,459	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
3/18/2021	CNFH	Fall	05-65-55	111,418	445,670	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production

Release Date	Hatchery	Race	CWT	Marked Release Number	Total Release	Percent Marked	Release Location	Mark	Agency	Release Type
3/18/2021	CNFH	Winter	05-65-38	37,814	37,814	100%	North Fork Battle Creek at Wildcat Road Bridge, Manton, CA	CWT, Ad-clip, left pelvic	USFWS	Jumpstart
3/19/2021	FRH	Spring	06-22-90	263,239	263,239	100%	Feather River at Boyd's Pump Boat Launch	CWT and Ad-clip	CDFW	Production
3/19/2021	FRH	Spring	06-22-91	250,788	250,788	100%	Feather River at Boyd's Pump Boat Launch	CWT and Ad-clip	CDFW	Production
3/22/2021	SCARF	Spring	06 23 46	1,100	1,100	100%	San Joaquin River at Highway 140	CWT and Ad-clip	CDFW	SJRRP
3/24/2021	CNFH	Fall	05-65-70	92,898	92,898	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Experimental
3/24/2021	CNFH	Fall	05-65-73	92,497	92,497	100%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Experimental
3/26/2021	CHNF	Fall	05-65-71	92,262	92,262	100%	Sacramento River at Scotty's Landing	CWT and Ad-clip	USFWS	Experimental
3/26/2021	CNFH	Fall	05-65-72	94,415	94,415	100%	Sacramento River at Scotty's Landing	CWT and Ad-clip	USFWS	Experimental
4/1/2021	FRH	Spring	06-22-92	250,438	250,438	100%	Feather River at Boyd's Pump Boat Launch	CWT and Ad-clip	CDFW	Production
4/1/2021	FRH	Spring	06-22-93	249,874	249,874	100%	Feather River at Boyd's Pump Boat Launch	CWT and Ad-clip	CDFW	Production
4/6/2021	SCARF	Spring	06 23 46	2,200	2,200	100%	San Joaquin River at Highway 140	CWT and Ad-clip	CDFW	SJRRP
4/8/2021	CNFH	Fall	05 65 56	114,149	456,594	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
4/8/2021	CNFH	Fall	05 65 57	109,956	439,824	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
4/8/2021	CNFH	Fall	05 65 58	109,545	438,178	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
4/8/2021	CNFH	Fall	05 65 59	113,658	454,633	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
4/8/2021	CNFH	Fall	05 65 60	106,547	426,189	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
4/8/2021	CNFH	Fall	05 65 61	118,137	472,549	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
4/8/2021	CNFH	Fall	05 65 62	113,515	454,060	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
4/8/2021	CNFH	Fall	05 65 63	103,911	415,643	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
4/8/2021	CNFH	Fall	05 65 64	121,400	485,598	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
4/8/2021	CNFH	Fall	05 65 65	103,862	415,449	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
4/8/2021	CNFH	Fall	05 65 66	113,700	454,798	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
4/8/2021	CNFH	Fall	05 65 67	119,085	476,341	25%	Battle Creek at CNFH	CWT and Ad-clip	USFWS	Production
4/16/2021	MOK	Fall	06 23 50	112,500	450,000	25%	San Joaquin River Sherman Island Net Pens	CWT and Ad-clip	CDFW	Production

Release Date	Hatchery	Race	CWT	Marked Release Number	Total Release	Percent Marked	Release Location	Mark	Agency	Release Type
4/18/2021	FRH	Fall	06 23 43	245,937	985,173	25%	Fort Baker San Francisco	CWT and Ad-clip	CDFW	Production
4/20/2021	NIM	Fall	06 15 36	167,120	669,005	25%	Mare Island San Pablo Bay	CWT and Ad-clip	CDFW	Production
4/23/2021	MER	Fall	06 15 74	75,436	266,000	28%	San Joaquin River Sherman Island Net Pens	CWT and Ad-clip	CDFW	Production
4/24/2021	MOK	Fall	06 23 51	110,000	440,000	25%	San Joaquin River Sherman Island Net Pens	CWT and Ad-clip	CDFW	Production
4/28/2021	FRH	Fall	06 23 44	255,846	1,024,494	25%	Conoco Pier 66 San Pablo Bay	CWT and Ad-clip	CDFW	Production
5/1/2021	MOK	Fall	06 23 52	111,250	445,000	25%	San Joaquin River Sherman Island Net Pens	CWT and Ad-clip	CDFW	Production
5/2/2021	MOK	Fall	06 23 53	111,250	445,000	25%	San Joaquin River Sherman Island Net Pens	CWT and Ad-clip	CDFW	Production
5/3/2021	FRH	Fall	05 23 45	262,644	1,051,803	25%	Point San Quentin San Francisco Bay	CWT and Ad-clip	CDFW	Production

## Appendix 4: COA Spring-run Chinook Hatchery Surrogate Summary Table, WY 2021.

Hatchery	Release Group	Date	Race	Total Fish Released	CWT Fish	Tag Codes	Loss Threshold
Coleman National Fish Hatchery	Group 1	3/10/2021	FR	1,290,150	322,538	05 65 42	806.35
						05 65 43	
						05 65 46	
	Group 2	3/24/2021 3/26/2021	FR	372,072	372,072	05 65 70	930.18
						05 65 71	
						05 65 72	
						05 65 73	
	Group 3*	4/8/2021	FR	5,389,856	1,347,456	05 65 56	3,368.66
						05 65 57	
						05 65 58	
						05 65 59	
						05 65 60	
						05 65 61	
						05 65 62	
						05 65 63	
						05 65 64	
						05 65 65	
05 65 66							
05 65 67							
Feather River Fish Hatchery	Group 1	3/19/2021	SR	514,027	514,027	06 22 90	1285.07
						06 22 91	
	Group 2	4/1/2021	SR	500,312	500,312	06 22 92	1,250.78
						06 22 93	
Nimbus Fish Hatchery	Group 1	Pending — late April	FR	1,600,000	400,000	N/A - BAY RELEASE	
	Group 2	Pending — early May	FR	800,000	200,000	N/A – BAY RELEASE	

\*Coleman National Fish Hatchery Group 3 was utilized as a substitute for Nimbus Fish Hatchery Groups 1 and 2.