DRAFT FRAMEWORK
NORTH YUBA RIVER
SPRING-RUN CHINOOK SALMON
REINTRODUCTION PLAN

May 15, 2023

INTRODUCTION AND BACKGROUND

Reintroduction of anadromous salmonids into the upper Yuba River Watershed has been the subject of discussion and study by the National Marine Fisheries Service (NMFS), California Department of Fish and Wildlife (CDFW), and the Yuba Water Agency (YWA) for many years. These efforts have included NMFS' (2014) Central Valley Anadromous Salmonid Recovery Plan, the North Yuba Reintroduction Initiative (NYRI), the Yuba Salmon Forum (YSF), the Yuba Salmon Partnership Initiative (YSPI – later referred to as YSP), and the Yuba Reintroduction Working Group (YRWG). The most recent discussions have been by the parties to a Settlement Agreement developing a Restoration Plan for the Yuba River Watershed. One component of the Restoration Plan is a Reintroduction Plan. This document represents the framework for development of the Reintroduction Plan for the Settlement Agreement, and this framework consists of a "Pilot Program" (with early, short-term, and mid-term components) and concludes with refinement of the Reintroduction Plan, incorporating information obtained during the Pilot Program. The Pilot Program will provide the foundation for development of a well-informed Reintroduction Plan to guide reintroduction of spring-run Chinook salmon into the North Yuba River, consistent with the NMFS (2014) Recovery Plan. Also, focusing reintroduction efforts on the North Yuba River is consistent with the Federal Register Notice for the Final Rule[1] ("NMFS 2022") establishing a nonessential, experimental population ("NEP") of spring-run Chinook salmon in the upper Yuba River Watershed.

The reintroduction into the North Yuba River upstream of New Bullards Bar Reservoir is expected to expand spring-run Chinook salmon geographic distribution, decrease the possibility of impacts from catastrophic events, decrease population effects caused by increasing water temperatures, increase phenotypic diversity, increase the attributes of spatial structure, and increase the overall amount of habitat available. All these factors would decrease extinction risk and thereby contribute to recovery (NMFS 2014).

REINTRODUCTION PLAN PURPOSE AND GOALS

It is imperative that the Reintroduction Plan has clearly defined goals and objectives to identify components of the Reintroduction Plan, the purpose of the Reintroduction Plan and what it is trying

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to accomplish, as well as specific objectives, metrics, and measures of success for individual components and for the Reintroduction Plan overall (McClure et al. 2018).

PURPOSE, GOALS, AND OBJECTIVES OF THE REINTRODUCTION PLAN

The purpose of this Reintroduction Plan framework is to clearly define the pathway to address the goals and objectives of the Reintroduction Plan. The NMFS (2014) Recovery Plan identifies re-establishing populations of spring-run Chinook salmon above impassable barriers to unoccupied historical habitats, including those in the Yuba River Watershed, as an important recovery action. The goal of the Reintroduction Plan is to contribute to the recovery of spring-run Chinook salmon by implementing a priority recovery action identified in the NMFS (2014) Recovery Plan that states "*Develop and implement a program to reintroduce spring-run Chinook salmon and steelhead to historic habitats upstream of Englebright Dam. The program should include feasibility studies, habitat evaluations, fish passage design studies, and a pilot reintroduction phase prior to implementation of the long-term reintroduction program*" (NMFS 2014). The Settlement Agreement Parties have agreed that the Reintroduction Plan is for spring-run Chinook salmon in the North Yuba River upstream of New Bullards Bar Reservoir, and that implementation of the priority recovery action consists of those components identified to be conducted prior to Reintroduction Plan implementation.

To accomplish the goal of contributing to recovery by implementing the priority recovery action, the Reintroduction Plan will include component objectives (NMFS 2010) consistent with the NMFS (2014) Recovery Plan. These objectives can be broadly grouped into the following categories:

- Habitat Capacity and Diversity
- Population Viability
- ESU Viability
- Recovery Unit Viability

HABITAT CAPACITY AND DIVERSITY

According to the NMFS (2014) Recovery Plan, habitat capacity considerations include sufficient habitat (type, amount, and quality) for long-term population maintenance. Habitat capacity and diversity relates to spatial structure. Spatial structure reflects a population's distribution among potentially available habitats, and refers to the arrangement of populations across the landscape, the distribution of spawners within a population, and the processes that produce these patterns. Species with a restricted spatial distribution and few spawning areas are at a higher risk of extinction from catastrophic environmental events (e.g., a single landslide) than are species with more widespread and complex spatial structure. For the Reintroduction Plan, the habitat capacity and diversity objective will be to contribute to recovery of spring-run Chinook salmon by providing access to historic habitat in the North Yuba River upstream of New Bullards Bar Reservoir and thereby increase overall habitat capacity, diversity, geographic distribution, and decrease susceptibility to the effects of catastrophic events.

POPULATION VIABILITY

Viability is defined by four key parameters identified by McElhany et al. (2000) of abundance, productivity, spatial structure, and diversity. Abundance (population size) and trends in abundance reflect extinction risk - small populations are generally at greater risk of extinction than large populations (McElhany et al. 2000). Productivity over the entire life cycle (i.e., population growth rate) and lifestage-to-lifestage specific productivity (e.g., abundance of outmigrant juveniles relative to the number of spawning adults), and factors that affect productivity provide information on how well a population is "performing" in the habitats occupied during the life cycle of the species (McElhany et al. 2000). Diversity of genetic and phenotypic traits allows species to use a wide array of environments, respond to short-term changes in the environment, and survive long-term environmental change (McElhany et al. 2000). Spatial structure reflects how a population's abundance is distributed among available or potentially available habitats and how it can affect overall extinction risk and evolutionary processes that may alter a population's ability to respond to environmental change.

A viable population is one with a low extinction risk in the wild over the long-term (McElhany et al. 2000). Lindley et al. (2007) established extinction risk criteria to address population viability. Low extinction risk is defined by a minimum total escapement, no apparent decline in escapement, no catastrophic declines within the last 10 years, and a low hatchery influence (Lindley et al. 2007). The Reintroduction Plan will consider progress toward achieving the attributes corresponding to "low extinction risk" of the reintroduced population as an appropriate target objective.

RECOVERY UNIT VIABILITY

The NMFS (2014) Recovery Plan identified diversity groups as recovery units. Four diversity groups were identified, with the Yuba River included in the Northern Sierra Nevada diversity group. The Recovery Plan identified an objective of attaining four populations in the Northern Sierra Nevada diversity group being at low risk of extinction. For the Reintroduction Plan, the recovery unit viability objective will be to contribute to the attainment of the Northern Sierra Nevada diversity group being at low risk of extinction.

ESU VIABILITY

The spring-run Chinook salmon Central Valley Evolutionarily Significant Unit (ESU) viability depends on the number of populations within the ESU, their individual status, their spatial arrangement with respect to each other and sources of catastrophic disturbance, and the diversity of the populations and their habitats. The NMFS (2014) Recovery Plan identified a spring-run Chinook salmon ESU-level objective of attaining the low extinction risk targets for each of the diversity groups and maintaining several populations at moderate risk of extinction. For the Reintroduction Plan, the ESU viability objective will be to contribute to the attainment of the NMFS (2014) Recovery Plan ESU-level objective.

GOAL OF THE PILOT PROGRAM

The goal of the Pilot Program is to establish a "proof-of-concept" for the biological and technical feasibility of reintroducing spring-run Chinook salmon to historical habitat in the North Yuba River upstream of New Bullards Bar Reservoir through development and implementation of a suite of evaluations. These evaluations will provide the foundation for development of a well-informed

Reintroduction Plan, where each step (evaluation) is intended to inform concurrent or subsequent steps. This systematic approach to developing a comprehensive Reintroduction Plan necessitates that the objectives of each Pilot Program evaluation are very clearly stated and aim toward development of information necessary to ultimately evaluate the feasibility of achieving the objectives of the Reintroduction Plan. It is anticipated that "SMART" objectives (Specific, Measurable, Achievable, Relevant, and Time-bound) for each evaluation will be identified as those specific evaluations are developed (McClure et al. 2018).

PILOT PROGRAM

Management actions should be purposefully sequenced to evaluate and address key environmental factors (McClure et al. 2018). Early phases of reintroduction planning efforts set the groundwork to identify approaches, procedures, and decisions in later phases (Hendrix et al. 2014; McClure et al. 2018). The Pilot Program component of this framework document addresses initial considerations in reintroduction plan development.

EARLY PHASES OF THE PILOT PROGRAM

Early phases of the Pilot Program address regulatory, technical, and biological considerations, including assessing factors that may affect how the objectives of the Reintroduction Plan will be met.

An early funding opportunity, in the form of monies granted to CDFW and administered by YWA, allowed early evaluation of certain subcomponents of the Pilot Program. Previous reintroduction initiatives for the Yuba River identified juvenile collection facilities as perhaps the technically most challenging component of a reintroduction program. Consequently, the technical focus of early funding through the CDFW grant has focused on the potential utility of rotary screw traps (RSTs) to collect juvenile outmigrants and associated movement and timing information. The use of rotary screw traps comes with a host of site selection and functionality questions that the preliminary work seeks to address. In addition to evaluation of the efficacy of RSTs in the North Yuba River, other components were identified for early funding. These components, which presently are in progress, include facilitation, public safety and outreach planning and implementation to cover the span of the RST investigations, water temperature monitoring, and alternative juvenile collection methodologies evaluation.

Evaluations and information obtained during these early phase subcomponents will inform development of the Reintroduction Plan. The following phases describe short-term activities of the Pilot Program and, although they are presented in the sequence in which they may occur, many or all of the short-term phases could be implemented concurrently.

SHORT-TERM PHASES OF THE PILOT PROGRAM

In general, phases 1 through 5 (below) can be categorized as "short-term" Pilot Program evaluations. The necessary permitting and regulatory compliance portion of Phase 1 for Pilot Program activities, and the pathogen risk component of Phase 3 should be completed prior to any reintroduction of spring-run Chinook salmon into the North Yuba River as described in NMFS, 2022 including prior to field validation studies during the Pilot Program. It is expected that the permitting and regulatory compliance components would only cover the Pilot Program, and that additional permitting would be necessary for components beyond the Pilot Program. Phase 6 consists of targeted "mid-term" Pilot Program evaluations to validate and refine assumptions and will include studies using fish translocated into the North Yuba River. Phase 7 of the framework, although not part of the Pilot Program, consists of coalescing information gathered during the early, short-term, and mid-term Pilot Program evaluations to refine the Reintroduction Plan. A preliminary schedule associated with various phases of the reintroduction framework is provided below.

NORTH YUBA RIVER REINTRODUCTION PLAN								
	Implementation of Plan Elements (Program Year)							
	0	1	2	3	4	5	6	7
PILOT PROGRAM								
Early Phases								
RST Site Testing & Evaluation								
Alternative Juvenile Collection Investigation								
Short-Term Phases								
*Phase 1 – Permitting, Compliance, Land Ownership & Public Outreach**								
*Phase 2 – Life Cycle Modeling & Parameter Refinement***								
Phase 3 – Donor Stock Genetic & Pathogen Risk Considerations								
Phase 4 – Collection, Transport & Release Planning								
Phase 5 – Ecological Interactions								
Mid-Term Phase								
*Phase 6 – Lifestage-Specific Field Validation Studies****								
REINTRODUCTION PLAN DEVELOPMENT								
*Long-Term Reintroduction Plan Development*****								
*Phase 7 – Reintroduction Plan Refinement*****								

* Permitting, compliance, and land ownership considerations for the Pilot Program will be addressed during years 1 and 2, but public outreach would extend for the duration of the Pilot Program.

** Development of a refined life cycle model framework is anticipated to be complete by year 2, although parameter refinement will occur over the duration of the Pilot Program.

*** Once permits are acquired and requisite environmental documentation is completed for the Pilot Program, and after pathogen risk assessment has successfully been completed, then lifestage-specific field validation studies would be conducted.

**** The Reintroduction Plan will continue to be developed over the course of the Pilot Program. The refinement in Phase 7 reflects coalescing of information gathered during Phases 2-6.

PHASE 1 – PERMITTING, REGULATORY COMPLIANCE, LAND OWNERSHIP & PUBLIC OUTREACH

Permitting and Regulatory Compliance

Develop and implement a detailed permit acquisition and regulatory compliance plan identifying anticipated permitting authorities, requirements and approvals that will be required prior to implementation of activities (phases 2-6) of the Pilot Program. The Pilot Program permit plan may address, but not be limited to, the following.

- U.S. Forest Service (USFS) approvals and permits.
  - Wild and Scenic Rivers.
  - National Historic Preservation Act.
  - Forest Management Plan(s).
  - Other special use and/or encroachment permits.
- National Environmental Protection Act.
- NMFS Endangered Species Act (ESA) 10(a)(1)(A) authorization and other ESA issues.

- Clean Water Act (U.S. Army Corps of Engineers (USACE) 404 and Regional Water Quality Control Board (RWQCB) 401).
- CDFW Streambed Alteration Agreement & Scientific Collecting Permit.
- California Endangered Species Act.

Land Ownership Considerations

- Coordinate with USFS regarding North Yuba River land use and land management issues.
- Collaborate with USFS to address mining claims at potential juvenile collection facility locations.

Public Outreach Considerations

- Develop and implement a public outreach plan that spans the duration of the Pilot Program.

Phase 2 – Life Cycle Modeling and Parameter Refinement

Life Cycle Modeling

A life cycle model (LCM) has been developed for the upper Yuba River Watershed (Hendrix et al. 2014; Hendrix 2020). The LCM Technical Memorandum (Hendrix 2020) appropriately identified improvements to the modeling framework and applicability of the results by incorporating a hydrologic time series and lifestage-specific relationships between hydrology, water temperature, and habitat capacity-constrained productivity (Hendrix 2020). Additionally, the LCM could be further improved by identifying additional survival rates rather than the single static survival rate for all lifestages from juvenile outmigrant relocation downstream of Englebright Dam, migration through the lower Yuba River, the lower Feather River, the lower Sacramento River, the Delta, ocean residency, and adult return to the lower Yuba River.

The refined LCM would be instrumental to informing the development of the Reintroduction Plan as it would allow sequential evaluation of lifestage-specific vital rates and quantification of the effect of a variety of factors on reintroduction success (Hendrix et al. 2014; McClure et al. 2018). This phase of the Pilot Program includes development of a detailed, refined LCM building upon previous efforts which: (1) incorporates hydrologic and water temperature variability in the North Yuba River; (2) incorporates hydrology-habitat relationships developed from the results of parameter refinement efforts (below); (3) utilizes refined stage-dependent lower Yuba River and out-of-basin survival rates; and (4) incorporates sensitivity analyses to identify parameter importance and inform additional data collection and monitoring efforts. The refined LCM is intended to be used iteratively throughout the Pilot Program to inform field validation studies, and to refine assumptions and parameterization of lifestage-specific vital rates as new information becomes available. The refinement of the LCM can be done in parallel with field validation studies and need not be complete before the Pilot Program experiments with fish *in situ*.

The objectives of LCM refinement are:

- To identify important lifestage-specific field studies (Phase 6) that would validate or positively contribute to the existing understanding of habitat-population dynamics through *in situ* experiments with spring-run Chinook salmon in the North Yuba River.

- To improve the parameterization of the LCM based on lifestage-specific field validation studies (Phase 6, below). The *in situ* study results would be used to calibrate lifestage-specific habitat utilization and vital rates, sources of mortality, and collection/transport efficiencies, among others.

Inform Field Studies

The LCM includes assumptions regarding each lifestage throughout the life cycle, including both habitat and vital rate parameters. Previous Yuba River reintroduction initiatives commissioned studies of habitat availability and suitability in the Yuba River Watershed, the results of which form the foundation of the current understanding of potential lifestage-specific habitat conditions in the North Yuba River[2]. Additionally, the current LCM, by necessity, includes broad assumptions of factors and lifestage-specific survival rates due to the lack of site-specific, empirically-derived data and information. Development and iterative application of the LCM will contribute to the identification of specific areas for *in situ* field investigations.

Develop an Optimization Scheme for Juvenile Release Locations

The effects of low flows on juvenile survival can be partially mitigated by releasing juveniles (captured as part of a trap and haul operation) further downstream to reduce exposure to unfavorable habitat conditions and predation: "*release point is a management lever that can be used to compensate for modest or even poor survival*" (Boughton, 2022); however, such strategy would need to be carefully designed and modeled to balance the negative impacts of straying and to avoid interfering with juveniles' natural imprinting processes, which supports successful homing of adults returning to the Yuba River to spawn. In order to ensure that a reintroduction program on the Yuba River is maximally successful, it will be necessary to develop alternative release location(s) and model comparative survival scenarios determining adult escapement and cohort replacement rates under wet, normal, dry and critically dry water year types.

Parameter Refinement

A foundational short-term activity is to obtain the information necessary to refine the habitat-dependent parameters within the life cycle model. Habitat carrying capacity parameters in the existing life cycle model (Hendrix et al. 2014; Hendrix 2020) limit the theoretical population productivity. Specifically, carrying capacity estimates for the spawning (fecundity) and fry rearing lifestages are critical parameters for understanding population productivity, because these lifestages exhibit the largest lifestage-specific abundances in the entire life cycle. Because of the relative paucity of lifestage- and site-specific habitat availability and suitability data in the North Yuba River, the existing lifecycle model is forced to put a theoretical "cap" (i.e., carrying capacity)

[2] The prior evaluations of habitat availability and suitability were based on fragmented sampling of substrate composition (rather than census surveys) and coarse resolution (i.e., 10 m by 10 m) terrain data which were used for gradient-based estimation of channel widths within the HAB module of the RIPPLE model (Stillwater Sciences 2013, Hendrix et al. 2014). As such, the resulting characterizations of habitat availability, suitability, and carrying capacity are rough approximations in need of refinement.

on these lifestages which may underestimate carrying capacity and therefore production potential of the North Yuba River.

The intent is to estimate, under variable flow and water temperature conditions, lifestage-specific carrying capacities using empirically-derived data to refine the parameterization of a refined life cycle model for understanding the reintroduction of spring-run Chinook salmon in the North Yuba River. It is anticipated that these efforts would include the following activities.

- Utilize updated habitat suitability and availability data to better estimate the quantity and distribution of lifestage-specific habitat components throughout the North Yuba River.
- Develop lifestage-specific habitat-discharge relationships.
- Improve the predictive capability regarding instream water temperatures as correlated with flow regimes in the North Yuba River. In addition to estimation of carrying capacity, greater accuracy will assist in the designation of release locations associated with variable instream conditions (McClure et al. 2018).

Phase 3 – Donor Stock Genetic and Pathogen Risk Considerations

Commensurate with the overall Reintroduction Plan goal of establishing and maintaining an independent, viable population of spring-run Chinook salmon in the North Yuba River, an additional consideration is potential effects of donor stock on genetic composition and phenotypic expression. As stated by NMFS (Cordoleani et al. 2021), the phenotypic expression where spring-run Chinook salmon juveniles remain in the river over-summer before emigrating the following fall is becoming increasingly rare in the Central Valley, but is critical to cohort success in years characterized by multi-year droughts and ocean heatwaves. As such, the Reintroduction Plan should include a strategy to facilitate this phenotypic expression in the North Yuba River reintroduced population. Therefore, the phenotypic and genetic characteristics of the founder group should be carefully considered because the founder group can have a large influence on reintroduction outcomes (Hendrix et al. 2014 including promulgation of the spring-run Chinook salmon juvenile over-summering phenotype in the North Yuba River.

Additionally, dependent upon the manner in which hatchery contribution to the population is interpreted relative to the overall goal of the Reintroduction Plan, donor stock considerations will vary. Consideration must be given to the manner in which use of Feather River Fish Hatchery (FRFH) would be interpreted relative to the low extinction risk criterion of hatchery contribution to the population. This Phase of the Pilot Program includes refinement of donor stock sourcing strategies in consideration of the overall Reintroduction Plan goal, including the following.

- Identify availability of potential donor stocks from FRFH and their availability relative to timing of adult release into North Yuba River based on hatchery operations (spring versus fall). This Phase includes determination of whether hatchery operations would restrict the availability of spring-run Chinook salmon for translocation to the North Yuba River to the fall, and evaluation of associated ramifications to Reintroduction Plan success such as truncation/elimination of phenotypic expression and reduction in diversity, resiliency, and sustainability.
- Identify abundance of donor stock(s) and whether reintroduction into the North Yuba River would directly or indirectly unacceptably diminish the population size of the donor source (McClure et al. 2018).

- Determine colonization methods, including the most appropriate lifestage, method and time frame for release.
- Develop genetic management program and plan for reintroduction.
- Develop criteria to determine if/when reinforcement (i.e., supplementation) with FRFH fish may be necessary and appropriate.
- Determine parasite/pathogen screening protocols and management prior to any fish translocations (McClure et al. 2018).
- Conduct North Yuba River fish health study per CDFW pathology protocols.

PHASE 4 – COLLECTION, TRANSPORT & RELEASE PLANNING

Previous Yuba River reintroduction efforts have identified Daguerre Point Dam as the most likely location on the lower Yuba River for an adult collection facility. This Phase includes building upon previous and ongoing efforts to refine and further develop appropriate methods and/or technologies for juvenile outmigrant and returning adult collection, transport, and release[3].

Facility considerations include evaluations to provide information to develop a preferred reintroduction strategy which includes: (1) adult collection, sorting and holding (presumably at Daguerre Point Dam); (2) adult transport, acclimation, and release into the North Yuba River; (3) collection of outmigrant juveniles; and (4) juvenile transport, acclimation, and release into the lower Yuba River below Englebright Dam. More explicit considerations and uncertainties to be addressed during this Phase include the following.

Juvenile

- Building upon early phase study results, evaluate potential technique(s)/facility ability to maximize capture of annual juvenile outmigrant cohort (i.e., cohort capture rate, a component of which is trap efficiency).
- Determine fish transportation requirements (e.g., water temperature, dissolved oxygen) over the duration of transport to ensure high juvenile survival during transport and post-release.
- Identify juvenile release locations that maximize survival and reduce handling.
- Identify protocols for optimal handling, sorting, and release conditions for juveniles.
- Conduct desktop analyses to evaluate the effectiveness of the juvenile collection facility under various flow regimes and times of year.

Adult

- Identify and evaluate potential adult capture techniques and facilities. Additionally, determine the need for specific infrastructure relative to Reintroduction Plan goals. For example, the potential need for adult sorting (based on potential genetic sampling and characterization, or mark/PIT tag presence) and/or holding.

[3] The need for collection, transport, and release planning in a pilot program is consistent with Hendrix et al. (2014) and NMFS (2022).

- Determine fish transportation requirements (e.g., water temperature, dissolved oxygen, etc.) to ensure high adult survival during transport and post-release.
- Identify protocols for optimal handling, sorting, and release conditions for adults.
- Determine the feasibility of variable adult release location based on water temperatures. For example, determine whether water temperature recorders on SCADA systems could be installed in the North Yuba River to provide information on locations exhibiting thermally suitable water temperatures, which then could be used as part of the transport and release protocols used by drivers releasing fish into the North Yuba River.

Phase 5 – Ecological Interactions

Interactions with species or populations that inhabit the target area prior to reintroduction should be evaluated in a reintroduction plan (McClure et al. 2018). Prior to incorporating the use of translocated Chinook salmon (eggs, juveniles, and/or adults) in field validation studies, potential ecological interactions resulting from translocated individuals should be identified and evaluated, if available information indicates the probable alteration of existing ecological interactions. Examples of potential ecological interaction evaluations include:

- The potential for residualization and establishment of an adfluvial Chinook salmon population in New Bullards Bar Reservoir post-reintroduction, and sport fishery management ramifications.
- Consider potential interactions and/or impacts to the extant kokanee population in New Bullards Bar Reservoir and the North Yuba River.
- Characterize the North Yuba River resident fish community and the potential for ecological interactions (e.g., predation, competition).

MID-TERM PHASE OF THE PILOT PROGRAM

Phase 6 – Lifestage-Specific Field Validation Studies

Once permits are acquired and requisite environmental documentation is completed for the Pilot Program, and after pathogen risk assessment has successfully been completed, then lifestage-specific field validation studies would be conducted to affirm and/or refine assumptions regarding lifestage-specific habitat utilization and vital rates, sources of mortality, or collection/transport efficiencies. The results of field validation studies would be used to refine the reintroduction plan and further refine the assumptions and parameterization of inputs to the LCM. These field validation studies would require spring-run Chinook salmon placed into the North Yuba River.

- Develop and implement survey techniques and protocols to study adults translocated to the North Yuba River. Evaluate post-release behavior, identify holding sites selected, and validate estimates of holding habitat suitability, availability, and carrying capacity.
- Develop and implement survey techniques and protocols to study juveniles hatched and/or translocated into the North Yuba River. Evaluate the efficacy of different techniques such as snorkel or seine surveys. Evaluate life-history strategies implemented by juveniles regarding young-of-year emigrants versus yearling emigrants. Identify rearing habitat sites selected, and validate estimates of rearing habitat suitability, availability, and carrying capacity.

- Implement carcass/redd surveys to identify spawning habitat suitability and utilization, obtain redd size and microhabitat utilization and characterization information, and to validate estimates of spawning habitat carrying capacity.
- Monitor and evaluate performance criteria (i.e., collection efficiency, cohort capture rate) for the North Yuba River juvenile collection facility.
- Determine the predation risk of outmigrating juveniles in the North Yuba River, at collection facilities, and at release facilities and locations, and identify remedial actions as necessary or appropriate in order to improve cohort capture rate.
- Use juveniles to assess survival from release in the lower Yuba River through subsequent adult returns to evaluate whether a sufficient number of adults return to accomplish the goals and objectives of the Reintroduction Plan.
- Determine the need for juvenile and/or adult stress relief/acclimation infrastructure based on fish behavior observations.

PHASE 7 – REINTRODUCTION PLAN REFINEMENT

The Reintroduction Plan will continue to be developed over the course of the Pilot Program. Phase 7 of the framework consists of coalescing information gathered during Phases 2-6 of the Pilot Program to refine the Reintroduction Plan to guide reintroduction of spring-run Chinook salmon into the North Yuba River. Under this phase, refinement of the Reintroduction Plan will include, but not necessarily be limited to, the following activities.

- Develop criteria to evaluate the progress of reintroduction, such as in-river productivity (annual ratio of juvenile outmigrants to female spawners) and cohort replacement rate (CRR) or intrinsic population growth rate.
- Incorporate the results of studies conducted during Phases 2-6 to refine the Reintroduction Plan.
- Develop a detailed permitting and regulatory compliance plan as part of the Reintroduction Plan.
- Develop a public outreach plan as part of the Reintroduction Plan.
- Develop a detailed operations plan that describes facility-specific operations and maintenance components, as well as adaptive management of facilities operations.
    - Describe lower Yuba River adult collection facility operations and identify triggers to modify the adult collection facility if/as necessary based on performance criteria evaluation.
    - Describe facility operations and identify triggers to modify the North Yuba River juvenile collection facility if/as necessary based on performance criteria evaluation.
    - Describe transport facility operations and identify triggers to modify and adjust transport facilities (i.e., trucks) if/as necessary.
    - Identify scheduled and representative types of unscheduled maintenance activities at reintroduction facilities, and develop remediation measures.

    - Describe procedures for coordinating with federal and state resource agencies in the event of scheduled and unscheduled maintenance, and implementation of remediation measures.

- Develop a reintroduction monitoring and adaptive management plan to address population-habitat interactions. The monitoring and adaptive management plan will describe an approach to respond to initial results from the reintroduction, and new information and/or changed conditions. Based on monitoring, adaptive management actions may be in response to considerations including, but not necessarily limited to, the following:
    - Identify triggers when the program may switch from using donor stock to using only naturally-produced fish, and if/when hatchery fish may be used to supplement the program in the future.
    - Identify ongoing monitoring for each life stage and how/if monitoring will be used to adjust project components.
    - Potential changes in run timing.
    - Timing of adult and juvenile translocations, as well as transport requirements.
    - Release location conditions.
    - Interspecific and ecological interactions.
    - Donor populations effects, including possible hatchery management actions.
    - Disease transmission.
    - Population response relative to Reintroduction Plan success criteria and metrics.